Steinbeis

TRANSFER

The Steinbeis Magazine

Life Through a Magnifying Glass

Feature Topic: Life Science
Experts at Steinbeis play a pivotal role in a variety of projects

Cross-border Enthusiasm for Science
Steinbeis Romania acts as project partner to European initiative

Well Welded, Whatever the Position
Steinbeis experts develop orbital micro-plasma powder welding torch

Creating a Map for Corrosion
Steinbeis experts map global corrosion conditions for metal components

02 | 2018

Find an overview of all Steinbeis Enterprises and their services on www.steinbeis.de → network

Dear Readers,

Professor Dr. Dr. h. c. Michael Przybylski is director of the Rüsselsheim-based Steinbeis Transfer Center for Biopolymer Analysis and Biomedical Mass Spectrometry. The work carried out at the center includes the structure identification of membrane proteins, the synthesis and structural analysis of modified proteins, and the identification of structures in autoimmune diseases.

In 2010, Przybylski, his center, and its industrial partner Genzyme CEE won the Steinbeis Foundation Transfer Award – the Löhn Award. The project partners jointly developed methods used in the clinical diagnosis of lysosomal storage diseases in Central and Eastern Europe.

To contact Michael Przybylski, write to michael.przybylski@stw.de.

The feature topic of this issue of TRANSFER is life science and its important influence as a key area of interdisciplinary research and development. The German economy would be inconceivable without the work going on in the fields of health care, food and beverage development, food safety, environmental chemistry, and environmental medicine. So this topic represents an important area of transdisciplinary collaboration between companies, academic institutions, and research centers in the Steinbeis Network, also reflecting key areas of interest within the Steinbeis organization: innovation, the sharing of competence, and know-how transfer.

The articles in this magazine provide some good examples of the know-how offered by Steinbeis Enterprises. They look at environmental toxicology using stem cell research, there is an outline of the latest results derived from patho-immunology in transplantation medicine (certainly an area of research that was neglected in the past), and we provide insights into the development and application of new technologies and digital methods in clinical medicine. In terms of new pharmaceutical developments, especially new techniques used in immune therapy, the characterization of antibodies is of central importance. The analysis of antibody epitopes described in this issue (the molecular recognition structures of antibodies) revolves around mass spectrometry, and this not only offers an essential starting point for new therapeutic antibodies (for example, in cancer therapy). These processes are gaining in importance when it comes to the characterization of pathophysiological antibodies during treatment, especially when it involves genetic engineering and synthetic proteins. One major problem, which often acts as a limitation in the treatment of lysosymal spinal disease based on enzyme replacement therapy, is the formation of antibodies. By identifying antibody epitopes, it becomes possible to develop new methods for molecular diagnostics and treatment.

I hope this issue of TRANSFER stimulates plenty of exchange and discussion, that it encourages closer collaboration on new technology – even supposedly unconnected technologies – and that this brings us nearer to the future goal of developing personalized medicine and health research.

With kind regards,

Michael Przybylski

"The diversity of people is an enrichment"

A TRANSFER interview with PRISMA CEO Stefan Nachbaur

Stefan Nachbaur is passionate about networking. As CEO of the PRISMA group of companies in Vorarlberg and Germany, he plays an active cross-border role in economic and regional development. It would be mistaken to think that this is just about overseeing real estate development. In addition to developing urban districts, city centers, innovation hubs, technology centers, business zones, and industrial areas, his work also involves establishing networked collaboratives to come up with new ideas, sponsoring institutions that operate care homes and supervised accommodation, and working with business startup models. When you meet the energetic networker, it immediately strikes you that for him, the success of a development project is inseparably connected with a constructive exchange of ideas and collaboration between companies, communities, and regional initiatives and associations. TRANSFER met up with Stefan Nachbaur for an interview.

Hello Mr. Nachbaur. The projects you implement in Germany with PRISMA are not normal, everyday projects. Not only do you focus on the right technical and local infrastructure, you also place emphasis on setting up sustainable company networks and initiatives aimed at promoting a regional climate of innovation. You invest your heart and soul in networks and this climate – why?

Every industry player has its strengths, experiences, and competences. Networking young and established business enterprises, universities, funding organizations, and municipal institutions, as well as other parties, creates synergies and provides valuable ideas and inspiration for a vibrant community to work and live. You get, as it were, living, networked areas of opportunity.

You worked on a somewhat different development in Ravensburg. This is a city of 50,000 inhabitants which now has innovative, technology-centric, and creative companies working together in a building called kup. Ravensburg. It's a working environment offering an integrated co-working space brimming with ideas and energy. At the same time, the building has integrated support facilities for people with disabilities. What was your motivation for working on this highly diverse and inclusive project?

The worlds of work and everyday life are changing continuously, as is society's approach to living together. This is a process that's enriching, not only for the innovative power of companies, but also for the diversity of all people, with or without disabilities. kup. Ravensburg is the answer to a question: How do we want to live and work together in the future? But at the same time, this is the motivation for everything we do. It's what drives us.

PRISMA works with a number of partners as part of an initiative called Start (k)up, focusing on the main thrusts of your projects. So you develop reliable partnerships that allow value to be added on a number of fronts. Just some of the things this involves are shared projects, providing support to established companies and business founders, and networking events. What other plans does the initiative have?

Completing kup. Ravensburg essentially provided the Start (k)up. initiative with a physical springboard, so it makes it possible to actually go about implementing things and making things happen. We're taking topics like innovation management, intercultural issues, and startups to kick-start a series of networking events and a whole variety of consulting services. The collaboration partners are playing an active role in this area and are part of the process.

Start (k)up. Ravensburg

Steinbeis is a member of a network called Start (k)up. Ravensburg, which provides support to business founders, spinoffs, and established companies in the economic zones of Lake Constance, Upper Swabia, Allgäu, and Vorarlberg. The network's aim is to establish a startup-friendly environment in the local economy by providing ideas and inspiration, special activities, and support, primarily by enabling people with very different abilities to work together inclusively.

Start (k)up. is a joint initiative between the PRISMA group of companies, the Liebenau Foundation, Steinbeis, the department of economic development at Ravensburg district council, Ravensburg-Weingarten University of Applied Sciences, the city of Ravensburg, and bwcon. The kup. Ravensburg building was erected to provide a platform for innovative, technology-centric, and creative companies. The building opened on June 14.

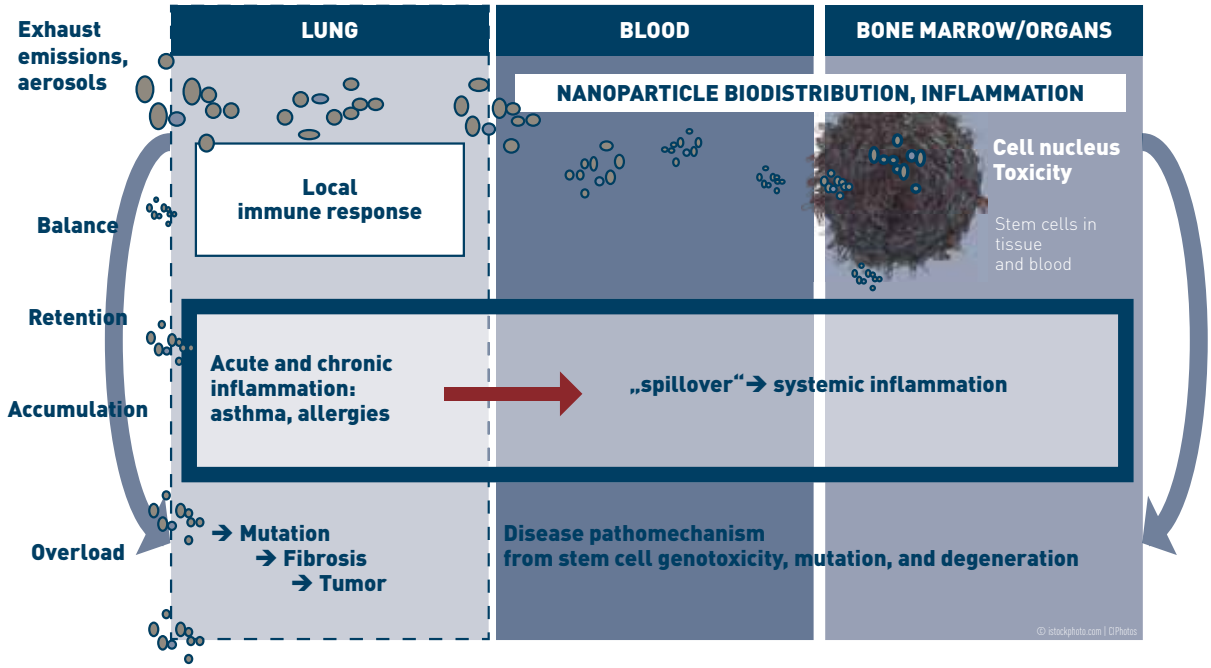
Stefan Nachbaur
PRISMA GmbH, center for the development of business zones and regional development (Friedrichshafen)
stefan.nachbaur@prisma-zentrum.com | www.prisma-zentrum.com

Feature Topic: Life Science

Insights from Steinbeis experts into recent projects

The life science market is expanding worldwide. There are several reasons for this – demographic developments, increasing levels of chronic disease, and general growth in the global population. Personalized medicine is now considered a megatrend in this market segment. And there are other trends bringing about a paradigm shift in this area, such as wearables, telemedicine, and mobile health (m-health). The modern economy would be unthinkable without digital technology, and this is forcing the life science industry to adapt accordingly. For companies, this trend means that they will have to accept the latest technological changes and adapt their business capabilities, research resources, and innovation systems. They will also have to match how they produce and sell products to current requirements, if not completely reinvent them. For the industry as a whole, the two most important factors in this regard are transparency and the safety of pharmaceuticals and data. In this issue of TRANSFER, our experts explain what these developments mean in specific terms for the projects being worked on at Steinbeis. Environmental toxicology, data protection, personalized medicine – these are just some of the many and diverse topics described in the pages that follow.

Image: © istockphoto.com/Bill Oxford



Can Nanoparticles Make People Sick?

A team of Steinbeis experts draws on the findings of stem cell research into environmental toxicology

Atmospheric pollution caused by particulates is emerging as a central factor in the development of cardiovascular, blood, and tumor diseases. Increasing exposure to nanoparticles – originating from combustion engine emissions, medical products, consumer cosmetics, and food additives – poses a health risk and this is entering more and more into the focus of debate surrounding medical issues. A careful assessment of the biological impacts is required to provide a basis for regulatory measures and product approvals. Developing these measures and processes is the task being worked on by experts at the Steinbeis Transfer Center Cardiovascular Research.

Inhaling particles contained in air contaminated by exhaust emissions and other sources of environmental pollution with ultrafine nanoparticles (less than 100nm) has proven to be a central factor in the development of cardiovascular disease, autoimmune disease, and cancer. In addition to this, the increasing use of industrial metallic and chemical nanoparticles in pharmaceutical and cosmetic products for consumers – not to mention foodstuffs – is causing a dramatic rise in exposure to environmental influences resulting in more and more concerns regarding safety. Toxicity stems from the uncontrolled intake of ultrafine nanoparticles through the lungs, intestines, and skin. This contrasts to larger particles, which the body has defenses against thanks to its immune cells.

For a number of years, the experts at the Rostock-based Steinbeis Transfer Center Cardiovascular Research have been looking at the uptake and processing of metallic and polymer-coated nanoparticles in the stem cells of human bone marrow. The stem cells are capable of processing the uptake of certain nanoparticles and can become damaged in terms of function. It is recognized that both damage to the cell nucleus and stem cell gene mutations are decisive triggers in the human body for disease development, and the Steinbeis experts have decided to focus their highly advanced analysis techniques on damage mechanisms. Their analysis involves high-resolution light microscopy (Zeiss Elyra PS-1) and molecular characterization of the function (GLP) of stem cells within the body. Their work will make it possible to apply stem cell research know-how directly to environmental toxicology.

Regulatory work in this area is currently of major importance within the European Union following the publication of a report by the European Chemicals Agency (ECHA), the committee that assesses materials that pose a hazard to health. The report looked at the high health risk posed by titanium dioxide particles, and the outcome is likely to be stricter regulatory measures imposed by the EU Commission. The report highlighted how titanium oxide and other nanoparticles enter the body through pulmonary alveoli and why this is pertinent to disease development. As well as causing local inflammation in the lungs, which can develop into asthma, it causes inflammation throughout the human body and this can be linked to the activation and proliferation of stem cells. Until now, it had not been understood how significant nanoparticle translocation is via the blood into body cells, especially the uptake of highly replicative cells: stem cells in bone marrow, the immune system, and the organs. The particles are capable of triggering genotoxicity (including mutations), especially with chronic inflammation stimulation, and this can lead to autoimmune conditions, rheumatism, cardiovascular disease, or even cancer degeneration of the stem cells. The cell uptake of every ultrafine nanoparticle is thus a primary factor in causing damage to the nuclei of stem cells, especially if they can pass freely through the 30nm pores of the membrane. As a result, new diagnostic techniques are needed to understand the genotoxicity and mutation evaluations of stem cells following exposure to nanoparticles. This would facilitate better judgments regarding how safe it is to be exposed to nanoparticles.

This is of particular importance when it comes to protecting developing organisms during pregnancy and infant growth phases. Similar to the approach with chemical substances, radiation, and epidemic infections, the aim must be to understand how to handle nanoparticles safely. To achieve this, it will be imperative to work on an interdisciplinary level.

References

- Seaton A, Godden D, MacNee W, Donaldson, K. Particulate air pollution and acute health effects. Lancet 1995; 345, 176–178.
- Seaton A, Tran L, Aitken R, Donaldson K. Nanoparticles, human health hazard and regulation. J R Soc Interface 2010; 7, 119–129.
- Manzetti S, Andersen O. Biochemical and physiological effects from exhaust emissions. A review of the relevant literature. Pathophysiology 2016; 23, 285–293.
- EFSA. Re-evaluation of titanium dioxide (E 171) as a food additive. EFSA Journal 2016. doi:10.2903/j.efsa.2016.4545
- SCCS, Gaffet, E., National, F. & Gaffet, E. SCCS OPINION ON Titanium Dioxide (nano form) as UV-Filter in sprays. 2018; SCCS/1583/17 Final.
- Müller P, Gaebel R, Lemcke H, Wiekhorst F, Hausburg F, Lang C, Zarniko N, Westphal B, Steinhoff G, David R. Intramyocardial fate and effect of iron nanoparticles co-injected with MACS® purified stem cell products. Biomaterials. 2017 Aug; 135:74-84. doi: 10.1016/j.biomaterials.2017.05.002. Epub 2017 May 4.
- Müller P, Voronina N, Hausburg F, Lux CA, Wiekhorst F, Steinhoff G, David R. Magnet-Bead Based MicroRNA Delivery System to Modify CD133+ Stem Cells. Stem Cells Int. 2016;2016:7152761. Epub 2016 Oct 4.
- Voronina N, Lemcke H, Wiekhorst F, Kühn JP, Rimmbach C, Steinhoff G, David R. Non-viral magnetic engineering of endothelial cells with microRNA and plasmid-DNA-An optimized targeting approach. Nanomedicine. 2016 Nov;12(8):2353-2364. doi: 10.1016/j.nano.2016.06.015. Epub 2016 Jul 4.
- Schade A, Müller P, Delyagina E, Voronina N, Skorska A, Lux C, Steinhoff G, David R. Magnetic Nanoparticle Based Nonviral MicroRNA Delivery into Freshly Isolated CD105(+) hMSCs. Stem Cells Int. 2014;2014:197154. doi: 10.1155/2014/197154. Epub 2014 Mar 31.
- Delyagina E, Schade A, Scharfenberg D, Skorska A, Lux C, Li W, Steinhoff G. Improved transfection in human mesenchymal stem cells: effective intracellular release of pDNA by magnetic polyplexes. Nanomedicine (Lond). 2014 May; 9(7):999-1017. doi: 10.2217/nnm.13.71. Epub 2013 Sep 24.
- ECHA-Committee for Risk Assessment RAC. Opinion proposing harmonised classification and labelling at EU level of Titanium dioxide. ECHA 2017; 23.
- Stone V, Miller MR, Clift MJD, et al. Nanomaterials vs ambient ultrafine particles: an opportunity to exchange toxicology knowledge. Environ Health Perspect. 2017; 10;125(10):106002. doi: 10.1289/EHP424.
- Terzano C, Di Stefano F, Conti V, Graziani E, Petroianni A. Air pollution ultrafine particles: Toxicity beyond the lung. Eur Rev Med Pharmacol Sci. 2010 Oct;14(10):809-21.
- Kreyling WG, Holzwarth U, Haberl N, et al. Quantitative biokinetics of titanium dioxide nanoparticles after intratracheal instillation in rats (Part 3). Nanotox 2017; 11, 454–464.
- Gustafsson Å, Lindstedt E, Elfsmark LS, Bucht A. Lung exposure of titanium dioxide nanoparticles induces innate immune activation and long-lasting lymphocyte response in the Dark Agouti rat. J Immunotoxicol 2011; 8, (2): 111–121. doi:10.3109/154769 1X.2010.546382
- Fairfield H, Falank C, Avery L, Reagan MR. Multiple myeloma in the marrow: Pathogenesis and treatments. Ann N Y Acad Sci 2016; 1364, 32–51.
- Orban E, Arendt M, Hennig F, et al. Is long-term particulate matter and nitrogen dioxide air pollution associated with incident monoclonal gammopathy of undetermined significance (MGUS)? An analysis of the Heinz Nixdorf Recall study. Environ Int. 2017; 108:237-245. doi: 10.1016/j.envint.2017.08.007. Epub 2017 Sep 5.
- Magdolenova Z, Collins A, Kumar A, Dhawan A, Stone V, Dusinska M. Mechanisms of genotoxicity. A review of in vitro and in vivo studies with engineered nanoparticles. Nanotoxicology 2014; 8, (3):233-78. doi: 10.3109/17435390.2013.773464. Epub 2013 Mar 20.
- Stapleton PA, Hathaway QA, Nichols CE, et al. Maternal engineered nanomaterial inhalation during gestation alters the fetal transcriptome. Part Fibre Toxicol 2018;15, (3) 1–15. doi.org/10.1186/s12989-017-0239-8

The Steinbeis Transfer Center Cardiovascular Research is currently working in close collaboration with stem cell experts, natural scientists, biotechnologists, computer scientists, and medical experts with the aim of developing the necessary analytical methods and techniques for assessing medical risks.

Image: Biodistribution in the organism and the health risk posed by nanoparticles (modified, based on Steinhoff G. und Tiedemann G.)

Professor Dr. med. Gustav Steinhoff is a professor of cardiac surgery at the University Medical Center Rostock and director of the Reference and Translation Center for Cardiac Stem Cell Therapy. He is a leading international expert in regenerative medicine, cardiac stem cell therapy, and gene therapy with nanoparticles. Steinhoff has been the director of the Steinbeis Transfer Center Cardiovascular Research at the University Medical Center Rostock since 2002. The center offers its customers support with application-based cardiovascular scientific research under contract; pre-clinical development, evaluation, and safety testing of cardiovascular biomaterials, transplants, and implants; the drafting of guidelines for medical treatment processes; and the drafting of medical/ethical and economic fundamentals for the ongoing development of treatments for cardiovascular diseases.

Professor Dr. med. Gustav Steinhoff
Steinbeis Transfer Center Cardiovascular Research (Rethwisch-Börgerende)
SU0586@stw.de | www.steinbeis.de/su/0586

"At the end of the day, the key consideration has to be what is best for the patient"

An interview with Professor Dr. Tobias Preckel, director of the Steinbeis Transfer Center Medical Engineering & Life Sciences, and Professor Dr. Sascha Seifert, director of the Steinbeis Transfer Center E-Health-Systems and Medical Informatics

The future of medicine, data protection, and digital solutions – these were just some of the current developments discussed in an interview with TRANSFER magazine by Professor Dr. Tobias Preckel and Professor Dr. Sascha Seifert.

Hello Professor Seifert, hello Professor Preckel – digital technology is changing all areas of our lives at the moment, including science and research. What does this trend mean for life sciences?

Preckel: One of the most important changes is that the insights we're gaining from life science are increasingly derived by networking data. Previously, the standard approach was to do something like pick an individual gene or single out a protein, examine its individual components and maybe also the interactions within a cell, and then use this to try and work out what is happening. The approach now is completely different, and the big concept in this respect is systems biology. Now it's about using new methods in research experiments to look at not just one component, but the overall picture involving all genes or a whole protein set in a cell. This generates huge volumes of data. The challenge now is to work out meaningful links emerging from this data. I believe this is the most important aspect of current developments.

Seifert: There are also major things going on in sensory analysis. There are new kinds of sensors, for example for third-generation DNA sequencing, and these are about the size of a memory stick. Computer science and algorithms are getting better and better such that a normal laptop can be used to analyze massive volumes of data. A further important trend is the shift towards mobile devices, which are already being used as sensors or being applied to diagnostics.

A question for Professor Preckel: What trends do you believe will dictate the future of medical technology and, in particular, medical diagnostics? And what challenges will they lead to?

I believe there are three important trends. The first has already been mentioned by Professor Seifert: DNA sequencing. New techniques have now made sequencing the human genome so cheap that the costs can be met by a medical insurance company. This means that genetic information on patients will always be available and this can be used to work out all kinds of things, such as the risk of a certain disease; this will make it possible to take the necessary precautions. But it also creates an issue when it comes to data privacy protection. Another new area opened up by DNA sequencing is that patients can be treated individually. This is about personalized medicine whereby treatment is matched individually to each patient. The second trend relates to the growing importance of bioinformatics. DNA sequencing involves major volumes of data and these have to be stored and analyzed. The third trend I'm observing is cell reprogramming, whereby certain methods can be used relatively easily to exchange genes that affect diseases. Of course, this is a vision of the future – the idea that diseases can be combated by changing genes in body cells – but extensive research is going on in this area. This approach also entails risks. Bio-hackers can use the same method to turn relatively harmless bacteria into extremely dangerous bacteria which could then be used as a bio-weapon or in terrorist attacks. Then of course there are the ethical issues – human characteristics can be changed by using genetic techniques, such as the color of people's eyes or hair, or maybe even mathematical abilities. Those are the three most important trends. But the new developments are also resulting in companies that were previously not involved in medical areas discovering new markets for their products. In these markets, they face completely unfamiliar challenges, because they involve extremely long-winded approval processes and entirely different customer requirements. To deal with these challenges, they need the right expertise. So they'll either have to develop this expertise internally or buy it in from outside. This is a trend that's quite specific to this industry because of the new developments.

Turning now to Professor Seifert: The big crunch with digital transformation in the medical industry is how to protect highly

sensitive patient information. What do you believe can be done to meet this challenge?

People keep talking about data protection, but actually it's not the data we need to protect but personal rights. When the new General Data Protection Regulation (GDPR) came into effect in May, it had major implications for all branches of industry, including hospitals and medical practices. Everything has to be documented and for doctors' practices this involves a major amount of work. That's why I believe that a new sector will be formed in this area to help doctors manage the job in hand. Data privacy is also an extremely tricky issue when it comes to research. Basically people want to generate lots and lots of data for research so the question is, what should be done with it? An example: Researchers may work out that a person has a certain disease. That person ought to be told about it, which goes against the grain of data privacy, but there's no way to do it anyway because the data that's available is anonymous. But on the other hand, especially given the fact that we're in an era of big data, one has to wonder whether data really is anonymous anyway. More often than not, the data can be used to work out who somebody is without even logging their name or address. From 70 SNP upwards – SNP refers to variation at a certain position in the genome – it becomes possible to link data to a specific individual. Given the current trend toward setting up bio-databases, this data could be used to positively identify who that person is. A number of suggestions have already been made, for example by the German Ethics Council, on ways to protect data in bio-databases. Data protection is also an important issue when it comes to the cloud. Most cloud providers are based in the United States, where data protection works differently from Europe. The other example comes from what happened with the Strava fitness app. The routes people were running were logged by GPS, and this unveiled secret military bases used by the USA. So as you can see, protecting data privacy means you have to think about a whole host of different factors. I'm not sure I can say what the right way is to solve this, but there are a number of different trends going on. But one thing's for certain: The GDPR is an excellent move in the right direction.

What direction do you both think medicine will take us in the future? Will we be treated by computers and looked after by robots?

Preckel: I think the human element is and will remain an important part of the healing process when people are unwell. We could perhaps use robots to cover the technical side of things, medication and device handling – the routine tasks, but this would never replace human interaction with doctors or care workers. One thing I think will get better in the future is the quality of medical treatment. For example, mistakes can be avoided when administering treatments by merging different types of medical data. Another aspect could be that doctors won't just make decisions by themselves, but several doctors could be given an opportunity to go through data and make decisions together, without physically sitting in the same room as the patient. I see the developments stemming from digital transformation as a largely positive thing. But there are also cost factors, because it's less expensive to have data looked at abroad. But what about quality? If that does happen, it will need to be ensured that the medical training people undergo abroad corresponds to German standards.

Seifert: I feel quite positive about it, for example with things like the principle of second opinions. This is where computers can be used. For example in imaging diagnostics, software is often used to check if a doctor has noticed everything. We will also have to accept that we'll have to rely on robots and ultimately this will be necessary because of the shortage of skilled workers and demographic changes. Of course, with medicine it's a fine balancing act between quality and costs, but the only way to resolve this is to improve the technology. At the end of the day, the key consideration has to be what is best for the patient. Developments are already headed in the right direction such that patients are becoming more and more involved in their own treatment and they're kept informed so they can be involved in the decision-making.

Image: © fotolia.de/Elnur

Professor Dr. Tobias Preckel

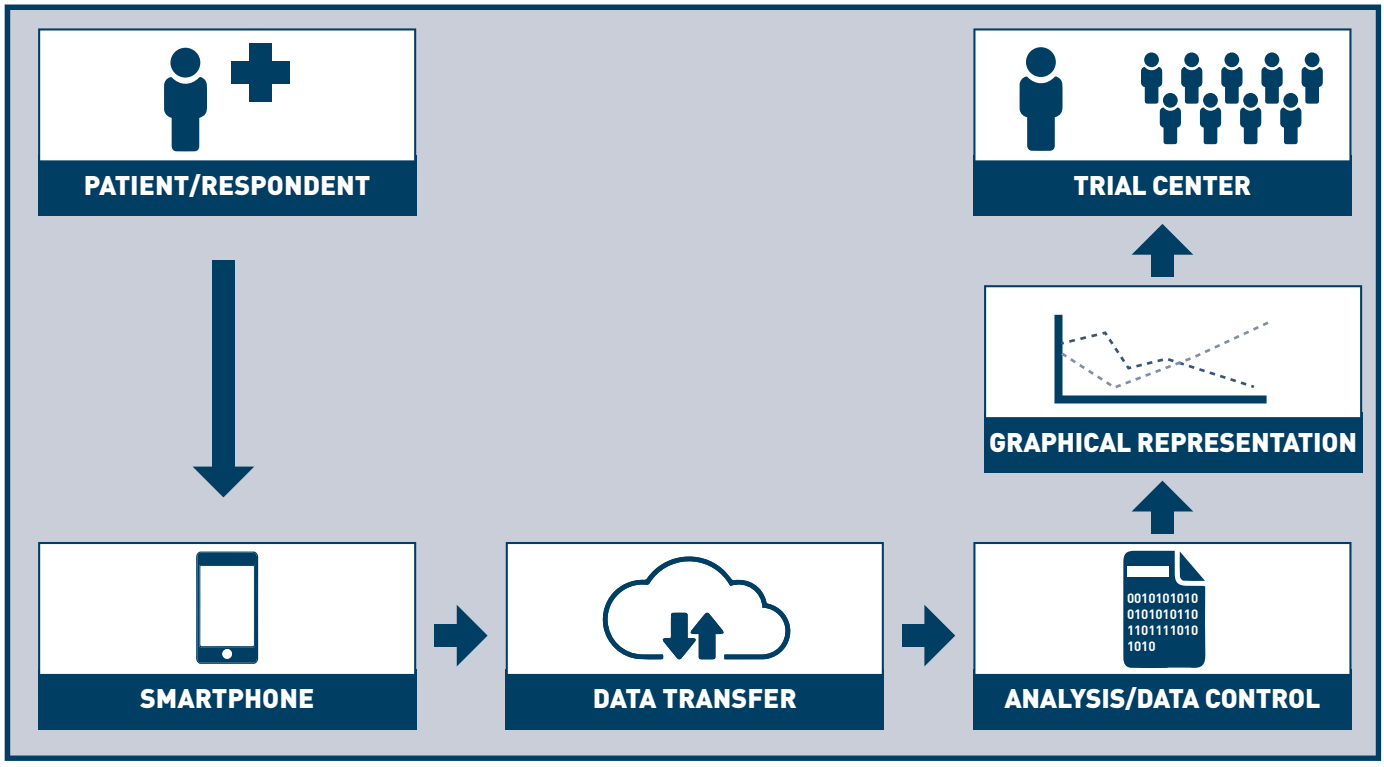
Professor Dr. Sascha Seifert

Professor Dr. Tobias Preckel is director of the Steinbeis Transfer Center Medical Engineering & Life Sciences at Pforzheim University, which offers clients technology transfer, market analysis, and technology audits in the fields of medical engineering and life sciences.

Professor Dr. Sascha Seifert is director of the Steinbeis Transfer Center E-Health-Systems and Medical Informatics at Pforzheim University. The projects worked on at the Steinbeis Enterprise include supporting customers with applied research projects in the form of technology consulting, coaching in the fields of information systems, computer-aided detection and treatment, mobile health, and bioinformatics used in life science applications.

Professor Dr. Tobias Preckel
Steinbeis Transfer Center Medical Engineering & Life Sciences (Marxzell)
su2119@stw.de | www.steinbeis.de/su/2119

Professor Dr. Sascha Seifert
Steinbeis Transfer Center E-Health-Systems and Medical Informatics (Königsbach-Stein)
su2123@stw.de | www.steinbeis.de/su/2123



WeSeniMuS: Wearable Technology in MS Research

The use of mobile technology and wearables in clinical studies

The development costs of new pharmaceuticals have increased many times over the last decades. More than 50 percent of all expenditures are now channeled into clinical development. Using mobile technology and wearables to make clinical research safer and improve financial viability could bring about a fundamental change in clinical research in the years to come. The Steinbeis Research Center ProMyelo has now entered into a project alliance to investigate how this could work in practice.

Clinical studies involve carrying out an experiment with the support of healthy test persons and voluntary patients. The idea is to examine important questions regarding new treatment options, vaccines, or diagnostic procedures, and even look into new application areas for known pharmaceuticals. Clinical studies tend to span several phases, taking place one after the other to identify any potential risks posed by a new treatment, the effectiveness of a medicine, or any impact that treatment may have on certain factors dictating quality of life. The aim of a Phase I trial is to determine any issues relating to the safety or tolerability of a pharmaceutical product in the body after administration. Human test persons are observed to ascertain the severity of any side effects after they have taken the medicine. In many cases, a Phase I trial only involves a small number of participants; perhaps between 6 and 10 healthy subjects will be enrolled. If the preparation being tested passes the first phase of a trial and is found to be tolerable, Phase II begins. The idea of a Phase II trial is to gather initial information on the safety and effectiveness of a potential new medicine among patients. It is also examined whether different dosages have an influence on the effects of a medicine. In many cases, several Phase II trials are carried out to check medicines among different patient groups or investigate indications. The actual proof of effectiveness and tolerability for a medicine comes from a Phase III trial. The aim of this trial is to replicate actual conditions as closely as possible. Phase II and Phase III clinical trials always include (at least) one control group. The effectiveness of the preparation being investigated is compared to that of a standard medicine (typically already in use to treat the condition). Alternatively, if there is no standard medicine, comparisons are made to a placebo. Phase IV studies are conducted after a pharmaceutical product has received regulatory approval from the competent authorities. This phase of a study (commonly referred to as post-marketing surveillance, or PMS) is designed to assess the long-term effect of treatment with a medicine. This approach makes it possible to understand more uncommon undesirable side effects. Overall, each stage of pharmaceutical testing is therefore designed to examine the effectiveness and safety of a potential new medicine.

Ideally, human test persons or patients will be monitored continuously at every stage of a study in order to establish as early as possible if there are any changes in a medical condition or side effects. But in reality, continuously monitoring people is (still) not practicable, unless of course people are tested in the rooms of the hospital or study center. This is why clinical studies tend to establish the effectiveness and safety of drugs by ensuring that the intervals between tests are more or less kept as short as possible. Depending on the condition being examined, people involved in the trial typically visit a physician every four to eight weeks in order to check the progress of their condition and see if there are any side effects. Doctors only have a limited amount of time to record test parameters. Long examination intervals and short windows within which to carry out the examinations entail two possible risks. The

first is that possible side effects may not be detected until it's too late or may not be noticed at all. The second is that the effectiveness of a new active substance may not be understood in enough detail. Both issues – by themselves or together – can result in delays in the approval process of a new drug, and this raises the cost of the individual trial phases. The Steinbeis Research Center ProMyelo, has joined forces with LMU Munich, RWTH Aachen University (C. Kohlschein; IMA and Dr. S. Jonas/mhealth), and Hannover Medical School (Prof. M. Stangel and S. Gingele) to examine the extent to which wearables can be used to recognize the side effects of drugs as early as possible and provide a more precise assessment of their effectiveness.

Wearables are basically all kinds of devices that are worn on the body and have been fitted with sensors. Signals from the sensors are transmitted wirelessly to share data with an end device, typically a smartphone. Examples of wearables are activity trackers worn on the wrist, smartwatches, measurement devices wrapped around the chest, electronic scales, blood pressure measurement devices, and clips attached to clothing. Apps are used to gather data from a wearable, and this is then forwarded via the internet to a trial center or the clinical investigator for systematic evaluation. Using wearables already makes it possible to monitor a whole host of bodily functions and factors such as skin temperature, weight, blood pressure, heart rate, quality of sleep, oxygen supply to the blood, or paces walked – so in essence, they facilitate real-time monitoring. They also make it possible to capture a variety of cognitive parameters such as speech recognition, memory, alertness, or cognitive controls and with the right apps, these parameters can be observed as a trial progresses.

The first step the Steinbeis experts intend to undertake for the WeSeniMuS (Wearable Sensors in Multiple Sclerosis) project will be to investigate whether wearables can be used to monitor the state of health of people with multiple sclerosis (MS). To do this, volunteers and MS patients will be given different types of sensors to wear. Their health will then be observed according to established clinical procedures, and this will be compared to the measurements taken by the wearable sensors. Aside from tracking their mobility (using the Apple Watch Series 3 and a Garmin vívosmart HR+ fitness tracker), daily measurements will be taken of their blood pressure (QardioArm), weight (QardioBase), cardiac activity (QardioCore, a wearable ECG), and oxygen saturation (iHealth Air Pulsoximeter).

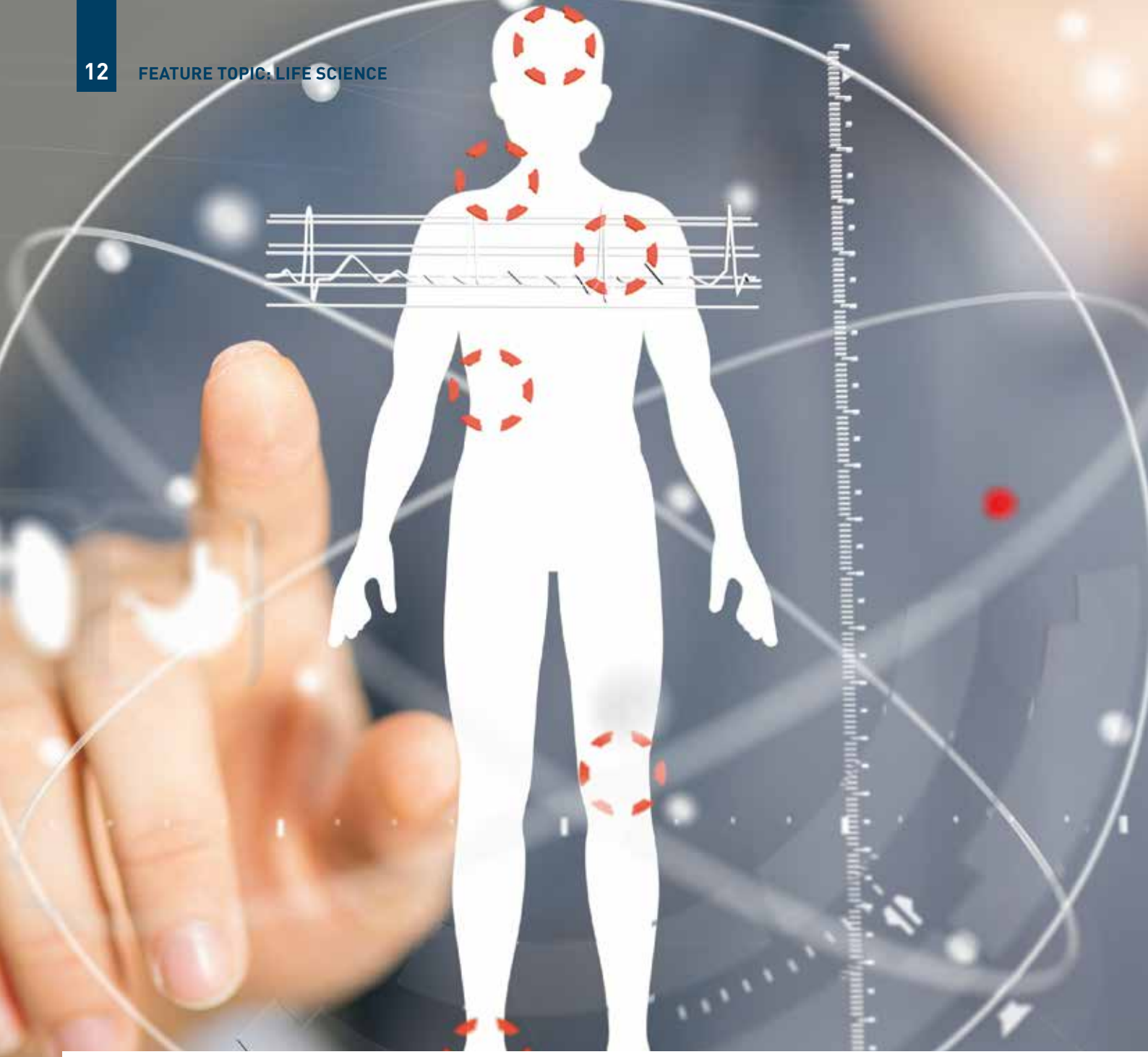
Motor impairments are known among MS patients, but it is less common to observe MS patients already suffering from cognitive deficits during early stages of the condition. Yet up to 70 percent of patients are affected by this. Cognitive problems become noticeable when patients have difficulties concentrating or paying attention, or become increasingly forgetful. The experts have proposed using two specific groups (batteries) of neuropsychological trials: a Brief Repeatable Battery for Neuropsychological Evaluation (BRB-N) and a battery called Minimal Assessment of Cognitive Function in MS (MACFIMS). These will help assess the cognitive performance of MS patients. Both batteries span several tests at the same time. The MACFIMS can be completed in around 90 minutes; the BRB-N takes roughly 35 minutes. The aim of this kind of neuropsychological testing is to evaluate different types of cognitive performance traits, such as attentiveness, memory, language, flexible thinking, and problem-solving abilities. Regular cognitive testing among MS patients is not widely established practice in clinical settings and rarely features in clinical trials. The researchers have entered into a partnership with the makers of an app called Peak to adapt smartphone software so as to capture not just physical data but also patient performance in a variety of cognitive areas. The aim of the Steinbeis experts is to use the subproject to answer some fascinating questions, such as whether using the app to measure the cognitive abilities of MS patients will provide reliable information compared to established testing procedures.

More and more clinical trials now involve digital technology. According to a report issued by the Gartner Group in 2015, it was forecasted that around ten percent of clinical studies would involve the use of wearables by the end of 2017. As digital transformation accelerates, society is undergoing fundamental change and medicine will inevitably have to come to terms with this. In some fields, digital transformation has already reached an advanced stage, but in clinical research it is only just getting out of the starting blocks. Using smartphones or wearables on (and even in) the body could improve the reliability of trial data generated by MS studies. The Steinbeis Research Center ProMyelo would like to capture simultaneous information on physical and cognitive parameters and provide a holistic picture of patients – and thus make clinical studies more efficient, less expensive, and more importantly: safer.

Image: A schematic representation of data acquisition, transfer, and analysis

Professor Dr. med. habil. Dr. rer. nat. Markus Kipp is director of the Steinbeis Research Center ProMyelo at the University of Munich. The Steinbeis Enterprise offers its customers support with the planning and implementation of research projects revolving around neurodegenerative issues, neuroinflammatory issues, or both. It also develops new in vivo animal models in the field of neurobiology as part of preclinical study projects (neuroscience).

Professor Dr. med. habil. Dr. rer. nat. Markus Kipp
Steinbeis Research Center ProMyelo (Munich)
su1777@stw.de | www.steinbeis.de/su/1777



"It's not just the medical experts who have challenges to face, but the entire healthcare system"

An interview with Professor Dr. Hans-Peter Deigner, director of the Steinbeis Transfer Center for Personalized Medicine

Personalized Medicine: What exactly is it, what benefits does it offer and what challenges does it present? What does the future have in store for it? Professor Dr. Hans-Peter Deigner spoke to TRANSFER magazine about these topics.

Hello Professor Deigner. Could I ask how you would describe personalized medicine, and what benefits does it offer to patients?

Personalized medicine basically refers to all measures that can be used to make a more exact diagnosis and offer more precise treatment. It also entails making better prognoses. In the future, it will make it possible to avoid certain diseases. So this means we'll be able to make earlier interventions and introduce measures that are targeted at and adapted to specific individuals. Cancer treatment will likely be one area where the concept of personalized medicine will be introduced the quickest – for several reasons. It's been known for a while that no two tumors are the same, so the likelihood of a successful treatment outcome is higher if treatment is matched to patients and their circumstances.

What are the challenges faced by medical experts when using these techniques, and what can or should they do about these challenges?

It's not just the medical experts who have challenges to face, but the entire healthcare system. An important part of this is reimbursement – "Who's paying for what and under what circumstances?" This is an issue that people are currently offering some absurd answers for. The insurance companies and paymasters expect service costs to be met for each diagnosis or each diagnostics parameter, and average costs are supposed to come to a certain amount. Blanket fees per case are not exactly helpful when it comes to making progress in medicine. It would make more sense to invest a lot more in certain areas, because some investments will pay for themselves in the long term. But ultimately the problem is that approaching the entire field of medicine from a business perspective is simply not in the interests of the patient. For me – and the same applies to doctors – it's absurd to look at this mainly from a commercial perspective and it's certainly not in the interests of patients, but unfortunately this is increasingly what happens with privatization.

Does personalized medicine solve skyrocketing costs in the healthcare industry or does it at least help cut costs in the long term? Opinion is divided on this one. What do you think?

Naturally I think it'll be more expensive in the short term, because development costs money. The more parameters you have, the more exact the picture of the condition of a patient, but that means investing more time and energy – and that costs money. But if you can extend the healthy stages of life of an individual, or avoid damage to someone's health later in life, or even make it possible for a patient to stay alive, the costs will be worth it in the long term. Timelines are different depending on the role you play in the healthcare system. Often, prognoses and prevention don't look beyond the next 20 years. Instead people try to work out what's worth doing for the next one or two years. So overall I'd say things don't necessarily have to be more expensive, but of course it does depend on people's interests, which can be highly diverse.

What developments do you think will shape the future of personalized medicine?

I think personalized medicine is already in a position to be introduced successfully today, at least in areas where it doesn't have to cost much. For example it's already possible to use existing data to run evaluations at fairly reasonable cost. I have a colleague who evaluated the data of patients in intensive care with a hospital. They looked at data that's generated anyway, but nobody had actually looked at it in so much detail before, or not in the way they did. What this means is that relatively large volumes of data are already being gathered, so if you can use data mining and approaches based on bioinformatics and statistics, data can be used for the benefit of patients. A number of companies that understand the ins and outs of data processing have worked this out already. They actually originate from a completely different field, but they're now moving into personalized medicine.

One thing that should be noted is that it's the overall condition of data that's decisive when it comes to moving personalized medicine forward, in view of the accelerating developments. In other words, we've finally got to have some population studies that cover off a good section of the population and run over an extremely long period, ideally for an entire lifespan. A lot of time will still have to pass for the foundation of data to improve significantly, especially if it is to be combined with existing data and used much better than it is now. On top of that, for the majority of people in the industrialized world, the most important diseases are extremely multifactorial and are dictated by hundreds or even thousands of gene activities. Of course this can't be evaluated properly if you only base studies on a couple of thousand patients, because you don't have enough data. But if you had access to the data of millions of patients and this even spanned a longer period or told you something about relatives or families, that would completely change things. On that basis, we could make significantly more accurate predictions and we could even make treatments available, but that will still take us decades. But on the other hand, as I already mentioned, very soon there will be ways to use the data that already exists. Technological progress in areas like sequencing is accelerating things and doing even more to cut costs. More information can be obtained from genes, gene activities, RNA, proteins, or metabolites, and it's becoming increasingly possible to analyze and evaluate this data in the right context. So the technical prerequisites are being fulfilled and the developments are happening that will dictate this process – and there are also social developments. Consensus is needed on this, plus the right guidelines regarding data use, for us to collect and evaluate such large volumes of data from individuals. And of course we also have to think about ethical issues. So as you can see, there certainly are a lot of problems that still need to be worked out, but we have to tackle them and we have to do this quickly if we want to make progress for the good of patients.

Image: © fotolia.com/vege

Professor Dr. Hans-Peter Deigner and Professor Dr. Matte are co-directors of the Steinbeis Transfer Center for Personalized Medicine at Furtwangen University (HFU). The Steinbeis Enterprise looks at the development and validation of biomarkers, biostatistical and bioinformatic analysis, the design and assessment of experiments and clinical studies, and the approval of medical products.

Professor Dr. Hans-Peter Deigner
Steinbeis Transfer Center Personalized Medicine (Rottweil)
su1789@stw.de | www.steinbeis.de/su/1789

Minimizing Risk with IMMODGEL and PANBioRA

New research findings on the prevention of immune responses after the fitting of implants and assessing the risk posed by biomaterials

To avoid or at least reduce often undesirable immune responses to implants, an innovative system comprising chemical and biological components has been developed as part of an EU research project called IMMODGEL. The project was coordinated by Steinbeis 2i, which has also submitted a successful proposal to the EU for a follow-on project to evaluate the risks posed by biomaterials.

Patients with implants often experience side effects. Progress has now been made with implants used in dentistry and Head and Neck surgery thanks to an EU project called IMMODGEL, and developments will soon make their way into medical practice. The IMMODGEL project involved developing an innovative system comprising chemical (hydrogel) and biological components (immune system cells) for dental and laryngeal implants made of titanium. They have been designed to be highly adaptable so that they can be used for a variety of implants, medical devices, and transplants. A diagnostic test has also been developed comprising an "on-chip" system capable of predicting the immune responses of individual patients. Chemical and physical settings can be adjusted to avoid rejection, and for the first time implants can be adapted individually.

Working in collaboration with Protobios, a company from Estonia, the University of Heidelberg detected specific markers that can be used to describe the reactions of individuals to titanium. The results were used to work out the optimum combination of biomaterials and cytokines to inhibit inflammation. To exponentiate this effect, the University of Nottingham team analyzed the topography of surfaces and selected optimal microstructures for integrating into the final therapeutic solution. The other partners in the consortium helped improve the formulation of the gel and developed an adhesive layer that will keep the gel on the titanium surface. The consortium partners discovered unexpected antimicrobial properties in this layer, and this led to the submission of the first patent by Protip Medical and INSERM in the field of polypeptide and hyaluronic acid coatings. Two further patents were submitted before completion of the project and further submission is also planned. To derive benefit from the project results in the long term, the scientific coordinator is planning to found a startup in the fall of 2018. The firm will focus on the solutions and methods developed under the IMMODGEL project for suppressing immune responses to dental and laryngeal implants. American researchers spearheaded by Prof. Ali Khademhosseini at the Brigham and Women's Hospital in Boston have developed a "Foreign Body Response on-a-chip" system, which can analyze reactions to titanium under conditions similar to in vivo testing.

The research findings offer major potential to develop an innovation that should not just reduce the scale and duration of inflammation caused by implants. It should also improve the healing process after their insertion. The project will thus help reduce the negative consequences of implants and the pain suffered by patients. It will also help cut associated medical costs in Europe. The IMMODGEL research into embedding macrophages has also established a favorable starting point for further research in this area, which has received little coverage in the specialist literature until now. The treatment approach developed under the project has been successfully trialed and validated in animal experiments, producing highly promising results.

The IMMODGEL project was completed in September 2017 with the support of the universities of Heidelberg, Nottingham and Strasbourg, the Brigham and Women's Hospital (United States), and several SMEs, including Protip (France), Protobios (Estonia), and Contipro (Czech Republic). Steinbeis 2i acted as the coordinator of the project and was responsible for managing administrative and financial aspects. It also provided consortium partners with support on protecting intellectual property rights and disseminating project results.

At the same time, the project results are laying a foundation for a new Horizon 2020 research project called PANBioRA (Personalised and/or Ge-

neralised Integrated Biomaterial Risk Assessment, Grant Agreement No 760921). Five of the eight partners working on the IMMODGEL project are continuing their research into immune responses as part of the PANBioRA project. The project will last four years and is being funded by the European Commission under a Horizon 2020 programme looking at the "Development of a reliable methodology for better risk management of engineered biomaterials in Advanced Therapy Medicinal Products and/or Medical Devices".

Biomaterials play an increasingly important role in medicine. They can be used in a variety of applications, ranging from implants, to bandage materials for covering wounds, and organ replacements. There are a number of different types of biomaterials on the market and they can be used for the same methods of treatment. But doctors find it difficult to decide which materials are best suited to which patients, primarily because each patient may react differently to the same biomaterials. Until now, there has been no suitable and sufficiently wide-ranging method for assessing the risk of using biomaterials. Since January 2018, Steinbeis 2i has been providing an administrative umbrella for the coordination of 17 partners from 11 European countries to work on a solution to this problem. The aim is to develop a method that can be applied to the standardized evaluation of biomaterials in order to assess intervention risks on several levels. With the new method, it will for the first time be possible to predict a patient's reaction to a specific biomaterial before it is implanted. This will make it possible to minimize costs and improve health outcomes.

The method will be based on a module-based platform in order to analyze antibody reactions, cyto- and genotoxicity, systemic and local effects on tissue, and any impact on adjacent tissue (organ-on-a-chip). In addition, the end product will be supplemented with physical/chemical and biochemical experiments, as well as prediction models on a system level. This should be achieved by linking test modules and risk radar instruments alongside a biomechanical testing system. One of the biggest challenges with the project lies in integrating different types of analytical technologies in a single system. As a result, one of the most important tasks at the beginning of the project was to establish user needs for the integrated PANBioRA system. The consortium is working on a multidisciplinary level and is made up of SMEs, scientific research organizations, hospitals, and technology transfer experts – once again underlining the complexity of the innovative initiative.

Besides Steinbeis 2i two further Steinbeis enterprises are involved in PANBioRA. Steinbeis Advanced Risk Technologies GmbH (R-Tech) will identify and evaluate needs, priorities, expectations and capacities of stakeholders with respect to the development and use of an integrated risk governance framework for biomaterials.

Steinbeis Advanced Risk Technologies Institute doo Kragujevac (SARTIK), a branch of R-Tech, is responsible for the multi-scale modelling part applied to biomaterials and will develop models for the assessment of data deriving from the integrated systems.

Both the IMMODGEL initiative and the PANBioRAIMM project point the way for future research and development work in the field of personalized medicine. Minimizing implant rejection and carrying out a comprehensive assessment of biomaterials opens the door to efficient treatment options, which will also save time and money. This will reduce the incidence of complications; this in turn will improve clinical outcomes and help minimize healthcare expenditures in the long term. In addition, the initiative will establish new procedural standards for evaluating biomaterials and make this approach to treatment accessible to a broader group of patients.

Image: Team PANBioRA

Melanie Ungemach is an employee of Steinbeis 2i GmbH. Steinbeis 2i works in the field of innovation and internationalization and is a partner in the Enterprise Europe Network of the European Commission, which currently involves 600 partner organizations in over 50 countries. The aim of the network is to provide support to companies on all issues relating to business in Europe, innovation, research, and technology transfer. It also helps firms exploit the findings of European research. Steinbeis 2i is a partner in the Baden-Wuerttemberg consortium and works in collaboration with the craft industry association Handwerk International, bw-i, the Ministry for Economic Affairs, and six chambers of industry and commerce.

PANBioRA announces recent project results, scientific publications, and its participation in events through social media on Twitter https://twitter.com/panbiora, Facebook and LinkedIn. It also makes announcements on its project website.

Melanie Ungemach
Steinbeis 2i GmbH (Stuttgart/Karlsruhe)
Melanie.Ungemach@stw.de | www.steinbeis.de/su/2017 | www.panbiora.eu | www.immodgel.org

„Combining ultrastructural and molecular biology analysis would be ideal for gaining new insights“

An interview with Professor Dr. Ulrich Schraermeyer, director of the Steinbeis Transfer Center OcuTox

Professor Dr. Ulrich Schraermeyer talked to TRANSFER magazine about current developments in the treatment of age-related macular degeneration and his fascination with electron microscopes and the potential they offer.

Hello Professor Schraermeyer. Our eyes are a miracle of nature but as we get older our eyesight starts to fade. You're hot on the trail of new active ingredients for treating degenerative diseases such as age-related macular degeneration (AMD). What is the current state of research?

We've developed a drug called Remofuscin for treating dry macular degeneration. It can remove lipofuscin and it's expected to be in hospital use this year once the EU has provided funds for a clinical study. Initially it will be used for patients with Stargardt disease. As soon as we have positive results from this trial, which I'm assuming we will, the investors will be lined up to fund a trial with patients suffering from dry macular degeneration.

You place a strong emphasis in your research on electron microscopes. Why is this instrument so important to you?

Electron microscopes are so important to me because they're the only devices capable of making subcellular structures visible. You just need to think about the fact that most known cell organelles were discovered with an electron microscope. I don't think everything has been discovered yet, and with the help of electron microscopes new organelles will be found. Scientific developments have been going in the direction of molecular biology for around 40 years now, and they've resulted in so many new insights. But at the same time, development of routine electron microscopy has started to stagnate or it's even come to a complete standstill. It's different with cryogenic electron microscopy, but that's only suitable for certain types of issues (such as understanding protein structures). The classic disciplines of electron microscopy such as pathology, anatomy, and cell biology have basically withdrawn into the sidelines. Most young anatomy specialists or pathologists are no longer able to assess ultrastructural images these days. The consequences of this trend are that we no longer have access to the technical and scientific staff we need to carry out electron microscope work. This means there is a huge opportunity for electron microscopy in the future and it will undergo a renaissance. Forty years of molecular biology research and the findings it has produced have not been processed with respect to the ultrastructure, so this now provides us with different insights into new details compared to 40 years ago. Combining ultrastructural and molecular biology analysis would be ideal for gaining new insights. But not much has happened really, except for tomography.

I'd like to demonstrate what I mean with an example. The fovea is a tiny area on the retina of the eye measuring around 1.5 millimeters in diameter. It's tremendously important, because it's the only place where there are enough photoreceptors for us to see properly and do things like read. The last high-quality electron microscopic examinations of the fovea were performed around 40 years ago. But within the fovea there's an even smaller area called the foveola. It has a diameter measuring only 0.35 millimeters. Actually, we wouldn't have any eyesight

without the foveola. Yet despite their importance for our eyesight, the first important anatomical details of the foveola were only published this year – by my research group – and none of this would have been discovered without electron microscopy (Tschulakow et al., 2018).

There's still so much to discover with electron microscopy – and it goes on and on. Imagine there's an organism being treated with a new drug. Very often, treatment will have an influence on the subcellular ultrastructure and when researchers try to analyze such treated tissues, usually it's new territory for them. Their observations are fascinating but it's difficult to share them. But such changes make it possible to draw conclusions regarding mechanisms and effects, and often it's not so easy to learn these things from other methods. The amount of information contained in an ultra-thin section can be phenomenal. Just one ultra-thin square section with a 1 millimeter edge can be magnified 20,000 times to a length of 20 meters and an area of 400 square meters. For this reason alone it's obvious that not all ultrastructural details can be known yet, although that's what's sometimes claimed. I'm still fascinated by electron microscopy because of its enormous potential to discover new things.

Your Steinbeis Transfer Center OcuTox is specialized in experimental vitreous and retinal surgery. What kind of issues is it currently working on?

Many eye diseases – such as retinal vein thrombosis, macular degeneration, diabetic retinopathy, or optic neuropathy – are also caused by a reduction in retinal or choroidal blood flow, and as a result of this the oxygen partial pressure can drop sharply, so that retinal cells die. This can quickly lead to blindness. There is no known treatment for rapidly restoring the partial pressure of oxygen to physiological levels. When oxygen is introduced through a catheter into the retro-orbital region, it diffuses into the retina and increases the partial pressure so that the retinal cells can survive longer even though the retinal blood flow is completely or partially blocked. In retinal vein thrombosis, for example, this approach buys time until the vessels are supplied with blood again, so it enables the photo-receptors to survive. We've developed a device that makes it possible to regulate the retinal oxygen partial pressure to physiological values by introducing oxygen into the retro-orbital region. The Steinbeis Transfer Center OcuTox is currently developing a prototype as a proof of concept with the aim of preventing blindness after retinal venous thrombosis. Investors and collaboration partners are still being sought for further clinical development of the new device.

Finally Professor Schraermeyer, what developments do you expect to see in ophthalmology over the next decade?

I believe that the future of AMD research lies in understanding the function of pigments in the retinal pigment epithelium (RPE): melanin, lipofuscin, and melanolipofuscin. Melanin plays a crucial role as a pigment in providing protection against oxidative stress, which the pigment epithelium is strongly exposed to. It is also important for the lysosomal detoxification of bisretinoids and other toxic metabolites. The other pigments, melanolipofuscin and lipofuscin, increase stress in the pigment cells, among other things through activation of the complement system. Research into age-related retinal degeneration will be dominated by attempts to answer the question of how to reduce or remove lipofuscin content in RPE cells, and this will result in new therapeutic options. Another research topic in the future will be understanding the interactions between the retinal pigment epithelium and the unique endothelium of the choriocapillaris, which recedes in dry AMD or begins to proliferate in wet AMD. Understanding the factors that flick the switch will be crucial for future therapeutic developments. It's already possible to influence the balance between pro- and anti-angiogenic factors, without or in combination with anti-VEGF therapeutics – and to do this in such a way that the vascular leaks are closed, simultaneously avoiding undesirable atrophy effects. These are the kinds of treatment options we're working on. Getting them into the hospital is basically a financial issue. It's important in gene therapy to understand how and where viral vectors gain access to the target cells and how new genes are integrated into the genome. How this works with photoreceptors is still not understood to this day.

References:
Tschulakow, A. V., et al. (2018). The anatomy of the foveola reinvestigated. PeerJ 6: e4482.

Image: © istockphoto.com/mingazitdinov

Professor Dr. Ulrich Schraermeyer is director of OcuTox, the Steinbeis Transfer Center at University Hospital Tübingen. The services offered by his Steinbeis Enterprise range from electron microscopy/light microscopy to biochemical analysis, visual function testing on laboratory animals, and toxicity assays.

Professor Dr. Ulrich Schraermeyer
Steinbeis Transfer Center OcuTox (Hechingen)
su0959@stw.de | www.steinbeis.de/su/959 | www.ocutox.com

Innovation Knows No Borders

Steinbeis Innovation Center coordinates cross-sector business network for medical technology

Digital transformation is a door to opportunity, but it also presents a number of new challenges to many sectors of industry. It is resulting in networks between a multitude of markets hand in hand with technology convergence, and this makes it possible to zoom in on individual customers and users. This also applies to the field of medical technology. Products now contain integrated silicon chips and actuators are now networked or connected. When you add sensors to this picture, for the first time it becomes possible to genuinely understand customer needs. Services and products can be adapted individually to maximize customer benefit. What this all means is that B2B markets, which could previously have been described as relatively self-contained, are now expanding into B2C markets. To adapt to these changes in the field of innovation, companies will have to change their approaches and systems when it comes to innovation. They now need the right know-how regarding hardware and software developments and they will have to think through product usage scenarios at all stages of the life cycle. Standardized approaches to innovation will no longer be enough. To develop personalized products and new business models, new strategies now need to be developed. This is where a project called CIP-MED comes in. The initiative, which is receiving backing from the Federal Ministry of Education and Research (BMBF), offers a cross-sectoral business network for medical technology companies to acquire a more systematic approach and methods for working on innovation across different sectors of industry. The focus of the project lies in developing personalized products and services for use in medical technology. The project is being spearheaded by the Steinbeis Innovation Center for Innovation Engineering.

Cross-industry innovation is and always has been a tried-and-tested way for companies to access new fields of application and markets. There are basically two approaches a company can adopt: They can either lift solutions out of other sectors of industry and apply them to their own markets (the outside-in method) or they can transfer their own know-how to new fields of application (the inside-out approach). The idea is to focus on working together to add value, so companies should pool and combine their skills and competence. When it comes to medical technology, the industry in Germany consists of lots of SMEs (93% of all firms), so both approaches hold potential.

The CIP-MED innovation network, which is being overseen by the Steinbeis Innovation Center, comprises a design agency from Frankfurt called Iconstorm and a variety of firms and members of other industry and innovation networks, such as Biopro Baden-Württemberg, the IVAM Microtechnology Network, the LMBW state mechatronics network, Medical Mountains, and other important players. The specialties of the network members span a variety of key fields such as medical technology, microsystems engineering, mechatronics, and health care/life sciences. The aim is to work together in fostering networking in the industry. The network offers a platform for exchanging

experiences and trying out new ideas. The teams look at the different methods and approaches of cross-industry innovation to work out a systematic approach for capturing the requirements of industry by involving experts from the fields of personalization and user-centric innovation.

CIP-MED aims to provide support to medical technology SMEs in leveraging the possibilities offered by digital solutions, personalization, and human-centered design to enter new markets. The focus lies in methods based on cross-industry innovation. The aim with this approach is to sidestep a company's existing value chain and exchange know-how with firms in other sectors of industry. This kind of innovation is typically only stumbled upon by chance by SMEs, so the innovation forum wants to help make their approach more systematic.

An important part of this is pinpointing the right methods by involving experts in user-centric design. Working together makes it possible to come up with new business models and put them through their paces. The experts also write a kind of "action manual." The aim of writing instructions is to provide pointers on the methods that best match different sizes of company, situations, and sectors of industry. The forum also works like a networking organization for members to work with the right partners with the right skills.

There can be no doubting the economic advantages of personalized products and services. The personalization trend is picking up momentum in B2B and B2C markets and as such, it offers significant sales potential. Another important aspect regarding medical technology is that one third of industry turnover currently stems from products that are no more than three years old. As innovation increasingly develops into an interdisciplinary task, the CIP-MED innovation forum offers its members an opportunity to exploit this potential for their own purposes.

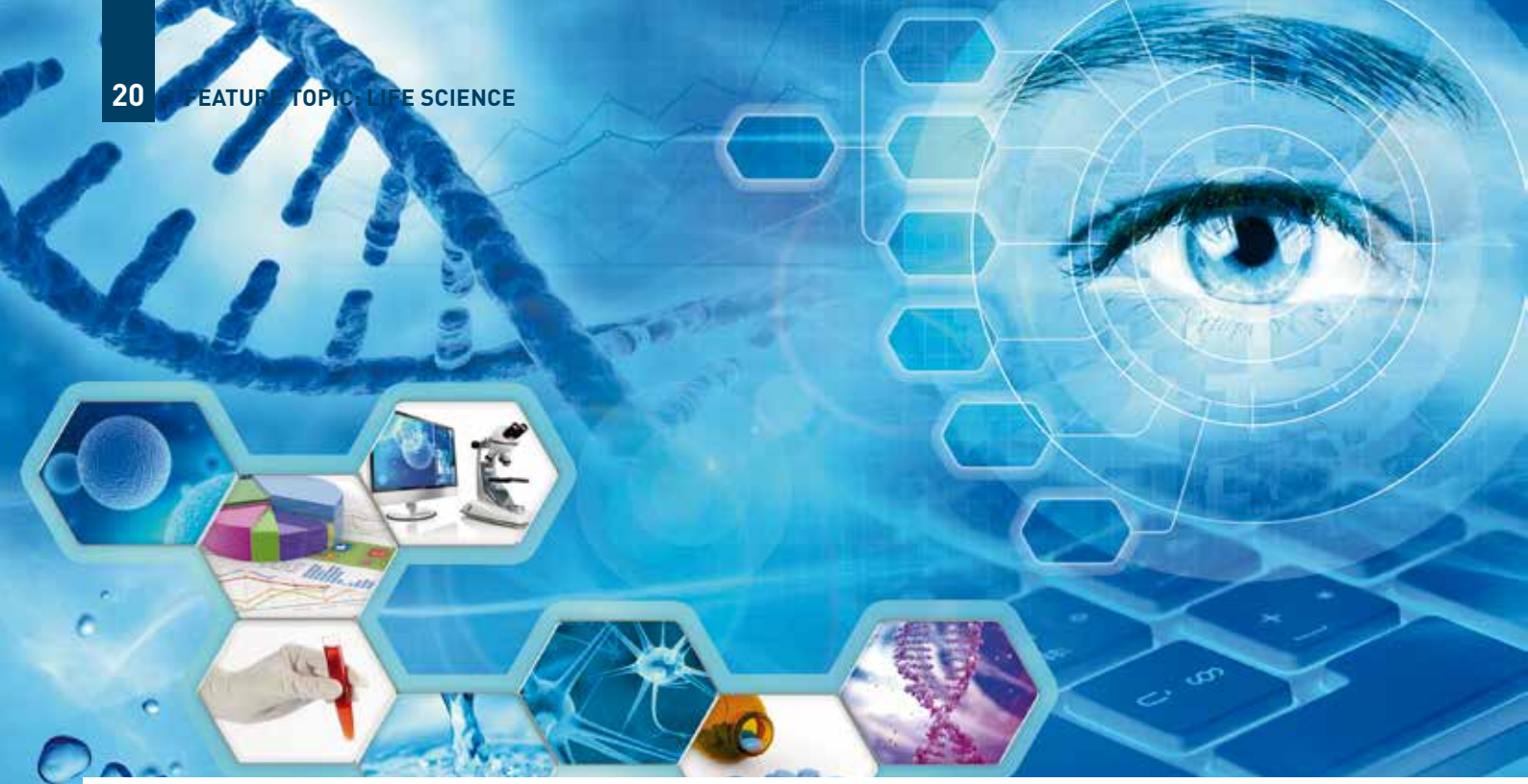
The forum offers its members ways to link up know-how from other relevant market segments. Important practical issues can be addressed, such as market access, barriers to entry, and limiting factors of a technical or organizational nature. At the same time, the forum members have a chance to rub shoulders with other firms that are a good match when it comes to implementing cross-industry innovation. They gain insights into the methods of user experience design, the development of personalized (smart) products, and different ways to re-engineer their business models.

Baden-Wuerttemberg is practically predestined to act as home to the CIP-MED innovation forum. The region around Tuttlingen is referred to by some as Medical Valley and it serves as an important business cluster for the medical technology industry. This cluster has specialized in the development and production of innovative surgical instruments, orthopedic solutions. and diagnostic systems. The state of Baden-Wuerttemberg is also characterized by a large number of business clusters and networks in other fields of technology, such as microsystem technology, mechatronics, and life sciences. This establishes the best possible conditions for the methods of cross-industry innovation. The role of CIP-MED should be to provide companies with a vehicle for creating synergies and intensifying collaboration. To do this, the forum will also try to dovetail its activities with digital initiatives in the long term. Examples of such initiatives include so-called micro-test beds, which foster cross-industry collaboration through web-based ecosystems in order to add new value across a multitude of fields at the same time.

Image: © iStockphoto.de/eplisterra

Dr.-Ing. Günther Würtz is director of the Steinbeis Innovation Center for Innovation Engineering. The Steinbeis Enterprise helps its customers develop new concepts including process and technology roadmaps, product and service roadmaps, and value-add roadmaps.

Dr.-Ing. Günther Würtz
Steinbeis Innovation Center Innovation Engineering (Stuttgart)
guenther.wuertz@stw.de | www.steinbeis.de/su/1420



„A technology isn't an end in itself – it's an engine of innovation"

An interview with Professor Dr. Ralf Kindervater, director of BIOPRO Baden-Württemberg GmbH

In an interview with TRANSFER magazine, Professor Dr. Ralf Kindervater describes the work of BIOPRO Baden-Württemberg GmbH, its goals, how its work translates into business practice, and much more.

Hello Professor Kindervater. BIOPRO was founded in 2002 as the State Agency for the Promotion of Biotechnology. What were the objectives at the time for setting up the agency?

BIOPRO was set up solely as a biotechnology agency as part of a development initiative focusing on biotechnology. Bioeconomics and the healthcare industry entered the picture ten years later. The aim was to pull the four bioregions together to form a state-level initiative. There were already a number of precursors to the organization, which had tried to do the same thing, but they were unsuccessful. The third move entailed establishing BIOPRO as a state agency and to use this as a springboard for networking four bioregions in Baden-Wuerttemberg: Heidelberg, Freiburg, Ulm, and the metropolitan area in and around Stuttgart. At that point, biotechnology areas were only really known in Bavaria, North-Rhine Westphalia, and Berlin. Baden-Wuerttemberg did already have a large number of renowned research institutions and universities, plus certain business establishments encompassing around 130 biotech companies, but they were basically not linked to one another. As a result, one of the central tasks of BIOPRO was to take the four existing bioregions and form them into a uniform overall entity within Baden-Wuerttemberg for the field of biotechnology.

BIOPRO has developed successfully since it was set up. What were the reasons for moving things forward and what are the current goals?

We totally understood that our task wasn't just to concentrate on looking after biotech firms and keep the general public up to speed with the status of current research, which is a societal role we now fulfil through two state websites. It's especially important to ensure people are kept informed, especially with new technologies, to provide society with an objective picture. But a technology isn't an end in itself – it's an engine of innovation. So the question we asked ourselves was which sectors of industry could be made more innovative by using (new) biotechnology. We dovetailed this with specific factors in the state, so on the one hand we knew which research institutions were looking into which issues, but we also knew in which companies these research results could be implemented. The next task was to take everything into the sectors of industry where it could be used. The first sector we worked with was the pharmaceutical industry, where we referred to the process as industry biologization – which incidentally is a topic that's quite relevant again. The aim at the time was to take research insights and use these to bring together corresponding biotech firms with the pharmaceutical industry. The second sector of industry we started to look at in 2006/2007 was medical technology. This is a field that belongs to those who become involved in radical innovation. One example of this is Aesculap, which many years ago invested in TETEC to work together in the field of biological knee cartilage implants and spine implants. This is the kind of partnership that shows that a classic medical technology company can also make a success out of current biotechnology trends. Next came the chemical industry, one of the most successful examples of which is our business cluster for biopolymers and biomaterials. Its aim is to develop polymers based on renewable raw materials. But to succeed as an agency of innovation, you always have to stay one step ahead. Our biopolymer/biomaterial cluster empowered us to act as the ideal enabler for moving Baden-Wuerttemberg forward, even in an area like the bioeconomy. That's exactly what we've been doing since 2010 and as a result, in 2013 an amendment was

made to our articles. This meant that BIO-PRO was no longer just about being a biotechnology agency but also an executive partner in developing the healthcare industry and bioeconomy in the state. Since 2017, we've been involved in the development of a state strategy for a sustainable bioeconomy. Another important area we started working on in 2018 has an impact on the healthcare industry, which in terms of export power ranks number three among all industries in Baden-Wuerttemberg, after mechanical engineering and the automotive industry. The state government has acknowledged this and it's now triggered a process which will be made public in July: dialog on the role of Baden-Wuerttemberg as a player in the healthcare industry. This will be social, scientific, and business dialog aimed at safeguarding the future of the healthcare industry in Baden-Wuerttemberg. This is also an area affected by radical change due to digital transformation, personalization, and a whole slew of new technologies. Then there are issues such as EU regulations, like the new medical product legislation and in-vitro diagnostic regulations. These pose a major threat to our companies, which are typically small or medium-sized businesses. All of these topics will flow into the dialog, which we'll also help shape.

Biotechnology is one of those key technologies offering tremendous potential to innovate and fuel convergence, but where there are opportunities, there are also risks. Which trends will dictate the future of the industry, and what challenges do they entail?

Like all new key technologies, biotechnology offers potential – but yes, it also entails risk. Let's take genome editing based on CRISPR/Cas9 as an example. This technology makes it possible to split DNA precisely, almost like you would in a garage laboratory, though in that sort of place you can't really fathom the implications of what you're doing. Of course this method has potential. If diseases are genomic, you can spot and heal them. But what might be the side effects of such treatments? And of course, there are ethical issues. These are the sort of topics or issues that crop up when technologies are developed for the first time, or redeveloped, and they're the sort of topics society, science, and business need to think about. The task of a state agency – and this is our remit – is to strive for public dialog on these topics. This is exactly the way it is for the bioeconomy. You have to ask yourself whether our consumer-centric lifestyle is right if we want to preserve our planet for the generations to come. And of course this is where responsible innovation plays a role – not innovating come what may, but innovating with a certain sense of responsibility and consideration for the impact of innovation. That brings us back to the topic of understanding the impacts of technology.

The bioeconomy bridges a gap between technology, the environment, and efficient business. So it acts as an enabler of biobased, sustainable economic growth. Sounds good, but how does that translate into business practice, especially in Baden-Wuerttemberg?

When an economy is fully developed – like the economy in Baden-Wuerttemberg, which is a cohesive whole and booming – changes like this are only possible in small steps. For example there are a couple of rural areas where people have been working on biotechnology for years and they're doing everything they can to be independent and supply their own energy with solar power, wind energy, and bioenergy. But these little areas are of course predestined to turn their bioenergy villages into bioeconomy villages. Even in the cities there are signs of the beginnings of such bioeconomies, like pyramid systems for using wood scrap. But of course people have to enter into a continual dialog with public bodies, as well as key players in the private economy, which is what we're doing. The areas where we think interacting with us and our machinemakers/mechanical engineers will accelerate bioeconomic systems are the partnerships we have with EU projects. A good example of this is our INTERREG project along the Danube corridor: DanuBioValNet. Our aim here is to interact with non-bioeconomy clusters to share the acquired knowledge of the bioeconomy with traditional sectors of industry. We're the ones who have to manufacture the bioeconomic machine technology. We're the ones who have to take it out to people and enter into bioeconomic partnerships with local companies. And then, at the end of this process, the semi-finished products and end products of bioeconomical production come back to Baden-Wuerttemberg. So we have to use small, local activities and steer bioeconomic developments in close collaboration with partner states and do this in such a way that Baden-Wuerttemberg finds itself in a win-win situation, which it can benefit from on several fronts. The issue of digital transformation is also important, because we can use eco-evaluations, life cycle assessments, and biodiversity analysis to simulate and model lots of raw material sourcing scenarios, from conversion, to adaptation into semi-finished products, or even further processing into end products; and based on this, we can make decisions that are right for the future of our state.

Image: © fotolia.com/Paulista

Professor Dr. Ralf Kindervater is director of BIOPRO Baden-Württemberg GmbH and honorary professor at Karlsruhe Institute of Technology (KIT) in the department of chemical engineering and systems control engineering. BIOPRO Baden-Württemberg is a state agency for the promotion of bioeconomy and biotechnology issues, as well as the pharmaceutical industry and medical technology (healthcare industry). It has set itself the goal of representing interests in these areas in society and highlighting the benefits of innovations.

Professor Dr. Ralf Kindervater
BIOPRO Baden-Württemberg GmbH (Stuttgart)
info@bio-pro.de | www.bio-pro.de

An Impressive Treatment: Enzyme Therapy

Steinbeis experts conduct research into diagnostic and treatment processes for lysosomal storage diseases

Lysosomal storage diseases (LSDs) are a group of metabolic diseases in which defects in a specific enzyme lead to severe pathological changes in organs. Although individual types of LSD are rare, general incidence levels are relatively high (roughly 1 in 8,000). Depending on the defective enzyme, LSDs can cause damage to organisms in a variety of ways through conditions such as liver or kidney damage, heart attacks, and neurological damage. In recent times, of all the different treatment methods available, enzyme replacement therapy (ERT) has proven particularly successful. ERT involves delivering missing or defective enzymes through an infusion of human recombinant proteins. ERT works for a variety of LSDs, but unfortunately it is extremely expensive: The costs of treatment per patient per annum can be as high as €300,000. The Steinbeis Transfer Center for Biopolymer Analysis and Biomedical Mass Spectrometry is conducting research into alternative treatment methods.

A major problem with ERT is that antibodies form against synthetic enzymes, and this can lead to severe allergic reactions (see reference literature, 1-6). Antibodies bind with the therapeutic enzyme, and this neutralizes and hinders therapeutic effects. In many cases, treatment can only be continued if patients are administered powerful immunosuppressives, but these also cause severe side effects. There is therefore strong interest in alternative therapies for blocking or removing antibodies in enzyme replacement therapy, in the same way that there is strong general interest in protein therapy.

Antibodies work by only binding to short, specific peptide segments of a protein. These sections are called epitopes, and their structure and binding affinity are decisive when it comes to the specific nature of an antibody. It is crucial to identify the structure of epitopes and their binding affinity, partly for medical advancement and the development of diagnostic and therapeutic biomarkers, but unfortunately this is currently not possible using conventional methods. To identify the epitopes of antibodies, the experts at the Rüsselsheim-based Steinbeis Transfer Center for Biopolymer Analysis and Biomedical Mass Spectrometry have developed a method which combines surface plasmon resonance (SPR) biosensor analysis with mass spectrometry (MS). For the first time, this makes it possible to identify molecules while simultaneously determining antibody epitope affinity. The success of the work speaks for itself: The applicability and efficiency of the new combined method have already been validated by successfully identifying epitopes in a series of antibody protein complexes (reference 7).

The Steinbeis experts in Rüsselsheim recently performed an epitope analysis of antibodies following enzyme replacement therapy for Fabry's disease (FD). FD is a lyposomal storage disease that affects the skin, kidneys, and cardiovascular system and has other pathological effects. The disease, which has only been identified in around 5,000 patients in Europe until now, is caused by mutations in a gene in the X chromosome. The company Genzyme, which has been working with the Steinbeis experts for a number of years, has recently made successful advancements in the treatment of FD by using enzyme replacement therapy, and in 2010 its work was honored with the Steinbeis Foundation Transfer Award. Patients are given infusions of the recombinant human enzyme during enzyme replacement therapy. Although therapy can be successful, there are significant drawbacks due to reactions in the immune system and immunoglobulin antibody formation, and this can even result in life-threatening complications.

The identification, chemical synthesis, and optimization of epitope affinity and the stability of antibody epitopes open up new possibilities to avoid reactions of the immune system and increase the therapeutic effectiveness of ERT in lysosomal storage diseases. There are two treatment options. The first involves pretreating patients with the epitope peptide in order to neutralize antibodies. The second is to remove antibodies by using special blood cleansing techniques. Both methods are designed to significantly enhance the efficacy of therapeutic procedures with proteins, paving the way for new developments and new clinical applications involving epitope peptides as therapeutic guidance frameworks and specific diagnostic options.

The facts

Fabry disease is caused by mutations in the αgalactosidase A (αGal A) gene. The GLA gene provides a code for the αGal A enzyme, which degrades globotriaosylceramide in the lysosomes of cells. The Steinbeis experts successfully identified the epitope of αgalactosidase with a human anti-αGal antibody by using mass spectrometry with the sequence αGal(309-332) – see reference 7. The epitope is chemically synthesized and delivers high, nanomolar affinity comparable to the overall protein. It also provides an essential basis for neutralizing immunogenecity after enzyme replacement therapy. The synthesis and affinity characterization of the 23 amino acid-long epitope sequence showed a defined conformation, which the research team is currently looking into in more detail. The αGal (309-332) peptide epitope should thus be suitable for developing clinical procedures for deactivating antibodies for ERT, for example through molecular apheresis.

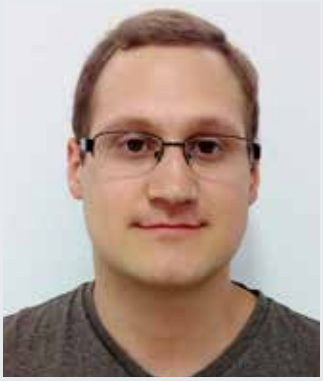
References:

1. M. Gillian et al.: Agalsidase alfa: a review of its use in the management of Fabry disease, (2012) BioDrugs. 26: 335-354.
2. B.W. Bigger et al.: The role of antibodies in enzyme treatments and therapeutic strategies, Best Practice & Res. Clin. Endocrinol. & Metab., (2015) 29: 183-194.
3. S. Ortolano et al.: Treatment of Lysosomal Storage Diseases: Recent Patents and Strategies, Rec. Patents Endocrine Metab. & Immune Drug Discov. (2014) 8: 1872-2148.
4. G.E. Linthorst et al.: Enzyme therapy for Fabry disease: Neutralizing antibodies toward agalsidase alpha and beta, Kidney International, (2004) 66: 1589-1595.
5. Banugaria SN, Ng YK, Kobori JA, Finkel RS, et al. The impact of antibodies on clinical outcomes in diseases treated with therapeutic protein: lessons learned from infantile Pompe disease. Genet. Med. (2011) 13: 729-736.
6. Hennermann JB, Gökce S, Solyom A, Mengel E, Schuchman EH, Simonaro CM: Treatment with pentosan polysulphate in patients with MPS I: results from an open label, randomized, monocentric phase II study. J Inherit Metab Dis (2016) 39: 831-837.
7. Kukacka Z, Iurascu M, Lupu L, Rusche H, Murphy M, Altamore L, Borri F, Maeser S, Papini AM, Hennermann J, Przybylski M: Epitope identification and affinity characterization of human alpha-galactosidase A to a monoclonal antibody by SPR-affinity mass spectrometry. ChemMedChem. (2018) doi: 10.1002/cmdc.201800094.

Image: © iStockphoto.de/angelp

Prof. Dr. Michael Przybylski

Loredana Lupu



Pascal Wiegand

Dr. Stefan Maeser

Prof. Dr. Michael Przybylski is director of the Steinbeis Transfer Center for Biopolymer Analysis and Biomedical Mass Spectrometry, where he conducts research in this field with his colleagues Loredana Lupu and Pascal Wiegand. The work carried out at the center includes the structure identification of membrane proteins, the synthesis and structural analysis of modified proteins, and the identification of structures in autoimmune diseases.

Dr. Stefan Maeser works in research and development at Biogen GmbH, a global biotechnology specialist. Biogen develops, produces, and sells innovative medicines for people suffering from serious neurological diseases, autoimmune diseases, and rare conditions.

Prof. Dr. Michael Przybylski, Loredana Lupu, Pascal Wiegand
Steinbeis Transfer Center for Biopolymer Analysis and Biomedical Mass Spectrometry (Rüsselsheim am Main)
Michael.Przybylski@stw.de | www.steinbeis.de/su/723 | https://affymslifechemde.wordpress.com

Dr. Stefan Maeser
Biogen GmbH (Ismaning)
www.biogen.de

Leveraging the Full Potential of Digital Solutions

EU-backed training on digital solutions in the healthcare industry

In January 2018, the Steinbeis Transfer Institute Therapeutic Communication and integrated Health Promotion embarked on a three-year project with twelve partner organizations from eight European countries. The project is called Digital Skills on Computational Biology for Health Professionals (BioS) and its aim is to support the use of digital resources in the health care market across Europe by developing module-based computational biology curricula for doctors and the teams they work with. The curricula will then be launched and introduced.

The project is receiving backing from the Erasmus+ program offered by the European Union and the aim is to take the everyday reality of medical practices and hospitals into account, particularly in light of European guidelines for the healthcare industry. The following factors and issues should be looked at: Digital transformation – i.e., the options for automatically processing large volumes of data – will lead to changes on a number of levels in the healthcare market, especially with respect to existing care structures, processes, and outcomes. Scenarios that are currently conceivable or have been suggested – due to their context, or for economic reasons – may turn out to be wishful thinking or just a one-way street. Given the current situation, continuous monitoring is required in the training and continuing professional development industry, and it will be necessary to overhaul procedures in order to empower teams of medics to improve their ability to exploit the full potential of digital transformation. They will also need to be able to recognize and avoid certain risks.

Telemedicine makes it possible to offer medical support at any time and in any place. Professional, specialized centers can offer services in all kinds of locations. There are also ways of using telemonitoring to continuously track vital statistics and offer corresponding therapeutic interventions that are matched to actual needs. Currently, there are only a small number of acknowledged evidence-based standards. There are also no established service models that would be compatible with procedures followed in medical practices and hospitals. Electronic patient records would also offer effective ways to enhance efficiency and quality – and could reduce healthcare expenditures. Once information has been gathered and logged, it can be accessed anytime and in any place, sidestepping the need to repeat examinations and helping ensure patients receive care in keeping with guidelines. Despite this, little has been undertaken either on a domestic or European level to ascertain how information should be structured or evaluated. With the number of patients with chronic conditions or multiple morbidities on the rise due to demographic trends, ultimately it will also be important that the ever-growing volumes of information are indeed suitably structured and evaluated, especially given the nature of such patients. It will also be necessary to avoid data being senselessly allowed to lie fallow. Instead, to improve efficiency and quality through information, data will have to be structured as uniformly as possible across Europe and made easy to access. For many medical teams and their partners, work is still needed to continually expand methodical data protection training. As a result, another project has been also proposed to the EU to deal with this specific aspect.

Predictive and customized medicine can help improve diagnostics and treatment by offering gene analysis and molecular biological procedures based on the processing of large volumes of data. Ideally, this would enhance prevention and appropriately customized diagnostics and

The BioS projects focus on developing instruction videos and other forms of modern teaching materials for vocational training in healthcare professions. Training corresponds to relevant guidelines laid down by the European Union, in particular the European Qualifications Framework (EQF) and the European Credit System for Vocational Education and Training (ECVET).
The four planned modules are:

1. The fundamentals of the methods, tools, and resources of bioinformatics in medical practice.
2. Computational statistics for medical practitioners and other people employed in healthcare, with a focus on the interpretation of biomedical data, methods, and the evaluation of statistical relevance.
3. There are already a large number of commercial genetic information services worldwide. Course participants learn how to apply these to their daily work with patients. They learn how to interpret disease risks and identify suitable genetic studies for all eventualities.
4. The last module of the curriculum is dedicated to communication between carers and their patients and the ethical issues associated with new methods. This is because customized gene research and the services offered by bioinformatics involve handling sensitive patient information. This module covers training on consultation sessions, risk management, and decision-making.

Partner organizations: Steinbeis University Berlin, EUREHVA GmbH (Germany), e-NIOS Applications (Greece), BG Klinikum Murnau (Germany), Olympic Training (Greece), FOR SRL (Italy), Skybridge Partners (Greece), HiDucator Oy (Finland), Associació Bioinformatics Barcelona (Spain), Escola Profissional do Alto Lima (Portugal), University of Patras (Greece), German Oncology Centre (Cyprus), Association Medicale Européenne (Belgium).

treatments. The problem comes when diagnostics are not developed to the same extent as treatment options, because this raises a whole host of ethical issues. Suitable regulation will also be needed to avoid the misuse of predictive medicine. All of these new possibilities and the risks they involve require suitable training options, as is the objective with the BioS initiative.

It is likely that patients will be able to assume greater personal responsibility in the future due to the number of health apps now available, not to mention big data and algorithms. Quite possibly, people may also do more to look after or treat themselves. It is well known, however, that there could be correlation problems, and validating causal relationships is often problematic. As a result, how such solutions are used in practice will need to be supervised by doctors and possibly even controlled. This makes it essential that experts are sufficiently qualified to understand different developments.

The healthcare-related bioinformatics training offered at the beginning of the initiative will now be assessed as part of the BioS project. Until now, 52 official curricula are known to be on offer through BSc, MSc, or PhD programs, and these have been logged by the BioS partners for systematic evaluation. With the support of third-party specialists, the aim is also to conduct an in-depth analysis of identified evaluation parameters and a number of other factors by conducting surveys and interviews. A central pillar of this project will also be systematic literature research in this area. Since early May, relevant national and international events have also been looked into through active or passive participation. This is part of a general dissemination plan to capture specific events and pave the way for the experts to discuss and try out their own training ideas themselves. The Steinbeis Transfer Institute Therapeutic Communication and integrated Health Promotion has been asked to coordinate the overall organization of the project, although it is also helping with all other project deliverables such as selling, course development, course implementation, and quality assurance.

Overall, equipping people with the skills they need to understand the opportunities and threats of digital transformation requires high competence levels, not just when it comes to development, but also with respect to application and deciding which digital solutions should be used. Universities, medical associations, specialist societies, important networks, and product providers have therefore already been approached as part of future training initiatives and invited to become project partners. Politicians, convention agencies, and a whole variety of training providers are also promoting and leveraging the digitalization megatrend for their own purposes. A number of studies now offer new insights into the additional (or sometimes even inadequate) benefits of digital developments. The initiative sees the confusion this creates in this area as an incentive to systematically pull together, pool, evaluate and if necessary test and use such offerings as a modular (fundamental) bioinformatics curriculum for medical practitioners throughout Europe.

Image: © iStockphoto.de/CIPhotos

Professor Dr. Hartmut Schröder is director of the Steinbeis Transfer Institute Therapeutic Communication and integrated Health Promotion. The services offered by his Steinbeis Enterprise range from transfer-oriented research in the field of health communi-cation to advisory services for therapists and institutions in the field of therapeutic and health communication, and health management.

Professor Dr. Hartmut Schröder
Steinbeis Transfer Institute Therapeutic Communication and integrated Health Promotion (Berlin/ Potsdam)
su1424@stw.de | www.steinbeis.de/su/1424 | bios-projekt.eu

The German version of this text was agreed and coordinated with: Songül Secer (DEGEDI, Bochum), Stephan von Bandemer (IAT, Gelsenkirchen), Mehmet Canbay (EUREHVA, Essen), Peter Augat (BG Klinikum, Murnau), Franz Bartmann (AEKSH, Bad Segeberg), Winrich Breipohl (EUREHVA, Essen).

Continuing Professional Development That Pays

A hybrid education concept for Six Sigma projects

Since June, the Steinbeis Business Academy (SBA) at Steinbeis University Berlin has been working with the Six Sigma Akademie Deutschland to offer training as a project manager for Six Sigma improvement projects. The initiative is part of a new training concept, the aim of which is to ensure that quality assurance tools are both understood and internalized. The experts are offering a new hybrid approach that combines virtual instruction with classroom-based study.

Training that makes a distinction between imparting knowledge and the application of that knowledge – using digital instruction modules to prepare students for their time in the classroom – offers added value on two fronts, not just to course participants but also to their companies. Periods of virtual study enable students to spend less time away from the workplace, and the knowledge they acquire can be accessed during training sessions whenever needed. Classroom sessions offer plenty of variety and they are kept interactive so that students can focus on applying the knowledge they acquire. This cements understanding and makes it easier to transfer know-how to the workplace.

The Steinbeis Business Academy and the Six Sigma Akademie Deutschland now offer a new Green Belt qualification based on a 360° hybrid education concept. By the end of their training, course participants gain Six Sigma LEAN+AGILE Green Belt certification.

Six Sigma makes it possible to improve the efficiency of project management in the long term. After completion, course participants can apply their Six Sigma methods and deliver financial and strategic benefit to their organization. Their qualification also empowers them to conduct their own projects and apply quality assurance tools spanning each of the Six Sigma project phases.

The training is targeted at engineers, scientists, businesspeople, people with a technical background in research or development, production planners, and anyone involved in manufacturing or quality management at a service provider or production company. Anyone interested in the course can take part in a trial webinar and gain an impression of the content covered.

Jürgen Werner
Steinbeis Business Academy at Steinbeis University Berlin (Gaggenau/Berlin)
juergen.werner@stw.de | www.steinbeis.de/su/638 | www.steinbeis-academy.de/weiterbildung/arbeits-und-managementtechniken/six-sigma-green-belt-qualifizierung/

Smart Thermal Management for Future Fuel Consumption

Steinbeis experts develop a system approach for achieving future fuel consumption targets in China

The Chinese government has drafted a fuel consumption standard called China Phase 4 under which it is anticipated that vehicles will have to achieve an average fuel consumption of 5l/100 km (47 mpg). Li Gaojian (of Guohua SAIC – GM Wuling Automobile Co., Ltd) estimates that this will raise costs by more than 1,348 euros per vehicle. The entry price for the Wuling Hong Guang S1 MPV, which is now one of the best-selling cars in the world, would go up by more than 17%. Thermal management systems offer one of the most cost-effective options for reducing fuel consumption, although the extent of potential reductions is considered limited. Modern engines heat up very quickly such that the "hot/cold factor" can amount to less than 6%. Ino8 Pty Ltd Australia, a Steinbeis Transfer Center, has therefore been looking into the extent to which fuel consumption can be reduced even further thanks to new thermal management innovations, not just during cold starts but also once the engine has heated up.

One system offering new synergies is OVER8™ , which adopts a new approach to combining existing thermal management elements. The team working on a project with the Steinbeis director Dr. Frank Will took a car built in 2016 and subjected it to New European Driving Cycle (NEDC) testing. The tests were carried out in an accredited exhaust emissions laboratory according to ISO standard 17025. The experts examined new combinations of affordable solutions such as high-temperature cooling agents, evacuation of cooling agents during cold starts, heat accumulators, and other types of technology. Consumption reductions of 9% were documented in the first part of testing, 6% reductions were achieved with a combined cycle, and (surprisingly) even 3% reductions were found to be possible in the second part of testing.

An installed heat accumulator

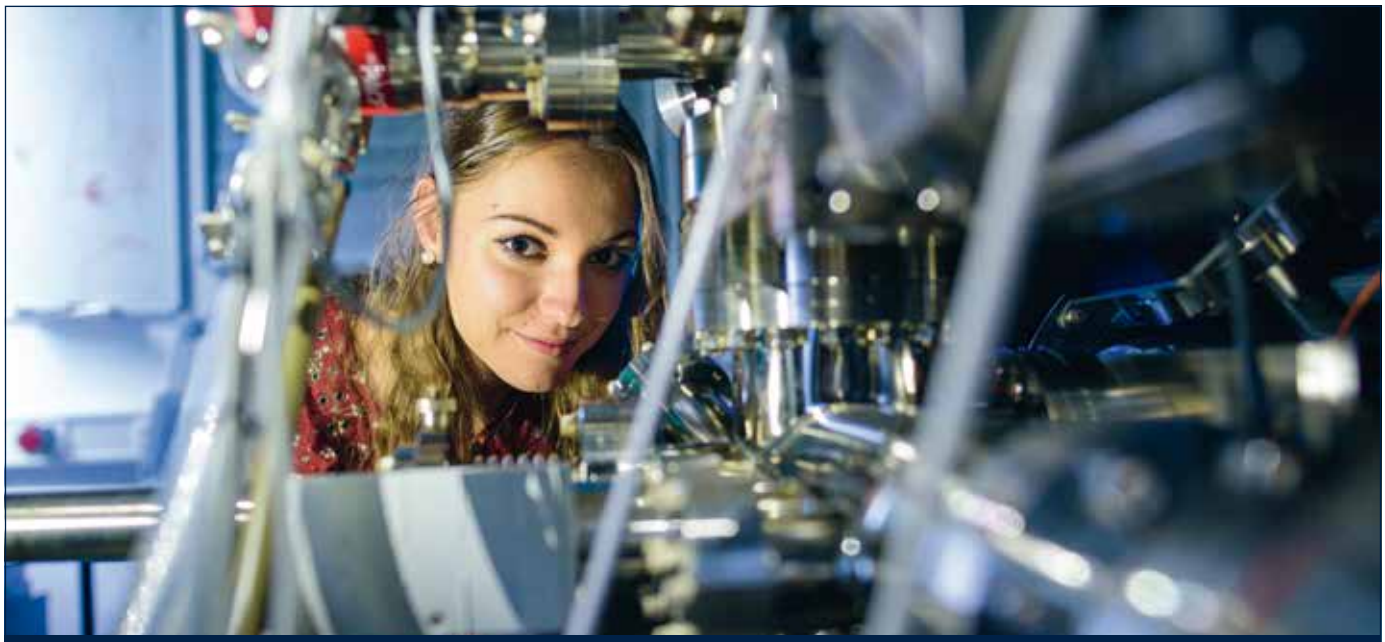
Among the challenges facing the research project were how to find a suitable location for measuring coolant temperatures, the interface between the dynamic coolant temperature sensor and the engine control unit (ECU), and the fact that standard engine calibrations were not optimal at coolant temperatures of 130°C and higher. The experts are currently planning further testing with an enhanced interface between the sensor and the ECU in order to assess further optimizations to the system configurations and identify the most cost-effective way to translate findings into production.

The research project was backed by the regional government in Liudong, Woco Industrietechnik, Evans Cooling Systems (Australasia, China, USA), Dana Canada, Mackay Rubber, Davies Craig, Wingmate, and Mahle Behr.

Dr. Frank Will
Steinbeis Transfer Center Ino8 Pty Ltd Australia (Jan Juc/Australia)
Frank.Will@stw.de | www.steinbeis.de/su/1954

Dr. Hongzhi Wang
Guangxi Liuzhou Jinhui International Technology Co., Ltd. (Liuzhou/China)

Li Gaojian
Lu Guohua
SAIC – GM Wuling Automobile Co., Ltd. (Liuzhou/China)



The atom probe tomography device at the University of Saarland. © Oliver Dietze

World-Class Research Requires World-Class People

Global market leader in the metal industry promotes material research at Saarland University

The raw material niobium is subject to strong global demand, especially in the steel industry. For example, it's used in pipelines because of its ability to prevent steel from becoming brittle, even at subzero temperatures. When used in vehicles, it ensures steel frames remain stiff but at the same time malleable. The metal ore is primarily extracted in Brazil and Canada from volcanic rock. The international market leader for this important raw material is the Brazilian company CBMM. The firm has agreed to sponsor a material science researcher at the University of Saarland as part of the first phase of a project at the Material Engineering Center Saarland (MECS, a Steinbeis Research Center). The scientists aim to use atom probe tomography to investigate how niobium atoms enter the nanostructures of steel and change its material properties.

Niobium is used in comparatively small quantities in steel production. "Only around one in every 10,000 atoms in steel is niobium. That's why it's all the more surprising that it's so effective in such minute concentrations. It makes steel tougher in such a way that it becomes malleable without compromising stability. But niobium also prevents steel from becoming brittle at subzero temperatures or suddenly shattering like porcelain," explains Frank Mücklich, professor for functional materials at the University of Saarland and director of the Steinbeis Research Center Material Engineering Center Saarland. This is particularly important for oil and gas pipelines laid in Arctic temperatures. Niobium is also added to steel in the automotive industry because it's the only way to ensure that steel parts can absorb sufficient amounts of energy in car bodies while at the same time shielding the passenger cell if there's an accident.

Frank Mücklich's research team is specialized in the spatial analysis of inner material structures based on a variety of scales. To do this, they use a number of different 3D methods and over the years the scientists have successfully refined their techniques to ensure they are closely matched to one another. "We use high-resolution electron microscopes, plus nano and atom probe tomography. The 3D data and 2D image sequences these provide are then entered into a computer to create an exact spatial image, right down to the individual atom," says Frank Mücklich. Using 3D analysis allows the researchers to observe all kinds of changes going on within the inner structures of steel, and this can be quantified to examine which mechanisms influence which required properties. "Our aim is to understand the inner structures of steel so precisely that we can see how niobium atoms enter inner microstructures during the production process. That's the only way to be able to 'design' suitable internal structures for steel to match certain applications. Then we would know things like the most effective way for us to get niobium to deliver superior material properties, or how specifically using niobium would enable us to reduce the need for other expensive alloy elements – or even avoid expensive parts of certain processes," continues Mücklich.

Frank Mücklich and his colleagues presented their precise 3D analysis method to a small group of internationally renowned niobium researchers, following an invitation to a joint workshop on the university campus in Saarbrücken last year. One company, CBMM, now wants to forge ahead with niobium research and is backing the Saarbrücken material researchers through a project called Niobium in Steel. The first phase of the project will take the scientists three years. The research is not just about understanding the mechanisms going on within steel in more detail, it is also hoped that it will help control production processes more effectively.

Prof. Dr.-Ing. Frank Mücklich
Steinbeis Research Center Material Engineering Center Saarland (MECS) (Saarbrücken)
frank.muecklich@stw.de | www.steinbeis.de/su/1294 | www.mec-s.de

Cross-border Enthusiasm for Science

Steinbeis Romania acts as project partner to European initiative

The European macro-region along the Danube corridor faces a number of societal challenges, with a shortage of skilled workers in the west and a lack of innovative power in the east. There are already some basic concepts for solving the issues on both fronts, mainly through MINT skills (math, IT, natural science, and technology/engineering). Another fundamental approach is to improve people's hands-on skills, so-called action competence, which is about applying knowledge in a targeted manner. Steinbeis Romania has now started an initiative to introduce young people in the Danube corridor to the many degree and business options offered in MINT areas.

A socio-economic study on the Danube corridor highlighted an urgent need to take action. Successful concepts like the youth research talent initiative Jugend forscht in Germany do have their equivalents in Eastern Europe, but they don't deliver the same results. The example most frequently pointed to in Eastern Europe is the Mathematical Olympiad, which is only targeted at specific participants, and knowledge derived from the program bears little relevance to business practice.

Knowledge is also central to the success of the European Early Innovators Initiative (EEII). Steinbeis Transfer Management SRL, based in Bucharest, is now the lead partner in a project that pulls together the essential skills needed to make proper use of knowledge. The other alliance members are the AREA Science Park in Trieste (Italy), the Common Regions NPO from Košice (Slovakia), and the recently founded Steinbeis Transfer Center in the Ukrainian city of Uzhhorod.

The project partners are logging all relevant programs and initiatives along the Danube corridor. Examples of successful funding programs for young people and scientists are being documented and evaluated in terms of the benefits they offer to multiple regions. The results will then be presented and discussed at four international EEII conferences in Bucharest, Bratislava, Trieste, and Uzhhorod, the aim of which will be to match young scientists together to potential business partners. For managers in business, the EEII is an opportunity to gain early access to

the latest ideas developed by creative and committed scientists. The team will supervise nine young scientists for the duration of the project, focusing closely on business application. The consortium aims to use the business concepts to show the potential impact of concepts.

Successful ideas will also be discussed with potential investors. This is because an important element of the initiative is to highlight the funding options open to young scientists in developing their business knowledge. In doing so, the EEII will provide concepts for inspiring schoolchildren in MINT topics. Future funding concepts will place an emphasis on private-public partnerships. These offer the required flexibility and facilitate solutions that are tailored to the specific problem.

The coordinators of the EU Danube corridor strategy have picked the EEII in order to focus on the goal of raising competitiveness. In the second round it has been earmarked for backing from the Danube Strategic Project Fund. The EEII is one of twelve funded projects with strong strategic potential to sustainably develop the Danube region. It started out as a European initiative in 2018 and will be continued under the name European Early Innovators Program (EEIP). The results of the EEII are being channeled into three or four specific projects which will be pulled together to form the strategic program. A consortium is being set up to implement the EEIP.

Backed by:

Steinbeis Transfer Management S.R.L. (STM)

Services

- Romanian sales and supply market entry
- Searches for specialists and managers
- Supervision of German investors
- Provision of research and development resources at selected universities
- Consulting on the use of funding

Key areas

Key focus at the Steinbeis Transfer Center Bucharest (HQ):

- Business opportunities in Romania
- Project management and funding
- Product development and innovation
- Planning of competitive technology transfer

Key focus at the Steinbeis Transfer Center in Alba Iulia:

- Renewable energy
- Energy efficiency

Key focus at the Steinbeis Transfer Center in Cluj-Napoca:

- Food and beverage production
- Food and beverage safety

Image: © iStockphoto.de/Steve Debenport

Jürgen Raizner
Steinbeis Transfer Management S.R.L. (STM) (Bucharest, Romania)
juergen.raizner@stw.de | www.steinbeis.de/su/1875 |
Project website: www.early-innovators.eu

Everyone on Board?

Steinbeis experts use digital onboarding to introduce new employees to a company

Welcoming new employees to a company – through inductions or onboarding – is about more than just sharing information and describing processes. People indirectly learn about the actual corporate culture, so onboarding plays a crucial role in employees' long-term loyalty to a company. The Institute for Effective Management, a Steinbeis Consulting Center, gives companies tangible support with safeguarding their digital competitiveness, also demonstrating how onboarding staff digitally not only has the potential to radically reduce sickness rates, but also how it can promote more effective knowledge management at a company.

A medium-sized engineering firm headquartered in Bavaria had to quickly take on 50 new employees for three of its other sites in different parts of Germany. The new employees would need to be integrated into the 1,500-strong workforce as efficiently as possible. Since the recruitment process took over a year, there was no way to design a standard induction for all of the new employees. With training continuously being carried out by different people, no existing QA procedures, and no long-term thinking in training documentation, in essence the firm had no proper inductions to speak of. As a result, new and existing workers were having to invest much more time in inductions than was necessary. Inductions sometimes took months and some on-the-job briefing sessions were much too late, resulting in delays to time-critical projects; this was also showing on the bottom line.

Another consequence of this was that people sometimes could not identify with the company and as a result, motivation was low. New employees described not really feeling welcome and said they didn't feel like they had even started yet. A dangerous combination of insufficiently motivated and poorly informed new recruits was making it difficult for people to work properly, and deadlines were starting to slip. Not only was this bad for work processes, the atmosphere at the company was suffering as a result of the new set of challenges. The firm had entered a vicious circle, with more than 50 percent of new employees not even completing their probationary period. The entire recruitment process had to start again from scratch, complete with all the problems.

After a number of further critical delays to projects, senior management decided that it was time to make improvements – urgently. The

company turned to the Institute for Effective Management, a Steinbeis Consulting Center headed up by Andreas Renner, who first assessed onboarding processes before streamlining them and optimizing them with digital solutions. A log was kept to precisely capture and standardize how recruits were given instructions and information. The successful ingredient of the digital onboarding project was a geo-based infotainment app called INTEREST. This app helps users take on information more efficiently and remember facts in the long term by using a technique called storytelling. The method makes it easier for new employees to relate to work processes and routines so they can use them themselves.

The new planning tool entails developing an appropriate learning concept and then creating e-learning modules, which allow managers at the company to share important information with new recruits concisely and succinctly in a uniform manner. Because the system can be used at any time and content can be revised if necessary, information sharing is not just a one-off; passing on knowledge at the company is now a smooth process. Examples of undesirable behavior were shown using actors, with managers fading in to correct their actions. The entertaining approach to this novel method of learning ensured new employees paid close attention during the e-learning modules. New recruits reported that the sequences with the managers providing advice added a nice, personal touch. New employees were also able to put names to faces and for the first time come into virtual contact with people.

To reinforce the new working relationship, a face-to-face welcome event was organized with new and existing employees and managers. Employees were welcomed personally and important information was discussed again. Aside from making onboarding more emotionally involving, another aim of the event was to encourage people to network within the company. The atmosphere was deliberately kept informal to allow staff to get to know each other a bit better in a casual setting away from the front line.

One of the first signs of the success of the Steinbeis concept was a reduction in sick leave and absenteeism. The company had indirectly promoted its own health policy and helped improve the atmosphere at work. A good working atmosphere promotes information flow, as Henri Fayol already ascertained in the last century. As a result, knowledge-sharing is noticeably quicker; this raises the efficiency of a company. Work processes were no longer becoming bogged down by the negative working atmosphere and a sense of anonymity. Instead, people felt capable of playing to their competence and a strong social network started to emerge.

Some 80 percent of the time previously taken to introduce new employees to the company was saved. Using e-learning modules was an opportunity to open managers' eyes to digital onboarding, and they were sensitized to the methods in new ways. Actually performing a role in the modules underscored how important it was for them to provide a role model.

Overall, the package of new measures gave new employees a good feel for the entire business, different departments, and their new co-workers. Over time, the number of working hours invested by coaches and their colleagues was reduced as an independent process developed for acquiring information about the company and learning new things, and this increased efficiency. The added value was enjoyed with almost no additional effort or outlay for the company. The initiative marked a 180-degree change in direction, allowing the company to turn a vicious circle into an effective induction process, also quickly optimizing procedures in the long term.

Image: © iStockphoto.de/Yuri Arcurs

Andreas Renner
Steinbeis Consulting Center Institute for Effective Management (Augsburg)
andreas.renner@stw.de | www.steinbeis.de/su/2024

1

2

Well Welded, Whatever the Position

Steinbeis experts develop orbital micro-plasma powder welding torch

Tubes and pipes, cylindrical components, and containers made of steel have become an indispensable part of plant facilities in many sectors of industry. They are needed for transporting, processing, and storing abrasive and aggressive media. Such equipment is typically subjected to a wide variety of corrosive stress and wear. To address this, the inner and outer surfaces of pipes and cylindrical components require special surface treatment, which not only needs to be economically viable but also has to provide protection against wear and corrosion. The experts at the Steinbeis Innovation Center for Intelligent Functional Materials, Welding and Joining Techniques, Implementation have been working with the mechatronic systems specialist Loesch T-P-L as part of an R&D project looking at the development of an orbital micro-plasma powder welding torch. The device is fitted with a compact guidance system for coating the insides and outsides of metal tubes and components similar to pipes using a whole variety of welding angles.

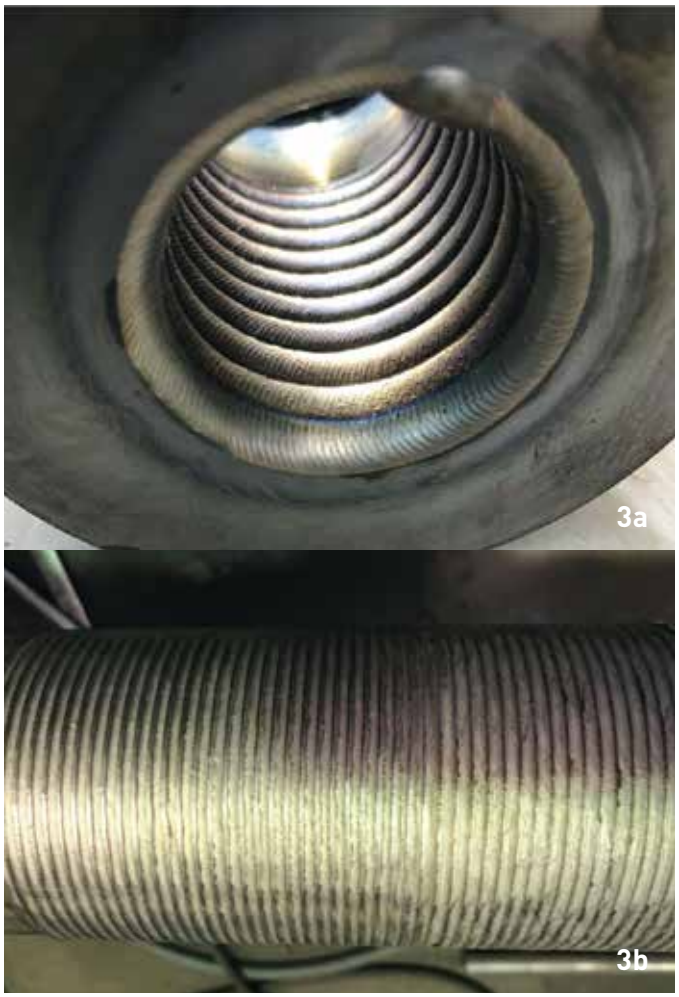
Adding coatings to improve the resistance of the inner and outer surfaces of materials, in this case rotationally symmetrical parts, helps protect them from material stress caused by abrasion and corrosion. More and more specialists are now turning to orbital micro-plasma powder welding to coat the inner surfaces of cylindrical parts, which not only have small diameters but also now tend to have thin walls. They are using this technique to add premium-quality protective layers in order to combat wear and corrosion on all kinds of material shapes and formats. The specific advantages of this method – such as the flexibility it offers in terms of varying welding consumables and layer thickness (0.5 to 5mm), excellent layer reproducibility, and the low levels of short-term energy required in combination with a low incidence of melting in base materials – make the process highly suitable for such applications. This is also because the process makes it possible to produce near-net-shape layers with predefined layer properties.

The project team used a new design for the welding torch. This has an efficient cooling circuit and offers a reliable process gas and powder supply system within the plasma jet to generate the required reproducible layer quality. The new method for producing the material makes it possible to determine, quantify, and ultimately optimize the complexity of influences on the micro-plasma welding process, such as gas flow mechanics and thermo-physical process effects. The experts working on the research project developed a process for matching the size of the burner head and its guidance system to specified inner tube diameters of at least 40 millimeters. This also made it possible to develop combustion function modules in terms of the required technical and design parameters. The following technical and financial factors played an important role in the development and design of the orbital micro-plasma powder welding torch:

- Maximum torch head size of 25 x 25mm for inner layers added to tubes or similar parts (internal diameter at least 40mm)
- Different coat thicknesses possible starting at 0.5mm
- Improved welding thanks to mechanically controlled components or module units for adding layers of a suitable quality
- Development and design of a special technical plasma and protective gas nozzle, for welding torch ranges of 100 – 200A
- Electric torch output of 200A with an electrode diameter of 3.2mm

As a result of the new development, the project team was able to raise the level of automation for adding plasma coatings to metal tubes and similarly shaped components. At the same time, they made it possible to add predefined layers to specific areas in keeping with stress requirements and thus protect materials from wear and corrosion, even with complex component surfaces. The required welding times have now been reduced to a minimum, which helps improve productivity.

The experts at the Steinbeis Innovation Center in Dresden have also been working with Loesch T-P-L to investigate the newly developed welding prototype by conducting comprehensive evaluation tests. To examine coatings on the inner and outer surfaces of cylindrical parts, they added



surfaces using high torch power levels and fast welding speeds. The aim was to investigate and evaluate the impact of different process parameters and the internal diameter of plasma jets on electric arcs and arc intensity. They also wanted to examine the formation of layers and their properties. To do this, they used flux consisting of hard alloys based on cobalt and nickel, but also hard alloys consisting of hard particles (cast tungsten carbide). By varying the process parameters of the welding current, voltage, and speed, and by adjusting the volume of process gas (plasma/protective gas) and powder delivery, the experts succeeded in adding layers of the required quality. The welding tests showed that it was possible to achieve a stable plasma welding process, flawless torch ignition and function, and good powder distribution and dosing below the necking nozzle into the plasma column. The quality of the added coating depended on chosen process parameters. Once assessment of the newly developed welding prototype and the guidance system had been completed, it was possible to produce high-quality coatings on the outer and inner surfaces of metal tubes and achieve the required component properties. After examination, the layers were found to be reproducible and the surface coatings were of suitable quality, providing sufficient evidence of the functional reliability of the prototype orbital micro-plasma powder welding torch, which was also easy to handle and offered an automated guidance system.

Steinbeis Innovation Center for Intelligent Functional Materials, Welding and Joining Techniques, Implementation (Dresden)

Services

Applied research, development, design, and exploitation

- Materials:
  - Intelligent materials for lightweight construction
  - Particle/fiber-reinforced composites
  - Memory alloys (smart materials)
  - Application of nanotechnology
- Joining:
  - Arc welding
  - Mechanical joining
  - Hybrid joining
  - Resistance welding
  - HFI welding
  - Mixture bonding
  - Manual, robotic MIG/MAG/WIG welding torches
  - Welding technology equipment
- Components:
  - Holistic design of joined components
  - Calculations, numerical simulation of functional materials, joining connections
  - Expert reports for failures and damage in joined component designs
- Exploitation:
  - Market analysis of state-of-the-art lightweight construction materials, joining technologies, and applications
  - Pre-sales, marketing
  - Staff recruitment
- Energy audits acc. to DIN standard 16 247:
  - Systematic inspection and analysis of energy use – energy consumption
  - Certification of energy losses
  - Calculation of potential to save energy
  - Development of financing models/profitability

Image 1: An orbital micro-plasma arc-welding process during lamination of a cylindrical component surface
Image 2: Evaluation of the orbital micro-plasma powder welding torch prototype featuring a compact guidance system for weld-cladding metal pipe surfaces
Image 3: The covered surfaces of metal tubes: **a)** inner surface coating, **b)** outer coating

Associate Professor Dr.-Ing. habil. Khaled Alaluss, Oleg Nuss, Prof. Dr.-Ing. Gunnar Bürkner, Dr. Lars Kulke
Steinbeis Innovation Center Intelligent Functional Materials, Welding and Joining Techniques, Implementation (Dresden)
khaled.alaluss@stw.de | www.steinbeis.de/su/1644

Michael Loesch
Loesch T-P-L mechatronic systems GmbH (Darmstadt)
mloesch@loesch-tpl.de | www.loesch-tpl.de

Innovation in the Craft Industry – Locally and Internationally

Steinbeis 2i GmbH provides advice on going international and innovation management

Internationalization and the ability to innovate often go hand in hand. Together, they offer enterprises an important opportunity to develop, especially in the craft industry. Despite this, many small companies have yet to understand how important these issues are for them. This is where an initiative called Innovative Manual Trades comes in. The project was launched by S2i in collaboration with the Baden-Württemberg Chamber of Skilled Crafts Handwerk International. It was backed by the Baden-Wuerttemberg Ministry of Economic Affairs, Labour, and Housing.

Over the past two years, more than 50 events were organized for over 800 participants across the state to raise awareness of the initiative. 250 enterprises received advice through so-called innovation and foreign country checks, and 47 companies qualified for fast-track consultations.

To unveil the potential of companies to innovate and go international, Steinbeis 2i and HI wrote an innovation and foreign country questionnaire, which was also filled out by enterprises during the short consultation sessions. The aim was to create a kind of discussion guide and depending on the focus and needs of companies, the questionnaire could also be expanded. If companies showed further interest, they could receive a fast-track consultation revolving around their actual needs run by two consultants working for S2i and HI. Indeed, this service proved highly popular. Company visits were also a good opportunity to go into the individual needs of enterprises and examine their specific situation.

For companies in the craft industry, it's crucial that their potential to innovate in everyday business is highlighted in the first short consultation session. It also needs to be shown that innovation is not just the responsibility of the development department at big companies. Innovation can be about developing a new product or re-engineering an existing product, and in services it can involve internal or external processes.

The Steinbeis 2i GmbH and Handwerk International campaign showed that small and medium-sized enterprises have a tendency to fo-

cus their core business on domestic markets.
Foreign business is typically only a second leg to stand on. This is particularly the case now that the German economy is booming. Some of the answers that kept coming back also point to one of the key obstacles encountered by companies: Domestic business is going so well at the moment that there are insufficient resources to manage orders, especially when it comes to personnel and time. Companies also lack certain know-how when it comes to the business environment in foreign markets, and sometimes they have language problems. It was also ascertained that marketing and sales tend to focus on domestic markets. It therefore proved helpful to the companies to point to good examples of other firms that made their first steps abroad or into new markets, and show examples of good ideas.

When it comes to innovation management, it was found that companies need more support with getting things done. SMEs often lack strategic orientation concerning business development, especially if they want to systematically identify and enter new markets. They often use company equity to fund their own developments and are not sufficiently aware of financing options.
S2i and HI will continue to offer companies advice and support with innovation management and internationalization. The experts can offer help and pointers on all kinds of issues:

- How to recognize and evaluate innovation, especially with regard to marketability
- How to work out who should be responsible for the innovation process and how to organize decision-making processes within a company
- How to systematically assess strengths and weaknesses when it comes to trends, the competition, in-house competence, company resources, and expansion in the sales department
- How to access finance and funding options
- Long-term project and customer management
- Internationalization skills and how to gain an understanding of foreign markets and market opportunities
- How to acquire market knowledge and quickly identify requirements when it comes to order processing, also for scheduling and project costing purposes
- How to establish networks in order to enter markets and process orders
- How to gain expertise in order to manage orders efficiently, also adhering to legal requirements
- Intercultural skills, language skills, and how to gain an understanding of a target region in order to acquire and keep foreign business and collaboration partners.

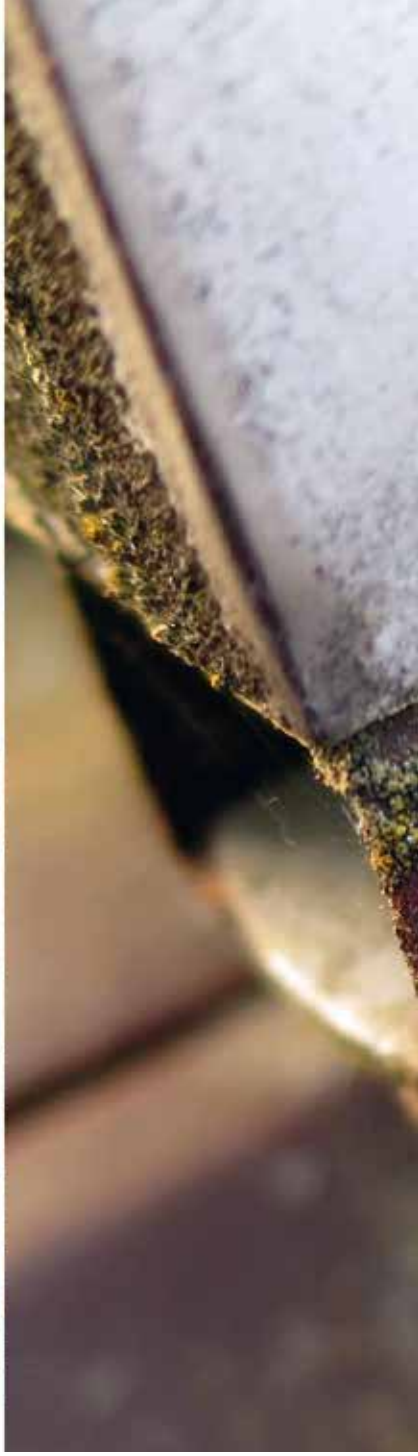
The SME Ticket
Competitiveness is fundamentally driven by a Companies' ability to come up with innovations, develop solutions, and introduce them to the market. Multinational European studies show that the biggest obstacle faced when successfully implementing concepts and research findings is a lack of capacity and skills within a company, particularly in terms of innovation management. Innovations also often fail because of a lack of strategic focus. S2i helps SMEs to develop goals, skills, and business capabilities in line with a coordinated innovation strategy. It also offers free introductory consultation sessions on innovation management.

The experts at S2i analyze the potential of a company to come up with innovations and its competitive strength. The aim is to provide support with strategic planning in order to recommend the actions required to implement innovations, also working with the company to define the key stages of a successful launch.

Hartmut Welck
Steinbeis 2i GmbH (Stuttgart)
hartmut.welck@stw.de

Image: The information day organized by Steinbeis 2i and Handwerk International Baden-Wuerttemberg. Rottweil, September 2017.

Charlotte Schlicke
Steinbeis 2i GmbH (Stuttgart)
charlotte.schlicke@stw.de | www.steinbeis.de/su/2017 | www.steinbeis-europa.de



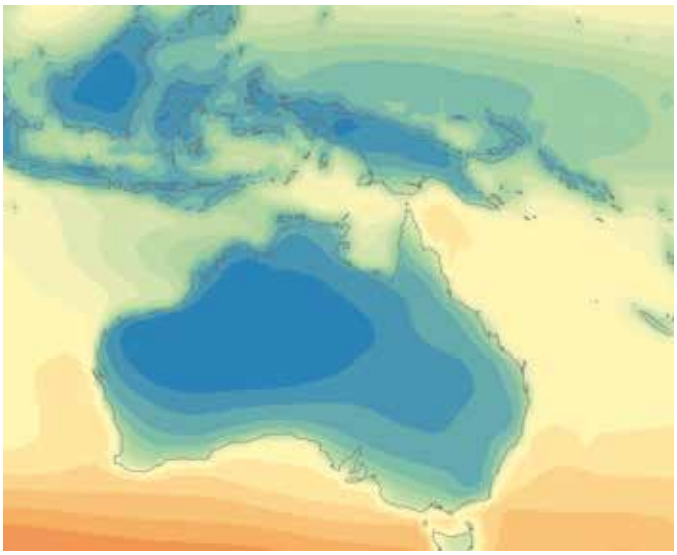
Creating a Map of Corrosion

Steinbeis experts map global corrosion conditions for metal components

The performance and longevity of any material or technical system exposed to the outdoor elements are influenced in a variety of ways by local environmental conditions. Atmospheric conditions, i.e. the weather and climate, have a particularly strong impact and are often crucial for materials. Any information on conditions is thus of major interest to producers and the actual users of materials and systems. For example, materials can be adapted to specific applications and locations, or maintenance schedules can be optimized. This can significantly improve the economic viability and safety of machinery. This is also important because digital technology and networking within industry mean that development methods and production will become increasingly customized in the future. FeLis, the Steinbeis Research Center specialized in remote sensing data and terrain data systems, is currently working on a research project aimed at modeling corrosion patterns.

An important example that highlights the potential negative impact of atmospheric influences on materials is metal corrosion, which causes significant economic damage year after year. There are a number of scales that show the extent of damage caused by corrosion, and these indicate that damage varies strongly depending on the location. A long-term measurement program would be required to estimate the exact extent of damage by specific location, but for practical reasons this would only be feasible for a small selection of areas, especially given the global nature of material distribution.

To address this issue, the FeLis Steinbeis Transfer Center, based in Bruckberg in Bavaria, has embarked on a collaboration with the Fraun-



Steinbeis Research Center FeLis

Services

- Measurement of remote sensing data, e.g. aerial photography, satellite data, laser scanner data
- Creation of 3D images using geodata
- Calculation of surface and terrain models based on remote sensing data
- Creation of maps and 3D models based on geodata, e.g. land use, building models, tourist maps, urban models
- Web-based GIS applications in forestry and environmental applications
- Setting up of geodata infrastructures
- Tourism information systems

Key areas

- Geodata processing
- Charting in forestry and environmental applications
- GIS and setting up of geodata infrastructures

hofer Institute for Solar Energy Systems ISE to develop a comprehensive global mapping system to capture the atmospheric factors that shape corrosion processes. These are mean annual air temperature, mean annual relative humidity, and the mean daily deposition rate of sulfur dioxide and chloride ions. Using these factors makes it possible to draw on dose-effect functions affecting corrosiveness as defined under ISO standard 9223. To develop sets of data on which to base calculations, meteorological information has to be re-analyzed. This information includes past sets of long-term data, which has to be consistent over time and can provide worldwide coverage.

Despite limitations in terms of the available methodologies, such as limited geographical definition due to the global scale of the project or uncertainties regarding the applied standard, the results do make it possible to make a broad-scale assessment of the average risk of corrosion. This includes corrosion rates during the first year of exposure for four metals: copper, zinc, unalloyed steel, and aluminum. One example of a possible application is the assessment of possible long-term damage caused to photovoltaic systems. As such, the data can be integrated into existing systems and databases, or displayed in the form of images to support the decision-making of producers and their customers.

Image left: Examples of corrosion caused to various metals
Image right: Example of an extract from a map showing individual corrosion factors

Prof. Dr. Barbara Koch
Steinbeis Research Center FeLis (Bruckberg)
barbara.koch@stw.de | www.steinbeis.de/su/953 | www.stz-felis.de

Social Entrepreneurship – A Corporate Mission to Solve Social Issues

Steinbeis University alumnus sets up web-based platform for acquiring competencies

Companies first started combating social problems as part of their business models as early as the beginning of the 20th century. The aim of these companies was not just to earn money. On top of turning in a profit, they wanted to do something good for society. These days, the goals of such companies would come under the banner of social entrepreneurship. Their aim is to deal with social issues, such as specifically tackling unemployment or pollution. One entrepreneur with such a goal is Oliver Queck, an alumnus of Steinbeis University Berlin. In 2016, Queck founded a social startup called JobKraftwerk with colleagues.

With more and more international crises hitting the headlines, there is a heightened need for social enterprises. The refugee crisis in 2015 made this highly palpable in Germany. The large number of immigrants flooding into the country was a game-changer. It had great impacts on social level as well as in the economic sector. One of the biggest challenges was and is to integrate refugees into the German labor market. In 2016, Oliver Queck and Tom Lawson, a colleague at T-Systems International, decided to found a social startup called JobKraftwerk in order to tackle the organizational difficulties presented by this situation. Having completed a master's degree in General Management at Steinbeis School of International Business and Entrepreneurship, which is part of Steinbeis University Berlin, he was already armed with the right tools.

Both business founders were motivated by a "desire to invest our knowledge and skills in something with a greater impact than another PowerPoint presentation for the board of directors," says Queck. That said, there was another key factor that affected their decision to set up the company: the district office in Reutlingen. "They were virtually trying to capture the skills of the 3,000 or so refugees in the district with pen and paper and then just go up to companies in the area." At this point JobKraftwerk comes into play, to optimize this whole process. The platform was initially set up as a multilingual tool for capturing skills on a smartphone and drafting CVs for refugees. The aim was to help refugees become more integrated into the labor market.

"Meanwhile JobKraftwerk sees itself as more of an integration and case management solution," explains Queck. The web-based platform is no longer just about capturing skills, it's also a tool for organizing information by bringing together all of the different parties involved in the refugee integration process. These include social workers, integration managers, volunteers, companies, and the refugees themselves.

Apart from coming up with an innovative idea, setting up a company also requires a solid grounding in management know-how. This is where Queck was able to build on his MBA at Steinbeis University. "The specialist and practical content was really useful for setting up my company because we were actually able to adapt a business model canvas and a business plan developed as part of the degree." The overview gained of all key management topics was probably the biggest help, especially in areas such as financial planning, market analysis, and marketing, and Queck believes this laid an excellent foundation for further tasks. "But we also shouldn't forget the old network from our time at the university. A number of former co-students are now important sparring partners for me and provide input," the SUB alumnus says.

Queck believes that social entrepreneurship is playing an increasingly important role in society. Social entrepreneurship is still developing slowly, but he feels this is due to the lack of experience German investors and foundations have when it comes to "impact investing." This term refers to investments made by organizations or private individuals in businesses with an impact on social or environmental affairs. At the same time, they are financially lucrative. Queck says that the rate at which social enterprises are being set up could be accelerated if investors and foundations channeled more investments into social areas. Furthermore another factor is crucial as far as the social entrepreneur is concerned: teams. The extent to which all key players gain acceptance should also not be overlooked. This is because in social entrepreneurship, users or customers are also contributors to the process.

Image: Oliver Queck (co-founder), Benedikt Frings (CTO/co-founder), Tom Lawson (co-founder)

Nick Lange
Steinbeis School of International Business and Entrepreneurship , Steinbeis University Berlin (Herrenberg)
nick.lange@stw.de | www.steinbeis.de/su/1249 | www.steinbeis-sibe.de

Oliver Queck
JobKraftwerk
oliver@lq-enterprise.com | www.lq-enterprise.com

Welcome to the Steinbeis Network

The platform provided by Steinbeis makes us a reliable partner for company startups and projects. We provide support to people and organizations, not only in science and academia, but also in business. Our aim is to leverage the know-how derived from research, development, consulting, and training projects and to transfer this knowledge into application – with a clear focus on entrepreneurial practice. Our platform has now resulted in the foundation of more than 100 enterprises. The result is a network spanning more than 6,000 experts in approximately 1,100 business enterprises – working on more than 10,000 client projects every year.

And this network continues to expand. For an overview of our most recently founded centers, go to www.steinbeis.de/en/news. Welcome to the Steinbeis Network!

More on recently founded enterprises in the network can be found at www.steinbeis.de/aktuelles

More on recently founded enterprises in the network can be found at https://twitter.com/SteinbeisGlobal

Harald Herrmann Appointed New Steinbeis Trustee

President of Reutlingen Chamber of Craft Industries Stepping in for Rainer Reichhold

Welcome to the Steinbeis Board of Trustees: This year, Harald Herrmann started deputizing for Rainer Reichhold as a member of the Steinbeis Foundation Board of Trustees. The businessman from Reutlingen has been President of Reutlingen Chamber of Craft Industries since 2014.

Born in Reutlingen in 1959, Herrmann is a master tiler and business economist (Cham. Comm.) and has been a plenary session member and executive board member of Reutlingen Chamber of Craft Industries since 1999. He was appointed district master craftsman of Reutlingen District Craft Association in 2001 after originally setting up a tile-laying company in 1992.

Herrmann has fulfilled a variety of honorary roles since 1994. From 1994 to 2012 he was senior master of Reutlingen Tile Craft Guild, he has been a board member of Reutlingen District Craft Association since 1995, and from 1998 to 2001 he was already deputizing as district master craftsman. He has also been involved in organizations on a state level. From 1994 to 2012 he was a board member of the Baden-Wuerttemberg Tile Guild Association, and since 2001 he has been a board member of a state working group of district craft associations in Baden-Wuerttemberg.

Since 1999 he has also been a member of a regional advisory committee of the Reutlingen-Tübingen-Zollernalb Guild Health Plan (IKK), which he chaired between 2005 and 2011. Herrmann is a jury member for an innovation award bestowed by the Reutlingen Kreissparkasse (savings bank), which promotes innovative services in the manual trades.

Anja Reinhardt
Steinbeis Foundation (Stuttgart)
anja.reinhardt@stw.de | www.steinbeis.de

Order of Merit Awarded to Rainer Reichhold

Steinbeis Board of Trustees member receives important award from the Federal Republic of Germany

In his role as president of the Baden-Wuerttemberg Crafts Congress, Rainer Reichhold has been representing the organization on the Steinbeis Board of Trustees since 2005 and he has now been a member of the Steinbeis Board of Trustees Committee for seven years. Reichhold has been awarded the Order of Merit of the Federal Republic of Germany by the Baden-Wuerttemberg Minister-President Winfried Kretschmann for outstanding contributions to the manual trades.

"Rainer Reichhold is a farsighted advocate of skilled trades in the state and plays a key role in shaping the future of the industry. His commitment to colleagues in other skilled manual areas, and issues and people beyond the manual trades, is exceptional," said Minister-President Kretschmann at the award ceremony.

Reichhold is a qualified electrician and is currently a managing partner of the Nürtingen-based company Elektro Nürk. He is also President of the Baden-Wuerttemberg Crafts Congress. Kretschmann praised Reichhold's ability to think beyond the horizon, the consideration he gives to future developments in the skilled trades, and his commitment to globalization, digital transformation, and sustainability in the manual trades. Reichhold has also taken on responsibility on a state and federal level through the Electrical Engineering and Information Technology Association. "This was a home game. As an electrician, he has a natural affinity to the megatrend of our times: digital transformation," said the Minister-President. "He has driven digital transformation within the association. But he also understands how important the topic is for the actual work carried out by association members." By doing so, Kretschmann said he became an advocate for giving the so-called e-crafts a clear digital positioning.

Minister-President Winfried Kretschmann (left) and Rainer Reichhold
Source: Baden-Wuerttemberg State Ministry

"I'm particularly delighted by the way Rainer Reichhold has also advanced the topic of sustainability," emphasized Kretschmann. As president of the Stuttgart Chamber of Craft Industries he was the first person to issue a sustainability report for the Stuttgart regional chambers. His willingness to look beyond the end of his nose is also reflected by the variety of areas in which he has lent support to the state government. "For example, there's his commitment to vocational training. Combating the shortage of skilled workers. So people can learn together – longer. But also to the integration of fugitives," highlighted the Minister-President. Reichhold is also a member of numerous trade associations and committees. Kretschmann praised Reichhold's "efficiency and analytical acuity," saying that "his working style is shaped by the right questions and quick decisions."

Anja Reinhardt
Steinbeis Foundation (Stuttgart)
anja.reinhardt@stw.de | www.steinbeis.de

Networking at the Entrepreneur Forum

Invitation from Steinbeis to the 6th exchange forum for experts

July 20, 2018: the next round of the Steinbeis Entrepreneur Forum, now taking place for the sixth time. The event will be staged in the Steinbeis House for Management and Technology in Hohenheim (Stuttgart). As in past years, Steinbeis Center of Management and Technology (SCMT) and the Steinbeis Foundation are inviting SMEs, Steinbeis customers, partners, students, and alumni of Steinbeis University Berlin to Stuttgart to exchange ideas and network.

Alexander Sachs will talk about his expertise in "Block in Action" and examine use cases beyond crypto currency. Sachs went into IT consulting after studying math, computer science, and sport. He is currently director of a blockchain lab team at codecentric, which specializes in the rapid implementation of prototypes in blockchain technology.

Dr. Gunther Herr, deputy advisory chairman of Kronach Innovation Center, will present alongside Benjamin Butscher, management consultant and investor, as part of a parallel talk on digital transformation in sectors of industry that were previously analog.

To round off the day, Johannes Ellenberg, a business leader and ardent fan of startups, will give a speech on "The Startup Code" and examine what SMEs can and must learn from startups.

Following the speeches, the audience will have an opportunity to discuss further issues with the presenters, as part of round table sessions, and enter into more detailed discussion.

The event is free, although visitors are kindly requested to register online in advance by going to www.scmt.com/events/unternehmerforum.html.

Sarina Gehrung
Steinbeis Center of Management and Technology GmbH (Filderstadt)
su1274@stw.de | www.steinbeis.de/su/1274 | www.scmt.com

Prof. Dr. Michael Auer, Steinbeis (left), Dietmar Lust

And the Winner Is...

Votes for the best TRANSFER article in 2017

As in the previous year, it was you who picked our winner, and the most popular article among readers in TRANSFER magazine in 2017 was: "Digital Solutions: A Curse, Blessing, or Both?" We congratulate the author Dr. Gunther Herr from the School of Management and Technology at Steinbeis University Berlin. Further congratulations go to our survey respondent Dietmar Lust, from Markgröningen, whose name came out of the hat after voting for the best TRANSFER article.

As in the past, a large number of TRANSFER readers submitted their votes for the best article. The clear majority of votes went to "Digital Solutions: A Curse, Blessing, or Both?" which appeared as a feature topic in the Digital Transformation & The World of Work 4.0 section of issue 4/2017. In his article, Herr examined what the trend toward digitalization is really all about and what impacts it is having on different sectors of industry and technology.

Marina Tyurmina
Steinbeis Headquarters (Stuttgart)
marina.tyurmina@steinbeis.de | transfermagazin.steinbeis.de

Experts.Knowledge.Sharing.

New releases from Steinbeis-Edition

Sharing our know-how with you.
Steinbeis-Edition, the publishing arm of the Steinbeis Foundation, regularly publishes works reflecting the scope of the Steinbeis Network's expertise. Spanning a broad spectrum of topics, these publications include individual papers, series, magazines, conference proceedings, and works linked to specialist events. All titles can easily be ordered via our online shop at: www.steinbeis-edition.de.

REProMag – Resource Efficient Production of Magnets

Carlo Burkhardt (Lead author)

2018 | paperback, color | 85 pages, German
ISBN 978-3-95663-162-7

About the project partner

The publication is the result of a working relationship with Steinbeis 2i GmbH (S2i). Steinbeis 2i is involved in projects relating to innovation and internationalization, drawing on more than 25 years of experience at the Steinbeis-Europa-Zentrum (SEZ). The SEZ builds bridges across Europe on behalf of companies, research institutions, universities, and regional economic development bodies.

Leadership. Personality. Innovation.

Werner G. Faix, Stefanie Kisgen, Jens Mergenthaler

2018 | hardback, color | 91 pages, German
ISBN 978-3-95663-177-1

About the authors

The School of International Business and Entrepreneurship (SIBE) is an international business and law school belonging to Steinbeis University Berlin (SHB) and is headed by Prof. Dr. Dr. h. c. Werner G. Faix and Dr. Stefanie Kisgen. SIBE has been offering master's degree programs since 1994 and currently has 800 enrolled students, over 4,200 successful alumni, and more than 350 partner enterprises. Dr. Jens Mergenthaler works as a project manager for scientific projects and is the academic coordinator of the PhD program at SIBE.

Energy Efficiency in Manufacturing

Georg Kleiser

2018 | paperback, color | 317 pages, English
ISBN 978-3-95663-178-8

About the author

Professor Dr. Georg Kleiser is a professor at Ulm University of Applied Sciences for Industrial Energy. In his teaching and research, he looks at energy efficiency in industrial settings with an emphasis on energy recovery systems. Kleiser is director of the Steinbeis Consulting Center for Energy-efficient manufacturing and a member of the Steinbeis Competence Center for Sustainable Energy. He has many years of experience in energy efficiency consulting for manufacturing enterprises and as the head of Energy Efficiency Round Tables.

Fascinated by Personnel Planning? Really? Is That Even Possible?

Wolfgang Elenz, Jan Schöll

2018 | paperback, b&w | 72 pages, German
ISBN 978-3-95663-164-1

About the authors

Wolfgang Elenz is an attorney and business mediator with over 30 years of experience in the fields of labor law and personnel. Since 2014, he has also been project manager at the Steinbeis Transfer Center for Human Resources Management and Corporate Communications. Dr. Jan Schöll is an attorney and specialist in labor law with over 18 years of experience in the field of consulting and process management at small and medium-sized companies.

The Decision-Making Maelstrom

Gernot Barth, Bernhard Böhm (ed.)

2018 | stapled, color | 84 pages, German
Mediation | Quarter II / 2018
ISSN 2366-2336

About the editors

Associate Professor Dr. habil. Gernot Barth is director of IKOME® (the Institute of Communication and Mediation), the Steinbeis Consulting Center for Business Mediation, and the Academy for Social Aspects and Law (a Steinbeis Transfer Institute at Steinbeis University Berlin). The focus of his work lies in mediation, especially within and between companies.
A qualified attorney and master of mediation, Bernhard Böhm is co-director of the Steinbeis Consulting Center for Mediation of Business and is head of the arbitration committee office of Steinbeis Consulting Centers (Steinbeis Beratungszentren GmbH), which are part of the Steinbeis Network. Additionally, he shares responsibility for a variety of domestic and European mediation projects involving cross-border mediation.

Digitalization Options in Real Estate Evaluation

Thomas Bühren

2018 | paperback, b&w | 81 pages, German
ISBN 978-3-95663-166-5

About the author

Thomas Bühren is an authorized officer at the German Real Estate Academy, University of Freiburg, and responsible for degree coordination and administration. He also holds rights of authority at DIA Consulting AG in Freiburg and works on the management of a variety of framework agreements aimed at determining transaction and loan value for institutional clients. He holds a bachelor of arts degree from Steinbeis University Berlin, which he completed in 2018 with excellence.

Guideline on Additive Manufacturing

Simon Hiller, Michelle Moisa, Dominik Morar, Kathrin Pfähler

2018 | paperback, b&w | 40 pages, German
ISBN 978-3-95663-172-6

About the co-author

Simon Hiller is a scientific assistant in the research department at the Ferdinand Steinbeis Institute working in the field of industrial internet and Industry 4.0 (smart production), with an emphasis on additive manufacturing. Before 2015, he studied medical technology (B.Sc.) as part of a cooperative degree program between the University of Stuttgart and the University of Tübingen. He then gained a Master of Business Engineering (MBE) at Steinbeis University Berlin and completed his degree in 2017.

Data Warehouse Solutions Based on Cloud Computing Platforms

Norman Bernhardt

2018 | paperback, b&w | 185 pages, German
ISBN 978-3-95663-169-6

About the author

Norman Bernhardt is Director of the Mobility & Travel Industry at the Berlin offices of pmOne AG, where he manages customers from a variety of different fields and provides advice on digital solutions, cloud computing, business intelligence, and analytics. Between 2012 and 2018, he gained a PhD in business and economics at Steinbeis University Berlin.

Available again:

Multivariate Analysis Methods

Marco Wölfle

2013 | paperback, b&w | 138 pages, German
ISBN 978-3-943356-91-5

Training. Competencies. Values.

Werner G. Faix, John Erpenbeck, Michael Auer (eds.)

2013 | hardback, b&w | 1041 pages, German
ISBN 978-3-943356-32-8

The Creative Power of Education

Werner G. Faix, Jens Mergenthaler

2013 (2nd reworked edition) | hardback, color | 304 pages, German
ISBN 978-3-943356-87-8

facebook.com/SteinbeisEdition twitter.com/steinbeis_ste

Yvonne Hübner
Steinbeis-Edition (Stuttgart)
edition@steinbeis.de | www.steinbeis-edition.de

Steinbeis

Publication details

Transfer. The Steinbeis magazine

The magazine on tangible knowledge and technology transfer
Edition 2/2018
ISSN 1864-1768 (Print)

Steinbeis GmbH & Co. KG für Technologietransfer
Willi-Bleicher-Str. 19
70174 Stuttgart | Germany
Phone: +49 711 1839-622
Email: stw@steinbeis.de
Internet: transfermagazin.steinbeis.de | www.steinbeis.de

Editorial coordinators:
Anja Reinhardt, Marina Tyurmina
Email: transfermagazin@stw.de

The author of each article is responsible for the content. The views and opinions expressed in the articles do not necessarily reflect the views and opinions of the editors. The publishers cannot guarantee that any of the websites or third-party platforms named in this magazine are either accurate, complete or available. The publishers have no influence whatsoever over the current or future design and content of any Internet pages that are linked to. The articles were written based on the content of the named websites at the time of publication of this edition of TRANSFER Magazine.

Cancellation:
If you would like to stop receiving Steinbeis Transfer magazine, simply cancel your subscription. Please contact us by writing an email to me dia@steinbeis.de or you can call us at +49 711 1839-5. Please note that the cancellation of your subscription may not come into affect until after the next edition.

Concept and design:
Steinbeis Foundation

Overall production:
Straub Druck + Medien AG, Schramberg

Photos and images:
Unless stated otherwise, photos and images were provided by Steinbeis Enterprises and project partners named in this magazine.
Cover: © iStockphoto.de/Sergii Trofymchuk

Steinbeis is an international service provider in entrepreneurial knowledge and technology transfer. The Steinbeis Transfer Network is made up of about 1,000 enterprises. Specialized in chosen areas, Steinbeis Enterprises' portfolio of services covers research and development; consulting and expert reports as well as training and employee development for every sector of technology and management. Steinbeis Enterprises are frequently based at research institutions, especially universities, which are constituting the Network's primary sources of expertise. The Steinbeis Network comprises around 6,000 experts committed to practical transfer between academia and industry. Founded in 1971, the Steinbeis-Stiftung is the umbrella organization of the Steinbeis Transfer Network. It is headquartered in Stuttgart, Germany.

198523-2018-02