

TRANSFER

The Steinbeis Magazine

The sky's the limit

Feature Topic: Aerospace

Insights from Steinbeis experts

Science and Business

Under One Roof

The Steinbeis House Karlsruhe organizes a Steinbeis Day

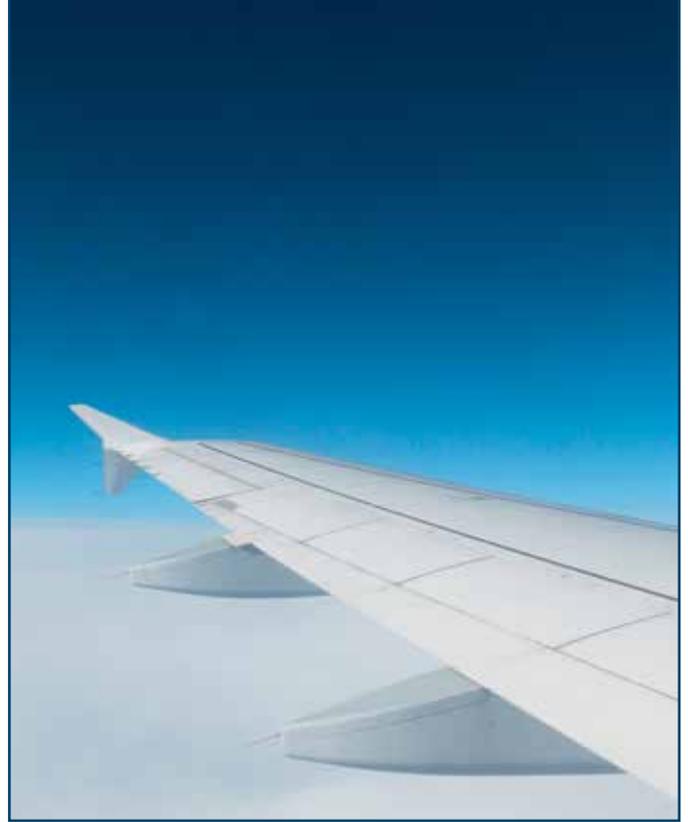
Monitoring Abrasion and Tracing Wear

How a team of Steinbeis experts developed a measurement procedure used in tribological characterization

Paving the road towards Exascale Computing

A project team works on improving the energy efficiency of supercomputers

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Dear Readers,



Prof. Rudolf Voit-Nitschmann is managing director of the aircraft maker Steinbeis Flugzeug- und Leichtbau GmbH and heads the Steinbeis Transfer Center for Aerodynamics, Aircraft Engineering and Lightweight Construction in Stuttgart. Voit-Nitschmann was awarded the Löhn Award – the Steinbeis Foundation's Transfer Prize – in 2011, in recognition of outstanding contributions to technology transfer.

The aerospace sector remains a key industry in Europe. Only recently, the 9,000th Airbus was handed over to its customer and aerospace sales have risen 40% over the last 5 years.

Following the introduction of weight-saving composite fiber construction, not only in space travel but also in airborne transportation and general aviation, the technological focus in the decades to come will lie in the development of ground-breaking drive systems. We are already seeing electric and hybrid electric engines entering research for use in powered gliders and small passenger aircraft, for example with the e-Genius electric airplane at Stuttgart University, the E-Fan project at Airbus, and the Pipistrel ALPHA Trainer. Airbus and Rolls-Royce are also looking into distributed aerospace propulsion concepts for large cargo aircraft. These involve combining a turbo generator with storage cells to generate power for several electric motors distributed throughout the aircraft. With this approach, it's possible to make a clear distinction between power generation and thrust generation, also unveiling completely new and efficient ways to configure airplanes. Digitalization in the cockpit and digital networks are also continuing to make advancements.

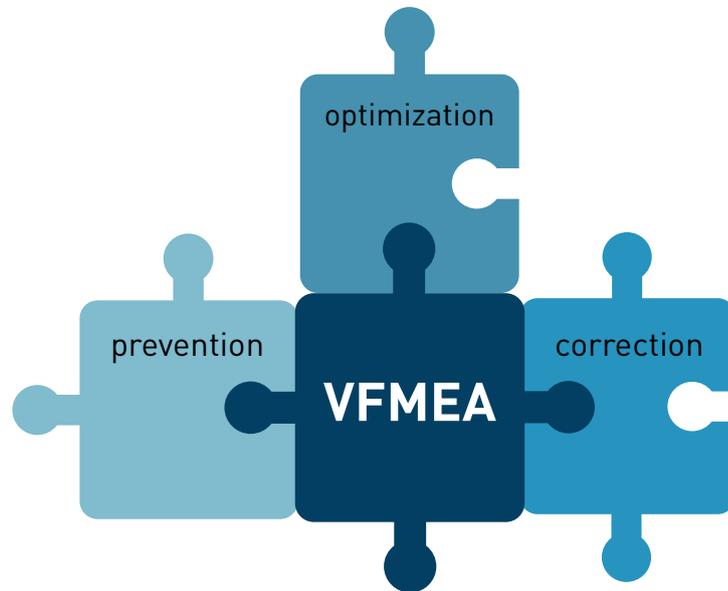
Another important trend for the future will be unmanned aircraft systems (RPAS), which will be used on observation, surveying, and surveillance missions. Powered by sunlight, high-altitude platforms (HAPs) will soon be taking on the role of satellites at heights of 20 to 25 kilometers. The technical conditions have already been fulfilled to do this but the regulatory authorities are still establishing a statutory framework for flying in unreserved airspace and this should be ready by 2020. There are opportunities for small and medium-sized businesses to innovate in this area, also as system suppliers to the aerospace industry.

In the field of space travel, satellite technology is having a stronger and stronger influence on commercial success and societal development, and it is now irreplaceable in environmental protection. As a result, development of the Galileo satellite navigation system and further development of satellite technologies used in communication, terrestrial observation, and environment monitoring are a key priority in the EU. Further development of the ARIANE launch system is allowing for significantly reduced launch costs and this continues to safeguard our ability to fly into space independently and competitively. Spectacular European space missions like Rosetta have made a significant contribution to how we see our own planetary system and space in general, and they will continue to play an important role in proving and developing physical models.

Steinbeis has created an efficient infrastructure with its Steinbeis Enterprise model, directly helping to transfer the results of technology research into industry. The Steinbeis Aircraft and Lightweight Construction GmbH (SFL) provides comprehensive engineering services based on over 20 years of experience, working with clients on everything from initial concepts to aircraft that are ready for takeoff, and even aviation approvals. Our strengths lie in our multidisciplinary approach to overall systems. Our small and creative team is highly skilled and specialized, and has the competence to develop complete airplanes in the CS 22, CS 23, and LSA categories, as well as unmanned aircraft. SFL shows that technology transfer really does have a role to play in supporting and engendering research at a university level, especially as far as RPAS and the e-Genius aircraft are concerned. Without the experience and input of SFL, these would not have been possible in the way they are now. Which is where I'd like to explain a guiding principle, namely that technology transfer is not a one-way street.

In this latest edition of TRANSFER, we provide insights into the projects, services, and products being worked on in the Steinbeis Network in the aerospace industry. I hope you find it an interesting read!

Prof. Rudolf Voit-Nitschmann



Optimal!

Steinbeis experts develop error reduction method for trade businesses

Craftsmen hate it when they make mistakes and waste materials. It's expensive and annoys customers. In more and more construction projects the error rates are rising, as are prices and the costs of corrective measures. According to an analysis by BauInfo-Consult, based on a sample of 1,800 interviews conducted between 2014 and 2015, 541 of the architects and developers surveyed estimated that the average cost of errors amounts to 11% of industry turnover. In 2014, a dozen or so companies from the region of Eastern Westphalia-Lippe agreed to test a quality improvement and error avoidance method that is specially geared to trade businesses and SMEs.

The idea was initiated by Professor Dr.-Ing. Ralf Hörstmeier, director of the Steinbeis Consulting Center for Applied Motion Technology. He is also involved in research and teaching at the faculty of engineering and mathematical sciences of Bielefeld University of Applied Sciences. Working in alliance with other partners, he has adapted industrial tools to match the needs of craftsmen and introduced them to the market as the "VFMEA method".

Industry has been using quality assurance methods for decades to eliminate or significantly reduce errors and their consequences. Ralf Hörstmeier has now adapted a method of error avoidance to create a tool suitable for craftsmen. It also covers the issue of wastage. VFMEA (a German acronym for "waste, potential error and influence analysis") is the name of this enhanced tool which he has been developing since 2013, making it adaptable to the size of the individual trade business, its specific processes, and the experience of all its employees. Carpentry, electrician, and painting firms were among those involved in developing the tool.

What inspired Mr Hörstmeier and his VFMEA team was the idea of offering "help to help yourself." The process let the owners of small businesses and their employees turn the spotlight on structures and processes. Based on a template covering organisation, communication, personnel, customer contacts, works orders, and purchasing, they looked at known errors, their causes, and any interconnections, with a view to exploring potential for improvements. Mr Hörstmeier has included nine types of wastage in the project analysis, relating to orderliness, movements, transportation, rework, employee assignment, waiting times, organisation, communication, and energy. The final result of each project is a full documentation with an individual catalogue of measures for the company concerned. "Then it's up to the firms what they do next," explains the project initiator, "but it's a manageable method in terms of the time and financial investment involved and it lays a foundation for the future."

One of the companies taking part in the pilot scheme was a painting business with a history going back 140 years. According to the owner, the VFMEA method is a good fit with their quality expectations. It was of

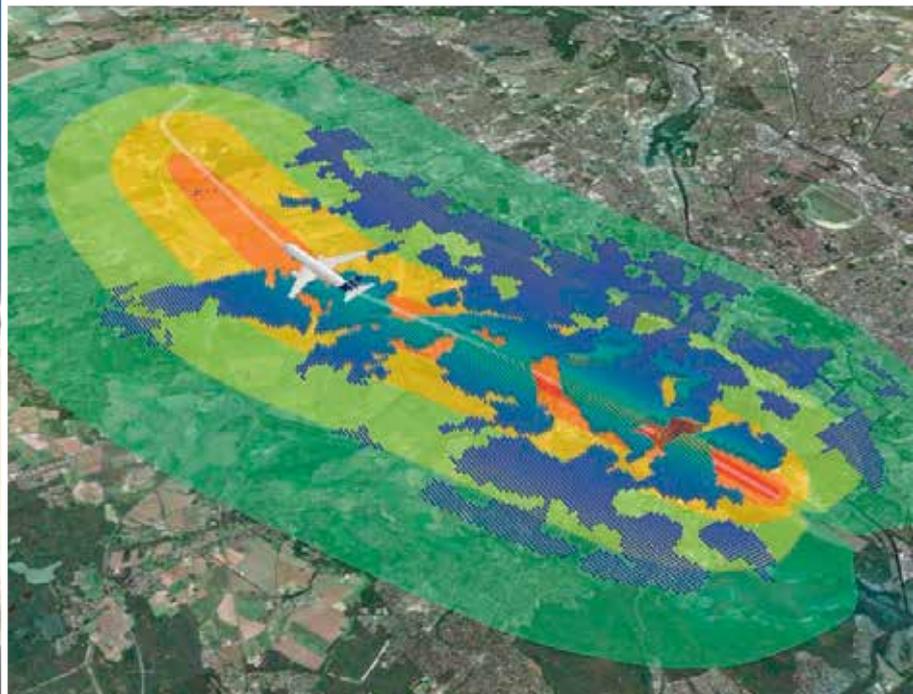
paramount importance that the company's eight skilled craftsmen, senior and junior ones alike, were involved in the process. "We worked with the external team of moderators to draft a list of errors and wastage in all areas of the company," says the master painter. "For me it was a real eye-opener that there was so much agreement where the starting points were for errors." The list will form the basis for future optimisations. "There has been a bit of a shift in mindset," continues the company owner. "It is noticeable that my staff are taking more initiative and responsibility." The insights gained have already resulted in improved processes, from driving to construction sites to project scheduling. Customer satisfaction has also risen.

"Irrespective of the size or success of a company, there is always room for improvement," says Lena Strothmann, President of the Chamber of Trade for Eastern Westphalia-Lippe in Bielefeld, "so one thing you have to do is pinpoint the potential to save money and eradicate errors. But often it's just improvements in communication that make you more successful." The VFMEA method has been beneficial to all the firms involved. Many have noticed that customer complaints have reduced to a minimum, reducing costs accordingly. A better business image and raised competitiveness have also been noticed. With the support of the Association of German Engineers (VDI) and the Chamber of Trade for the Stuttgart Region, the method is currently being introduced to businesses in Baden-Württemberg, focusing on practical application in small firms, medium-sized enterprises and trades from all business sectors.

Image: Prevention – correction – optimization. The VFMEA method



Prof. Dr.-Ing. Ralf Hörstmeier
Steinbeis Consulting Center Applied Motion Technology (Spengle)
SU1494@stw.de | www.vfmea.de



Feature Topic: Aerospace

Insights from Steinbeis experts

The aerospace industry is incredibly important to the German economy, bringing together four key fields of modern-day technology. It also plays a pioneering role in opening up new technologies in other sectors of industry. Just how and where is described by our Steinbeis experts: Prof. Dr. Mario Trieloff, director of the AstroGeomaterials Steinbeis Transfer Center, explains the role played by geoscience in exploring the universe. Prof. Dr.-Ing. Rüdiger Haas provides an overview of key developments in aerospace technology in recent years, also outlining current trends. Prof. Dr. Christof Büskens, who is director of the Steinbeis Research Center for Optimization, Control and Adjustment Control, introduces the European NLP solver WORHP and how it helps solve challenges in the aerospace industry. In an interview with Prof. Dr.-Ing. Rolf-Jürgen Ahlers, chairman of the Baden-Württemberg Aerospace Forum LR BW and deputy chairman of the Steinbeis Foundation Board of Trustees, Ahlers gives an outline of the aerospace sector in the state of Baden-Württemberg and future prospects. Prof. Dr.-Ing. habil. Monika Auweter-Kurtz, director of the German Aerospace Academy (ASA), a Steinbeis Transfer Institute, looks at training and continuing professional development and its role in boosting innovation. The director of both the Steinbeis Transfer Center for Manufacturing Technology & Machine Tools and the Steinbeis Consulting Center for High-Pressure Waterjet Technology, Prof. Dr.-Ing. Michael Kaufeld, explains how individual components can be optimized and why this is so important in aerospace production. Finally, Prof. Rudolf Voit-Nitschmann, director of the Steinbeis Transfer Center for Aerodynamics, Aircraft Engineering and Lightweight Construction and managing director of Steinbeis Flugzeug- und Leichtbau GmbH, provides an update on innovative developments in the field of unmanned aircraft.

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“What’s needed is interdisciplinary collaboration between physicists and geoscientists.”

An interview with Prof. Dr. Mario Trieloff, director of the Steinbeis Transfer Center for AstroGeomaterials

Prof. Dr. Mario Trieloff explains why geoscience is so important for exploration of the universe. In the interview, he also discusses questions surrounding the origins of the solar system, the Earth, and life itself, pondering on the future development of space exploration and the challenges this will pose for his Steinbeis Enterprise.

Professor Trieloff, space travel often brings eye-opening missions to mind, things like the recent New Horizons discoveries and those amazing images from space. You work in an area that, for any layperson, is probably a completely unknown in space – extraterrestrial materials and geomaterials. What topics and areas does this involve?

People often think that investigating far-flung heavenly bodies belongs to physics. Classic astronomical observation uses telescopes to examine electromagnetic radiation coming from extraterrestrial bodies, typically from huge distances. The strategy at the core of space missions is different. They involve transporting a relatively small load of scientific instruments to a target object somewhere in the solar system to study it at close quarters. This mainly involves engineers – to deal with flight capability and robotics – and physicists and chemists – to carry out experiments.

But when it's a planet with a solid surface, like Mars or the Earth's moon, or a small planetary body like an asteroid or comet, it's all about investigating rocks and minerals. This is where the right geoscientific expertise is needed, to interpret the results, and before that, to make the right instruments, to tackle the sorts of issues that are relevant to geoscience, or to test laboratory-type scientific instruments on suitable rocks and minerals – by which I mean extraterrestrial materials or geomaterials.

What happens specifically with the insights gained from researching extraterrestrial geomaterials? And what services does your Steinbeis Transfer Center for AstroGeomaterials offer in this area?

To judge the kinds of rocks and materials we can – theoretically – expect to find on asteroids, comets, Mars or the Moon, and to analyze these from a space probe, we've already gained some astonishingly good information by analyzing meteorites. Meteorites are typically a couple of centimeters or several meters in diameter – big chunks of rock that fell to earth at an extremely high velocity at around 10km per second. The collection of meteorites on Earth keeps growing; we currently have around 50,000 samples, most of which come from asteroids, and there are also minute dust particles from comets and about 100 meteorites from the Moon, plus a similar number from planet Mars. This allows us to “probe” many more planetary bodies than we would actually get from mission sample returns like the Apollo missions, Stardust or Hayabusa.

One obvious idea is to simply use samples from these meteorites as experimental material or calibration materials for experiments. But because these are extremely complex rocks or multi-mineral materials, it's better initially to carry out tests with the individual minerals that make up the rocks. Often the problem with this is that to separate off the minerals properly, you need large volumes of rocks or, for example, you need large volumes of materials to calibrate space experiments. But extraterrestrial samples are extremely rare and sometimes they're also

extremely expensive; often curators won't even make them available for such purposes, so you have to fall back on analogous terrestrial materials, which are available in sufficient quantities. The Steinbeis Transfer Center for AstroGeomaterials provides specific advice on selecting such rocks to ensure that the analogous material that is taken is suitable for gauging certain types of space experiments.

Your research at the University of Heidelberg also involves questions regarding the origins of the solar system. What secrets have emerged from interstellar dust about primeval materials and the solar system? What impact do you believe such insights could have on further developments in space travel?

With lots of space missions, like the current Rosetta project, the aim is to gain a better understanding of the origins of our solar system, the Earth, and life itself. We also look into these issues by studying meteorites. We now know that all bodies in our solar system originated from an interstellar cloud of gas and dust 4.6 billion years ago. There was a primeval nebular formation, a protoplanetary disk around our sun, which was just developing, with phases of heat lasting just a short time resulting in the first solid objects – only millimeters or centimeters in size. After a period lasting several million years, there were swarms of small planets whose descendants are today's asteroids. It then took another several tens of millions of years for the forerunners of today's terrestrial planets to take shape. We still find the remnants of these first solid objects in meteorites in our solar system, and we even find rare grains of stardust, micrometers in size, that developed in the wind of all stars even before our solar system existed. Without meteorites, we wouldn't know the exact age of the Earth and we wouldn't have so much detail of its constituent materials. Meteorites contain amazingly complex prebiotic materials such as amino acids, and these could have played an important role in the origins of life on Earth.

The meteorites that come down to earth are only meters in size. Much more rare, but also much more dangerous, are the ones that measure kilometers in diameter, like the ones that came down in the past and had such a significant effect on the geosphere and biosphere. They were linked to mass mortality between the Cretaceous and Paleogene periods – and the end of the dinosaurs – after a meteorite came down in Mexico 66 million years ago. Future space mission concepts are also looking at different ways to divert menacing asteroids early enough, or different ways to use asteroids to build a space industry.

Can you estimate from today's standpoint what challenges future space travel developments will pose for your Steinbeis Enterprise and how this might affect your portfolio of services?

During the pioneering time, the priority was flight capabilities. That won't be the case anymore, just getting a probe properly underway and maneuvering it away from Earth to the target object to land it on the surface. Such missions are only justifiable if more scientific insights are gained than from previous missions. What's needed in this respect is more professional and interdisciplinary collaboration between physicists and geoscientists. This will increasingly become the case if the missions are about sample returns – for example when it comes to selecting the right landing area. If the Earth were an unknown planet and we were

exploring it, the geoscientists would tell you how incredibly important it is to collect the first samples from specific places in order to find out something about the planet.

Steinbeis Transfer Center for AstroGeomaterials

Services

- Astromineralogical and geoscientific expertise on planning and carrying out spaceflight experiments
- Advice on acquiring and analyzing extraterrestrial geomaterials: materials analogous to planetary surfaces (e.g., asteroids, the Moon, Mars) and interplanetary/interstellar dust
- Advice on selecting, acquiring and preparing analogous materials, and interpreting measurement results

Key areas

- Extraterrestrial geomaterials: analogous materials to extraterrestrial rock found on planetary surfaces
- Geoscientific/astromineralogical expertise for physics/astronomy-based space research

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Prof. Dr. Mario Trieloff is director of the Steinbeis Transfer Center for AstroGeomaterials at the University of Heidelberg. His Steinbeis Enterprises offers clients astromineralogical and geoscientific expertise needed to participate in the planning and conducting of space experiments, as well as advice on the acquisition and analysis of extraterrestrial geomaterials.



Prof. Dr. Mario Trieloff
Steinbeis Transfer Center AstroGeomaterials (Heidelberg)
SU1583@stw.de | www.steinbeis.de/su/1583



“Transferring knowledge is an absolute prerequisite for the success of a product.”

An interview with Prof. Dr.-Ing. Rüdiger Haas, director of SITIS, the Steinbeis Transfer Center Institute for Transfer Technologies and Integrated Systems

Prof. Dr.-Ing. Rüdiger Haas talks to TRANSFER magazine, providing an overview of the important developments in aerospace technology in recent years and also outlining current challenges. In the interview, he explains the peculiarities of knowledge and technology transfer in the aerospace industry, even offering some personal predictions for the future.

Professor Haas, you've stayed loyal to space technology since your time at college. Can you give us an overview of the development milestones during this time and the ones that were important to you on a personal level?

While I was studying at Stuttgart University and during the years that followed, aerospace was a driving technology behind German industry. Research results and new developments emerged that defined an era, especially in the aircraft industry. I'd point to the short takeoff and landing airplane VFW 614. The revolutionary positioning of the engines meant it could even take off and land on poorly reinforced runways. In terms of helicopter developments, for a long time, the benchmark in civil and military helicopter construction was set by the MBB BO 105 with its hingeless rotor system. The multirole Panavia 200 Tornado proved that a consortium in different European countries was in a position to turn a complex weapons system into a technical and logistical success.

But it soon became evident that individual countries, and that includes the Federal Republic of Germany, are not in a position to deal with the huge development effort and costs associated with future aerospace projects on their own. Another example of collaboration between European states is the joint development of the A300, the first wide-body aircraft completely manufactured in Europe. Even today, Airbus aircraft serve as a symbol of a success story that became a threat to the American civil aircraft construction industry, and its significant market share.

In space travel, European rockets may have enjoyed limited success but they did teach Europe a lesson or two about different aspects relating to technical systems and production issues, and this was crucial. The experience gathered in this area fed into the development of a new rocket design. To this day, the family of rockets this resulted in – the Ariane – is a standard means of transport for taking all kinds of payloads into space.

In 2009, you set up the SITIS Institute for Transfer Technologies and Integrated Systems, a Steinbeis Transfer Center whose main activities include aerospace engineering. What sort of requirements do your customers come to you with in this area?

The emphasis at SITIS lies in aerospace technology. The research emphasis has been on improving cost-efficiency in flight, especially under the influence of Airbus. The economics of flying are about achieving faster cruising speeds, optimizing cruising range, and making maximum use of seating capacities – while still paying particular attention to noise and emissions. An essential part of this relates to the use of new materials and the new processing techniques or production possibilities this involves, taking test specifications and construction regulations into consideration. SITIS is ideally equipped in this area of research, with the very latest production technologies, measurement techniques, and testing procedures. There's also close collaboration in this field of R&D with aeronautic regulatory bodies like the EASA and the LBA (Luftfahrtbundesamt).

Aviation should become safer and more environmentally friendly. What role do production technology and materials engineering play in achieving this objective?

A decisive role! Increasing aircraft payloads generally call for lightweight construction, without shifting the structural boundaries of stress. This can only be achieved by using new materials, especially fiber composites and hybrid designs. Using these new materials in the airframe or wings requires completely new processing techniques and production technologies. It's especially important to examine damage to parts resulting from the processing technique. If microscopic cracks are created by not adapting the processing technology properly, the materials can fail, especially with parts subjected to dynamic stress in flight. It's a similar story with engine development. Improving efficiency and thus saving fuel is only possible now because of the tremendous advancements that have been made in metallurgy in recent years. The magic phrase here is nickel-based alloys – these are recently developed materials that make it possible to improve the bypass and pressure ratio in the engine. This results in a dramatic reduction in fuel consumption.

Few doubt that transferring knowledge and new technologies into business is imperative. What do you believe are the challenges of this kind of transfer in the aerospace industry?

Especially in the aviation and aerospace industry, transferring knowledge is an absolute prerequisite for the success of a product – and thus for a company. Even bigger companies can't cope by themselves with the myriad of tasks that are involved in developing a new airplane these days. We're now noticing a clear trend toward clustering. It's a simple principle: Everyone does what they do best. The result is a completely new-generation supply industry. And the result of this is a new landscape of so-called anchor companies – like Airbus, Lufthansatechnik etc. – plus small and medium-sized suppliers, service providers, and alliances of development companies with specialist tasks. This landscape is flanked by the relevant scientific research activities at universities, the major research institutions, plus application-based research and development being undertaken by Steinbeis Enterprises.

Where do you see future developments in aviation and aerospace taking us? What impact will these have on the services offered by your Steinbeis Enterprise?

The way we see it, the trends in aerospace technology are totally clear. Improvements in structural mechanics and lightweight design are making it possible for aircraft and space vehicles to carry heavier payloads. The starting point here is primarily the development of new materials. When it comes to pollution, the main priority is to make efficient use of fuel or improve the efficiency of engines. To improve aerodynamics, more attention will be paid to bionic systems in the future, as in "nature sets a perfect example." Work is already being done on completely new airframe concepts, especially on the wings. Quite possibly, the tasks SITIS works on may have to be redefined. New production technologies for special materials also have to be validated through appropriate testing and approval procedures. We believe this would be the optimum transfer support for the aviation and aerospace cluster.

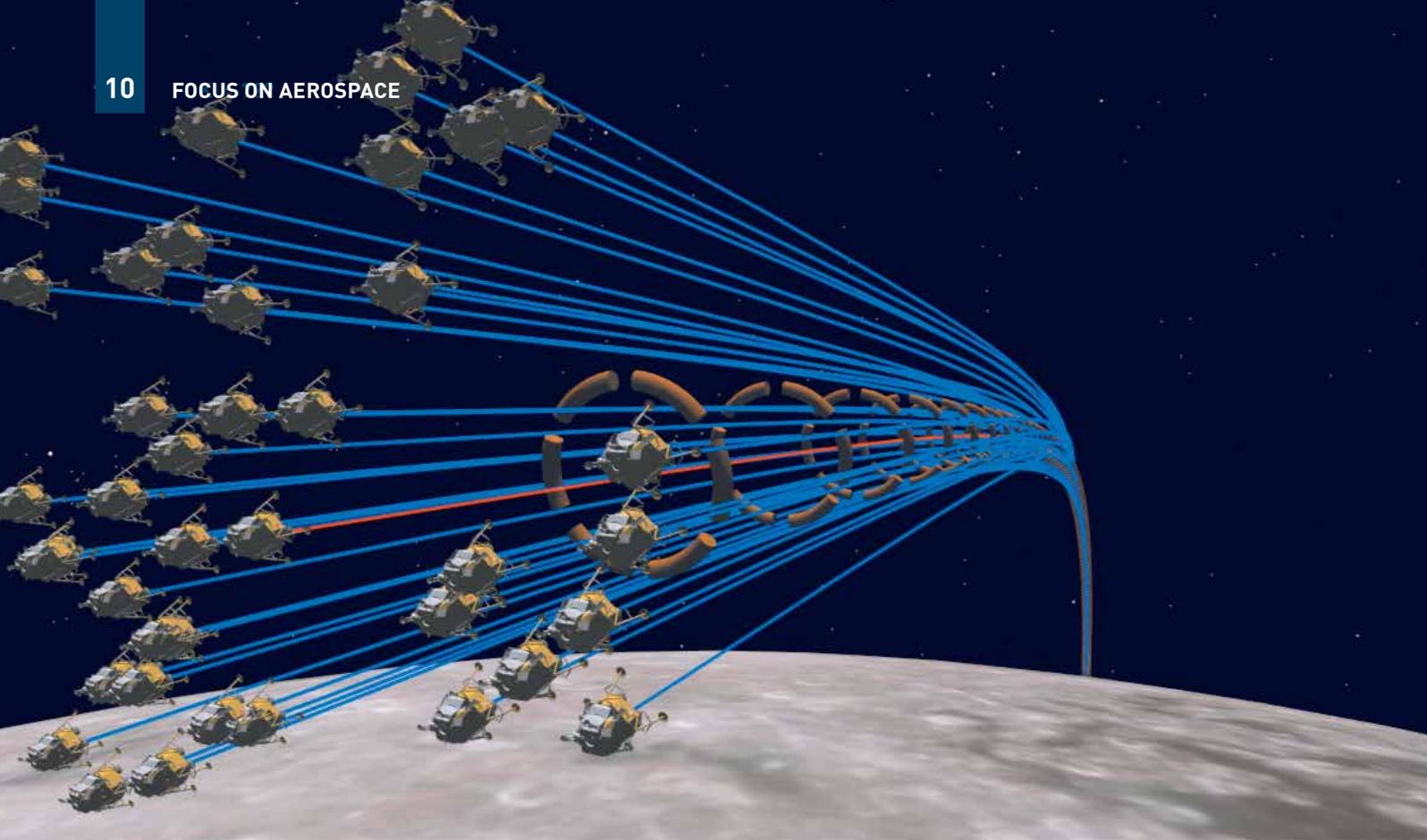
Image: © istockphoto.com/Joel Carillet



Prof. Dr.-Ing. Rüdiger Haas is the director of SITIS, the Institute for Transfer Technologies and Integrated Systems, which is a Steinbeis Transfer Center at Karlsruhe University of Applied Sciences. The emphasis of the work done at this Steinbeis Enterprise lies in the fields of modern tool and molding design, energy efficiency, medical technology, and the aerospace industry.



Prof. Dr.-Ing. Rüdiger Haas
Steinbeis Transfer Center Institute for Transfer Technologies and Integrated Systems SITIS (Karlsruhe)
SU1289@stw.de | www.steinbeis.de/su/1289



Making things optimal, not just better

WORHP: a European nonlinear optimization solution for the aerospace industry

The aim of modern modeling and simulation calculations used in aerospace is not just to gain an understanding of existing (i.e., real) systems, but also to make actual improvements in any given situation. But making improvements isn't the same as achieving the optimum. Enter nonlinear optimization (NLP), an approach being used in aerospace that has developed into a key technology capable of delivering competitive advantage. One particularly important solution in this area is WORHP (pronounced "warp"), the European NLP solver which was developed to provide a tool for solving real optimization problems in everyday practice. Optimization, Control and Adjustment Control, the Steinbeis Enterprise based at the University of Bremen, is coordinating adaptations to WORHP as part of a project looking at reducing pollution in aviation.

Since time immemorial, mathematics has been a tool for and the language of science and engineering. Without mathematics, it would not be possible to carry out modeling and simulation and thus improve technical and commercial processes. In essence, modern hi-tech is mathematical engineering. This was the finding of a report issued by a study commission of the American Academy of Sciences, which looked at the role played by mathematics in industry and science. This age-old science, driven by the imagination of intellect, is as enduring as ever, even if it often only sits in the wings and frequently goes unnoticed by society. Mathematics is not just the language of science, it is also a lynchpin between vastly different disciplines, fulfilling a function that transcends scientific endeavor. This lynchpin role is not just essential between different disciplines within science but also, in a direct sense, as a derivation of mathematics – forming connections, as is the case with knowledge and technology transfer and connections forged to the hi-tech field of aerospace.

Nonlinear optimization makes use of highly efficient mathematical processes. This involves drawing on the latest developments in computer technology to solve problems relating to the best-possible trajectories of aircraft during takeoff and landing, of space shuttles during ascent, or of satellite constellations. It can also involve working out the optimal

engine strategy for a landing on the moon or Mars. The potential this offers to the aerospace industry has also been picked up on by both the German Aerospace Center (DLR) and the European Space Agency (ESA), who started backing the development of the NLP solver (WORHP) as early as 2007. WORHP stands for We Optimize Really Huge Problems. Initially this involved software development, but later it spread out to address numerous development and service questions relating to aerospace, plus specific application scenarios.

Unlike most NLP processes, WORHP was not developed purely as a test environment for mathematical processes. Instead, its aim was to solve actual optimization problems relating to real applications. The result was a modern software package that not only meets the stringent standards outlined by the European Cooperation for Space Standardization (ECSS), but the European Space Research and Technology Centre (ESTEC) and the European Space Operations Centre (ESOC) have also given it technology readiness level 6-7 (TRL 6-7). TRLs are a method for estimating the maturity of software. For comparison, the scientific software used at most universities typically achieves a score of TRL 1-2.

High-dimensional models with millions of degrees of freedom, variables, and additional conditions are a particular specialty of WORHP, which it solves just as reliably and efficiently as little problems. WORHP is cur-

rently considered the most robust NLP process in existence. Since it was launched around five years ago, WORHP has taken the world by storm and it is now supported by other processes based on WORHP, among them: TransWORHP, which is used to calculate the optimum controls and trajectories, and WORHP Zen, which is used for the parametric sensitivity and stability analysis of optimum solutions.

A particular highlight within science is the supporting role played by WORHP at ESOC in the planning of optimal trajectories for BepiColombo, Europe's first mission to Mercury, which is scheduled to start in 2017 and is a collaborative venture between the ESA and the Japanese Aerospace eXploration Authority (JAXA).

Another area in which the WORHP NLP solver is being used is in optimizing the trajectories of aeronautical applications for Clean Sky, an EU project looking at "green operations" systems as part of Management of Aircraft Trajectory and Mission (MTM). The aim of the initiative is to make European aviation and the aerospace industry more competitive and – as the name implies – reduce pollution caused by emissions and aircraft noise, and thus develop cleaner and quieter aircraft. The Grasberg-based Steinbeis Innovation Center for Optimization, Control and Adjustment Control is also coordinating a sub-project looking at adapting WORHP to avionics constraints.

Another challenge for WORHP lies in a research project called KaNaRiA (a German acronym for "cognition-based, autonomous navigation based on resource depletion in space"). The underlying idea of this project, which is backed by the DLR and involves five partners, is to equip a space vehicle with an autonomous decision-making system capable of suggesting cognitively motivated strategies for the investigation and exploitation of resources on distant asteroids. The role played by WORHP in KaNaRiA is to calculate the optimum routes, subject to limitations, and to optimize landing trajectories and make optimal re-adjustments at different stages of navigation during missions.

For the Cognitive Autonomous Subsurface Exploration (CAUSE) project, WORHP has to automatically identify dynamic systems based on merged measurement data from a melting probe on Enceladus, one of Saturn's moons. It should also plan optimum trajectories and automatically interpret model-based and adaptive control concepts. The concepts that have to be developed to do this should not be restricted to exploration projects, however, but also feed into other application scenarios, such as autonomous robotic systems on Earth or diesel engine controls in cars.

The aim of another WORHP project in the aerospace field is to determine the optimum flight manoeuvre for a landing module orbiting the moon such that different limitations are taken into consideration and the vehicle can land safely on the surface. This involves compensating for the high starting speed of the landing module, primarily with non-modular engines, which should be switched off one at a time at the optimum moment. WORHP Zen is also playing a successful role in understanding the quality and susceptibility of trajectories.

Aside from the scenarios outlined above, WORHP is also being used on a multitude of practical issues involving automatic optimization. For example, scientists thinking about future missions to Mars are interes-

ted in understanding safe landing trajectories, taking the Martian atmosphere and reduced energy consumption into consideration. Similarly, WORHP can optimize the positioning of satellites orbiting the Earth to save energy and resources.

The application scenarios covered by WORHP are not just restricted to the aerospace industry, however. Many of the current research projects involve energy systems important to the German transition to alternative energy or the automotive sector. As part of the portfolio of the Steinbeis Research Center for Optimization, Control and Adjustment Control, the WORHP NLP solver is an important building block in transferring technology into industrial applications, after all, many practical applications are essentially based on optimization processes.

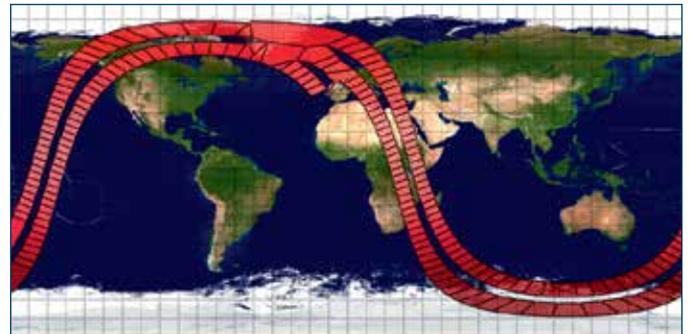


Image left: Fault analysis of optimized trajectories for a moon landing

Image right: Resource optimization through the mathematically exact simulation of areas flown over by satellites



Prof. Dr. Christof Büskens is director of the Steinbeis Research and Innovation Center for Optimization, Control and Adjustment Control at the University of Bremen. The experts at the Steinbeis Enterprise work in the fields of modeling, the simulation and identification of static and dynamic systems, optimal control and adjustment, real-time optimization, online optimization, and numerical methods and processes.

In 2008, the Steinbeis experts and OHB System AG won the Steinbeis Foundation's transfer award (the Lohn Award) for the mathematical optimization of satellite resource management systems.



Prof. Dr. Christof Büskens
Optimization, Control and Adjustment Control (Grasberg)
su1118@stw.de | www.steinbeis.de/su/1118



“Bring on the next ten years!”

An interview with Prof. Dr.-Ing. Rolf-Jürgen Ahlers, chairman of the Baden-Württemberg Aerospace Forum LR BW, and deputy chairman of the Steinbeis Foundation Board of Trustees

What areas does the LR BW work in? What challenges and opportunities lie in store for the aerospace industry in Baden-Württemberg? In a recent interview, Prof. Dr.-Ing. Rolf-Jürgen Ahlers provides some answers.

Professor Ahlers, you're the chairman of the Baden-Württemberg Aerospace Forum (LR BW). It was founded in 2005. What were the reasons for its foundation 10 years ago?

At the beginning we found ourselves in a really weird situation. We read a study about Baden-Württemberg that said the aerospace industry is not a key sector. For us as business people this was unacceptable. The aerospace industry plays an outstanding role in the state; when it comes to training, Baden-Württemberg plays just as much a leading role as it does in industrial applications. Innovations trickle down into other sectors of industry. So as a result, something had to be done. We decided we'd start doing something about the current status of the aerospace industry. We also got some ministerial support – the ministry of economics at the time set up a kind of task force and it was extremely successful. It quickly became clear that there were tremendous resources in

the state, on a scientific and industrial level. Right from the beginning, the LR BW forum's maxim was “together we are strong.”

As time went by, we published new brochures on the aerospace industry, conducted a study on a concept for putting the former airfield in Lahr to a different use, as we also did with the airfield located between Böblingen and Sindelfingen. Then in 2011 we worked with the WRS, the economic development agency for the Stuttgart region, and drafted the first skills atlas for our industry. The second edition is due to come out in the second half of 2015. So what we started in 2005 was a complete success.

This was all within the context of extremely close work with the LVI in Baden-Württemberg, the regional industry association, to highlight cross-industry aspects. Collaboration with the German Aerospace In-

dustries Association in Berlin (BDLI), and the AeroSpace and Defence Industries Association of Europe (ASD) in Brussels, has also played a successful part in forging networks. We've succeeded in stepping beyond Baden-Württemberg onto the national and international stage.

What activities is the forum involved in these days to pursue its goals? Where do you see challenges and opportunities for the forum?

We do a lot for our members, not just in terms of the specific projects we're involved in but also in expanding our network. So we organize events to stimulate debate on current issues and assess their implications for our area of work. We've set up working groups on certain topics to keep the process of exchange going. These include the supply chain and the issue of defense and security. There's a Virtual Aircraft working group on virtual reality and one on satellite technology. In terms of attending trade shows together, we've also brought things to a higher level.

In terms of what we get back from our members, we ensure that the very latest findings are communicated quickly and shared with the collective of other members. This happens in various ways, like through the working groups and special mailings that go out to members, but also through our newsletter. This flow of information keeps our members up to speed and at the same time it motivates them to do something.

We face plenty of challenges, for example changes in the supply chain, which are especially challenging for small and medium-sized enterprises. Technology is also changing rapidly. The challenge here is not just to trumpet out innovation like some sort of magic spell but to actually get involved with the nitty-gritty of new topics. Steinbeis has been especially good at thinking about one interesting aspect of this: Innovation-Quality. We need to understand what value there is in something new. There are opportunities tucked away in every nook and cranny, but we just need to make sure we remain focused, we need to strengthen our strengths.

You're also the deputy chairman of the Steinbeis Foundation Board of Trustees. How well do the two organizations or bodies work together, by which I mean the LR BW and Steinbeis?

Actually, I'm glad you asked that question, thank you. It gives me the opportunity to thank the Steinbeis Foundation for the close cooperation. On the one hand, there's a representative from Steinbeis on the board of the LR BW, Prof. Dr. Michael Auer, and on the other, we've already carried out a variety of activities together and this has worked well. The Steinbeis Enterprises perform an important function for small and medium-sized companies, including in the aerospace industry. And we also joined forces to set up the German Aerospace Academy, or ASA, where we're also keen to make new things happen in terms of training.

Baden-Württemberg is currently a leading region in German aerospace. What do you feel needs to be done to keep it that way in the future?

We need to be clear about the fact that, in terms of policy, the right

framework conditions are only possible if there is also clarity about the role of Baden-Württemberg as a location for the aerospace industry, so that companies will keep investing here and expand their operations. This also involves a clear commitment to keep supporting this technologically valuable industry. We need a shot of enthusiasm.

We're a state of ingenious inventors and thinkers – we get things done. Our industry is about creativity and determination to see things through. If we keep working together closely with universities of applied sciences, other universities, research establishments, but also our representatives from politics, we'll also remain successful in the future. After tens of years of successful work at the LR BW forum, I don't get the shivers thinking about the future. Bring on the next 10 years – we're looking forward to them.

Image: © istockphoto.com/xenotar



Prof. Dr.-Ing. Rolf-Jürgen Ahlers is chairman of the Baden-Württemberg Aerospace Forum (LR BW) and deputy chairman of the Steinbeis Foundation Board of Trustees. The LR BW forum represents the interests of the aerospace industry in Baden-Württemberg with the goal of pooling industry activities and fostering technological developments through collaboration between businesses and scientific institutions in order to implement them in innovative projects. It also promotes projects promising to optimize industry infrastructure in the state and improve competitiveness.

Prof. Dr.-Ing. Rolf-Jürgen Ahlers
Baden-Württemberg Aerospace Forum (LR BW) (Ostfildern)
rolf-juergen.ahlers@stw.de | www.lrbw.de



Highly Qualified Employees: The Foundation of Innovation and Competitiveness

Job-integrated training and continuing professional development enhances the innovative capacity of small and medium-sized enterprises

The aerospace industry has always been a key driver of emerging technology. Companies and scientific institutions in the industry have frequently been the source of ground-breaking innovations and they still are today. Such innovations quickly spread into related areas. Systems and products used in the aerospace industry have to adhere to extremely strict quality requirements and function properly under harsh conditions. So to uphold innovation and competitiveness, organizations need highly qualified workers, ideally with broad-based training and international experience. It is against this backdrop that the German Aerospace Academy (ASA), a Steinbeis Transfer Institute at Steinbeis University Berlin, develops concepts for offering innovative, vocationally integrated training and continuing professional development (CPD).

Aerospace technology will continue to shape the development of our society in the future and it will play a decisive role in the success of many enterprises. But it is becoming increasingly difficult to find qualified young engineers in Germany and for many companies, this is even hindering expansion. Many SMEs are affected by this, especially on the upstream supply side in the aerospace, automotive, and mechanical engineering industries. This is being made noticeably worse by demographic change. As life expectation continues to rise and the birth rate remains low in Germany, we will see changes in population structures meaning that it will be necessary to work longer and longer before retirement. The rising number of immigrants can probably only provide mild alleviation to this predicament.

In a country like Germany, where we have few of our own natural resources, other aspects that generally depend on the ability of our companies to innovate guarantee our quality of life and the standard of living. Highly qualified and motivated employees are not just a key prerequisite of the innovative, competitive and commercial success of every single business, they are the cornerstone of affluence in this country. We were quick to recognize this in Germany and the authorities in many of the federal states have been channeling comparatively large resources into research and graduate education in universities and the universities of applied sciences. By comparison, expenditures on maintaining vocational skills and providing further training have been minimal until now.

However, sweeping changes in German society and the working world have every potential to impair the innovative power of SMEs. The field of training for engineers and scientists has become more multifaceted and even more complex. Especially after everything switched to the two-tiered degree system, apprenticeships and career paths have become much more diverse, more and more people are taking a break in their career, and the number of years we will work will get longer. We will have to learn to adjust to all these changes and prepare ourselves for more. To do this, new training and CPD concepts will have to be developed. We must expect politicians and businesses to establish a framework that makes it possible for young people to strike a happy balance between family life and a fulfilling career. This will also involve taking into consideration growing requirements to travel. So the right training options plus supplementary offerings need to be developed to match.

To respond to these societal and economic challenges, which became perceptible relatively early in an innovative and highly networked internationally sector like the aerospace industry, an initiative of a Baden-Württemberg aerospace forum called LR BW resulted in the 2010 foundation of the German Aerospace Academy (ASA), a Steinbeis Transfer Institute and part of Steinbeis University Berlin. The focus at the ASA lies in vocationally integrated training and CPD for engineers and scientists working at aerospace companies, automotive or mechanical engi-

neering firms, or their suppliers. The ASA also focuses on the development and testing of innovative concepts to safeguard the workforce of specialists and forge international networks. The ASA focuses on a number of totally different target groups, working through its international network to collaborate worldwide with universities, technical colleges, research institutes and business enterprises. A Steinbeis Innovation Center, the ASA explores different ways for people to return to work (for example after parental leave) and develops training programs aimed at allowing older professionals to change career paths. It also develops and spearheads initiatives aimed at creating cross-border SMEs networks and centers of excellence in research and development.

All training and CPD programs offered by the ASA are based on the project competence concept developed by Steinbeis University. This allows company employees to study in parallel to their work, also offering the firms the right tools to expand their skills base without having to let go of cherished and trusted staff. For workers in specialist and scientific fields who would like to enter different areas, the ASA works with research and development experts to offer certification courses on key topics. These are matched to the needs of companies and place emphasis on honing skills and the personal development of course participants. The firms are involved in training, also benefitting from supervision from experts. These kinds of certification courses are an excellent way to systematically expand skill sets, laying an important foundation for lasting careers in science and technology. For people returning to work or forging new career plans, such training provides a solid basis for embarking on a new venture in a field with good prospects.

Europe's aerospace industry is international by nature and has seen more and more upstream supply activities shift to newly industrializing countries in recent years. Countries like Mexico and China – which have well-educated and highly motivated workers with lower wage expectations – are gaining in importance as production locations, to the detriment of European suppliers. Most SMEs are not just suppliers to the aerospace industry but also work in the automotive and related industries, where there are similar developments. As a result, it is particularly important to bolster the competitiveness of German SMEs. It is also necessary to promote networking among SMEs and expand their skills base.

Against this backdrop, the ASA has been working in collaboration with five other aerospace regions in northwest Europe. In late 2012, the consortium started an INTERREG initiative called TransNetAero with the aim of strengthening SMEs in the aerospace industry. As part of the three-year project, networking is being promoted through involvement with regional aerospace clusters as well as internationally renowned research, development and training establishments. The ASA is also leading efforts to develop a joint training and CPD program to run in parallel to full-time work. This provides an addition to the vocationally integrated training program of the ASA, offering common certification courses through research institutions in other European countries, to be shared throughout Europe. Working in collaboration with universities in Delft, Liege and Derby, plus the Center for Aviation Competence at the University of St. Gallen, the ASA is currently developing a vocationally integrated multi-degree master's in Aerospace Engineering. This will be offered in English. Students will receive training at centers of excellence

in five European countries. Every year, the best transfer projects on the TransNetAero CPD program will be honored with the Steinbeis Transfer Award.

The degree program and innovative projects offered by the ASA hold particular appeal for small and medium-sized enterprises as a means of bolstering their innovative strength and a useful tool to counteract the shortage of skilled employees in science and engineering areas. To this end, the ASA has developed and is currently evaluating two pilot projects to help companies gain access to the dearth of female engineers, as well as older engineers and scientists, and to keep these people on board. One program to help trained engineers return to their learned profession, in keeping with previous qualifications, is called WING. This program is aimed at professionals returning to work after a break for family reasons, and at people who have moved into other areas of work. Participants are offered a varied program to develop their skill base, with continuing advice and support when they return to work. For example, there are special courses with an emphasis on skills transfer. One such course offers Virtual Engineer training to allow older workers to move into completely new fields of work and open the door to new career opportunities. One ASA concept has already proven its worth as part of a project called QWing 50+, which was honored with the Demografie Exzellenz Award in 2013.

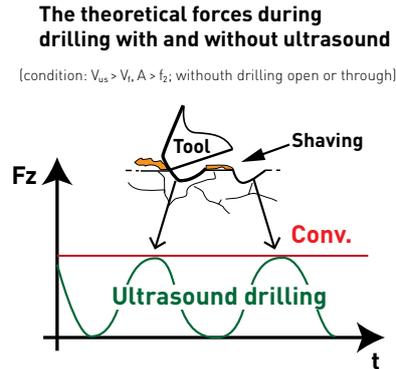
Image: a drone inspecting solar panels © fotolia.com/pixone3d



Prof. Dr.-Ing. habil. Monika Auweter-Kurtz is director of the ASA, a Steinbeis Transfer Institute and a Steinbeis Innovation Center which offers vocationally integrated skills development degrees, from bachelor's to doctoral studies, certification courses and seminars based on different qualification levels and previous education. Aside from training in technical areas, the ASA's courses also address fields of management and equal opportunity.



Prof. Dr.-Ing. habil. Monika Auweter-Kurtz
Steinbeis Transfer Institute German Aerospace Academy (ASA) (Stuttgart)
su1461@stw.de | www.german-asa.de



Research into Production in the Aerospace Industry

Optimizing the manufacturing of components

In the aerospace industry, quality assurance is an essential part of production, particularly when it comes to processes and components. High quality standards are driven by the extremely high technical requirements placed on parts. As a result, there are also special requirements placed on components, not only in terms of comprehensive functional testing before they actually enter use, but also in relation to how components are actually produced. The Steinbeis Transfer Center for Manufacturing Technology & Machine Tools has been working in this area with the Steinbeis Consulting Center for High-Pressure Waterjet Technology to identify different ways to optimize the production of components and develop new technologies.

To safeguard the proper functioning of components used in the aerospace industry, there are extremely tight tolerances, for example, in terms of exact measurements and material structures. Also, components can be extremely expensive, making it essential to include sufficient system safeguards at different stages of the value chain.

Launch vehicle production is marked by intense international competition so there is enormous cost pressure. This makes it more difficult to introduce new production technologies, also because the production techniques that have been used until now for such tried-and-tested parts have been through a significant number of approval procedures. Making changes to production methods during a live program is thus an extremely sensitive issue, requiring the appropriate forms of evidence and quality testing. Also, for the organization making the rocket, the prospect of increasing the metal removal rate from 1 cm³/min to 7 cm³/min – and potentially even raising it to 29 cm³/min – felt like a total impossibility. But in reality, EADS Space Transportation had already been working in collaboration with the Steinbeis Transfer Center for Manufacturing Technology & Machine Tools and had already achieved such a quantum leap, demonstrating that heavy-duty machining is possible, even with mission-critical components. Because of the interfering contours encountered during the production of combustion chambers, tool clamps need a minimum projection length of 300mm and the side milling cutters must have a diameter of 63mm and a blade thickness of 0.6mm.

The development partners optimized both components to cope with the extreme acceleration in milling speed. At the same time, they conducted tests on dry milling with minimal lubrication. Because the proper functioning of combustion chambers is essentially linked to structural effects resulting from the milling process, the experts also carried out a

series of tests to look at this aspect. They found that all crystals (or grains) were clearly being sliced smoothly by the cutting process. Fringes resulting from the process were of an acceptable size and under 10µm. The testing clearly demonstrated that performance improved significantly compared to conventional milling processes used to date – in other words, it would be more economical to mill at between 12,000 and 19,000 rpm. This is equivalent to improving efficiency by a factor of 6-10.

Another example of a development of new production methods comes from testing carried out on ultrasound-assisted milling in the production of engine parts made of materials that are resistant to extremely high temperatures. The Steinbeis experts moved away from previous application areas and decided not to apply the technology to tools made with undefined cutting edges or advanced materials, but instead to use conventionally designed tools. When the team carried out ultrasound drilling with interrupted cuts, they discovered the potential to reduce local milling forces by forming a protective chamfer on the tool, thus not only reducing contiguous temperature but also applying specific compressive stress to bore walls. They also found no weld-ons on the cutting edges resulting from oscillations. Compared to surface treatment without ultrasound, introducing ultrasound to milling in production (finishing, radial feed 0.5mm) resulted in a reduction in force, without tool chatter.

The combined effect of tool rotation and the axial ultrasound movement creates a "peel cut" and there is also a change in the effective direction of the peripheral cutting edges, such that there are phases with and without stress being applied to the tool.

Ultrasound technology is also used for so-called roll hammering, a process applied to surface compaction. Unlike glass bead blasting, which

results in random distribution, this uses NC-controlled movement to target the tool directly on a specific area of the part that is being compacted. This allows for the compaction to be varied right up to yield point, depending on variables such as static preload, ultrasound amplitude, track speed, and line spacing.

New types of production techniques can also be found in optimizations made in the production of integral aluminum and titanium parts. How perfectly a part is milled is not just about the specific milling parameters, but also an overall process of adding value: Successful milling is about machine optimization, matching tools to the milling parameters and appropriate programming strategies. This was most aptly demonstrated in the production of integral parts used in airplanes, especially parts that are over 90% milled. Aluminum milling involves high-speed milling machines with tool speeds of 24,000 rpm, whereby milling volumes of up to 3,000 cm³/min are possible. To optimize processes, the experts went through several stages of determining and enhancing machine performance. For example, they geared the high feed rates (9-15 times per minute) to design factors, identifying the limitations of the spindle system and tools, and taking suitable processing strategies into account within the NC programs, as well as key processing parameters. The time needed to produce integral components for the A380 Airbus could be dramatically reduced as a result.

When milling long-fiber reinforced plastics, the special layered structure of the material creates quite different challenges in production. If tools or process parameters are suboptimal, the edges of the materials being processed can become delaminated or result in protruding fibers after milling, which is clearly unacceptable in aviation. To avoid this, tool makers offer a variety of tool designs for drilling and milling composite structures, primarily in order to optimize the quality of the milling process itself. But aside from the design of the tool, the milling strategy applied to the part is central to the success of the milling process. The Steinbeis experts are currently working on a project that involves investigating the drilling process used for an unstable CFRP structure. The aim is to determine the degree of instability that would be acceptable for a specific drill hole quality, depending on certain influences, which can be static or dynamic in nature. The axial feed force (F_z) affects material deformation depending on the material's flexibility, resulting in a force (F_f) being exerted along the z-axis based on the equilibrium of forces. As the tool cuts through the final layer, spring tension makes the material recoil and this is conducive to delamination. Ultimately, knowing this provides the means of calculating specific options for reinforcing unstable CFRP structures. The results of such calculations can be evaluated according to the milling strategy, the machining parameters, and the degree of tool wear. The evaluation criteria used for this are: the degree of delamination (or the extent of fiber protrusion) and the exactness (dimensions and shape) of component design.

One alternative method for preparing parts – i.e., for cutting raw parts out of sheet materials typically used in aviation – but also for finishing or refining CFRP structures, is to use abrasive water jet cutting. The two alternative approaches often compete with one another and the experts at the Steinbeis Consulting Center for High-Pressure Waterjet Technology frequently conduct comparative testing on the processes applied to component materials, both in terms of process productivity and quality.

They are also currently working on a Web-based monitoring system for use during the process of water jet cutting of different types of CFRP materials. Their aim is to find reliable ways to monitor different parameters relating to delamination and unstable processing and thus make the overall process more reliable.

Image 1: Closer and closer to the limits of technological feasibility: a GP 7000 engine used in the A380 Airbus (factory photo supplied by MTU Aero Engines AG)

Image 2: The theoretical forces exerted during ultrasound drilling with drilling interruptions

Image 3: Processing of delicate CFRP structures.(factory photo supplied by W. Piekenbrink GmbH in Laupheim)



Prof. Dr.-Ing. Michael Kaufeld is the director of the Steinbeis Transfer Center for Manufacturing Technology & Machine Tools and the Steinbeis Consulting Center for High-Pressure Waterjet Technology at the University of Ulm. Work at both Steinbeis Enterprises revolves around manufacturing technology, tooling machines, tool technology, and quality/production measurement technology.



Prof. Dr.-Ing. Michael Kaufeld
Steinbeis Transfer Center Manufacturing Technology & Machine Tools
(TzPW) (Horgau)



Steinbeis Consulting Center High-Pressure Waterjet Technology
(BzHWT) (Horgau)
Michael.Kaufeld@stw.de | www.steinbeis.de/su/323 |
www.steinbeis.de/su/1787



Innovative Developments for Unmanned Aerial Vehicles

Steinbeis experts work in Quadcruiser development alliance

For the last 20 years, the Steinbeis Transfer Center for Aerodynamics, Aircraft Engineering and Lightweight Construction, and the company it spawned in 2007, Steinbeis Flugzeug- und Leichtbau GmbH (SFL), have been working with a variety of clients on innovative aviation solutions. The development services offered range from aircraft used in general aviation to projects involving remotely piloted air systems (RPAS). The work being carried out by the Steinbeis experts is focusing more and more on unmanned aerial vehicles (UAVs).

SFL already works as a project partner of the Manching-based company Airbus Innovations, playing a key role in the development of a groundbreaking UAV called the Quadcruiser. The unique selling point of this RPAS is its synthesis of vertical takeoff and landing (VTOL) capability with long-haul cruising that is both economical and fast, as well as extreme flight duration, or even a combination of these capabilities. These are features that are simply not possible with conventional helicopters or quadcopters. The quadcruiser takes off and lands like a quadcopter. It has four lifting propellers driven by electric motors and these are switched off during cruising and pointed in the direction of travel. An electric motor mounted at the rear then drives the UAV. Flight testing was carried out with a proof-of-concept prototype with a take-off weight of 12 kilos.

The Steinbeis experts working on the project are tasked with making important contributions relating to the design, including flight mechanics calculations and performance calculations. They are also responsible for building prototypes and systems integration. This is where the broad experience of the Steinbeis experts in the field of electric aviation has come in useful. SFL was involved in the flight testing, which started in December 2014. Their development work also includes the design, development and construction of larger prototypes with a higher payload, and the development of hybrid engine systems for longer flight durations and greater distances.

The Steinbeis experts are partnering with Airbus Innovations Manching, the Institute of Aircraft Design at Stuttgart University, and other members of the LuFo aviation research program, working together on issues related to RPAS hybrid engines. An RPAS can be used for observation and transportation purposes, especially when the aircraft needs to take off or land in urban areas or on inaccessible terrain, but also when a long flight duration is needed over a major distance. As a result, there are many areas in which an RPAS can be used, from civil observation and transportation missions to military activities:

- Long-distance transportation of medical supplies and mail

- Aerial photography
- 3D measurement of landscapes and buildings
- Stocktaking in agriculture and forestry
- Disaster relief
- Military observation and surveillance activities in inaccessible areas

The technical prerequisites have already been fulfilled to use unmanned aviation systems, but there is still no statutory framework for the general use of UAVs in unrestricted airspace. Nonetheless, a lot of work is being carried out in this area at the moment. Assuming this aspect will also be dealt with in the near future, the experts believe there is huge growth potential for this technology, expecting double-digit market growth.



Steinbeis Flugzeug- und Leichtbau GmbH (SFL) is headed up by two directors: Prof. Rudolf Voit-Nitschmann and Werner Scholz.



Prof. Rudolf Voit-Nitschmann

Steinbeis Flugzeug- und Leichtbau GmbH (Stuttgart)

SU1570@stw.de | www.sfl-gmbh.de

Measuring root cause for bearing wear

Steinbeis team develops measurement technique for the tribological characterization of reaction layers

What are the physical connections between tribological contacts and what impacts do they have on abrasion and wear? What improvements can be derived from knowing this and what can be done to solve specific problems such as the right materials to select? These are the kind of questions occupying the Steinbeis Transfer Center for Tribology Application and Practice at the Baden-Württemberg Cooperative State University in Karlsruhe. The center offers a variety of services relating to wear testing, damage analysis and surface measurement, as well as seminars on these topics. The results of their analysis provide a basis for working out physical chains of effects and these, in turn, provide a basis for possible improvements. Such aspects are reflected in the emphasis of work at the Tribology Steinbeis Transfer Center. One recent project allowed the center to provide its customers with a measurement technique for use with the extensive, non-destructive tribological characterization of tribochemical reaction layers.

The experts at the Steinbeis Center investigated the friction of a rolling contact made out of two cylindrical steel rollers with a hardness of 670 HV (HV is the Vickers Pyramid Number). One roll in the contraform contact setup is as a drive input roll, the other was a drive output roll. The function of the setup was to transfer torque or power. A relative movement of the two cylinder steel rolls leads directly result in wear (through slippage), for avoiding that the friction coefficient during the entire period of operation had to be sufficiently high. Another requirement relating to the friction coefficient is that it remain uniform along the whole length of the cylinder roll. This is because inconsistencies would result in an off-center point of load and leads to a torque to torque around the upper axle with subsequent losses of the function. According to the experts' observations, the structural density of the reaction layer was an important factor, since the friction coefficient was inversely proportional to it.

The tribochemical layers are produced by oxidation processes and are composed of various iron oxides and iron hydroxides. Exposed to light, they look like discoloration, mainly in different shades of brown. The formation of various oxides and hydroxides depends on the availability of oxygen and on the temperature. The layers have different physical properties relating to factors such as hardness (structural density), and these properties can cause topical differences in friction coefficients. Analytical methods used until now such as micro-hardness measurements, focus ion beam (FIB) cutting, and secondary neutral mass spectrometry (SNMS) are not suitable for entire rollers when characterizing the tribological effect of reaction layers without destruction it.

To determine a quantified value for the structural density – an important factor when it comes to friction coefficients – the team of Steinbeis experts found the photothermy because it allows for measurements without damage materials. This method uses a modulated, fiber-coupled diode laser which is expanded and directed on the surface of the sample. To measure rays of heat emitted from the surface (thermal waves), an infrared detector is used. The propagation of the thermal waves inside the material depends on the thermal properties of the material and can be characterized by the thermal diffusivity. This is inversely proportional to the product of the material density ρ and the specific heat capacity

c_p . In turn, this product is proportional to density. This indirect method makes it possible to work out differences in density based on different degrees of hardness, slippage/shifting, inconsistencies, load, or layering errors. The measurements that can be used are the amplitude and phases difference between the laser and the thermal waves that were measured.

Prof. Dr.-Ing. Dietmar Schorr, director of the Steinbeis Transfer Center for Tribology Application and Practice and his team have for the first time succeeded in characterizing tribochemical reaction layers over large areas, with a non-destructively method. This was achieved by using photothermy, taking photothermic measurements of three used rollers and three new ones. By taking measurements along the length of the rollers at specific laser penetration depths, the measurements allowed the team to identify significant differences between new parts and parts that had already been used. Furthermore, it was possible to take quantifiable measurements of different reaction layers, which correlates with the discolorations over the length of the roller. These colors could only be used as an indication for the tribochemical layers, however, and they said nothing about the complex structures nor the thickness of reaction layers, which as a rule was between 100 and 300 nm.

The Steinbeis analysis was therefore able to provide clients with a method that can be used to test the impact of influencing factors on reaction layers, and thus friction coefficients, substantiated by quantifiable measurements. This makes it possible to make specific improvements in product performance and reduce downtimes.

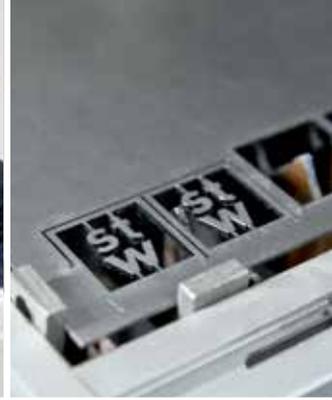
Image: © fotolia.de/ironear



Prof. Dr.-Ing. Dietmar Schorr

Steinbeis Transfer Center Tribology Application and Practice (Karlsruhe)

dietmar.schorr@stw.de | www.tribologieinwendungundpraxis.de



Science and Business Under One Roof

Opening of the Steinbeis House Karlsruhe

Technology transfer – bringing science and companies together to work in partnership on translating application-based research into marketable products. The fact that this concept works was demonstrated impressively by the Steinbeis Transfer Day in Karlsruhe in June, an occasion on which the new Steinbeis House was opened on the campus of Karlsruhe University of Applied Sciences. The building is considered a model project for the whole of the state, pooling the combined power of partners in knowledge and technology transfer under a single roof, and thus playing an essential role on the road from research to industrial application. The building has a floor area of roughly 5,500 sq m (59,000 sq ft) – plenty of room for university scientists, Steinbeis experts, and small and medium-sized enterprises (SMEs).

Karlsruhe University of Applied Sciences and Steinbeis have been working together successfully on knowledge and technology transfer for years. Further to the foundation of the jointly run company Steinbeis Transferzentren GmbH at Karlsruhe University of Applied Sciences in 2008, the construction of the Steinbeis House is an additional important milestone. Marking the opening of the house, Theresia Bauer, the Minister for Science, Research and the Arts in Baden-Württemberg, said: "For science to make a successful contribution and solve the problems we face, it has to be translated into applications. But the road from theory to practice is everything but simple. My wish would be that the Steinbeis House becomes a place where it's possible to actually see what it's like when research and application come together with an equal standing." As well as welcoming Theresia Bauer, Steinbeis and the university also enjoyed the presence of Klaus Stapf, the mayor and representative of Karlsruhe, as well as a variety of guests from universities throughout the state and key figures from industry and politics.

The opening day revolved around knowledge transfer from a broad variety of angles. After the official opening, the many guests in attendance were free to explore and look behind the scenes. "Market success and competitiveness need daring and entrepreneurship, smart, capable people, and effective and efficient transfer. Steinbeis and Karlsruhe University have been advocating this together since the early days of the Steinbeis Foundation, which is why we're all the more delighted that we can keep investing in this partnership together through the Steinbeis House," stated Prof. Dr. Michael Auer, Board Chairman of the Steinbeis Network.

Facts and figures: Steinbeis House Karlsruhe

- Transfer center and a basis for innovation for scientists at Karlsruhe University of Applied Sciences, for Steinbeis as well as SMEs
- Catering, machine hall, event room on the ground floor
- 5 floors
- Floor area: approx. 5,500 sq m
- Constructed in 18 months
- Building owner: Steinbeis

The five-story building contains rooms for scientists and SMEs to work in, as well as labs, a seminar room, catering facilities, and the entire Institute of Materials and Processes (IMP), which is one of two central research institutes at Karlsruhe University. The ground floor of the building includes production facilities with state-of-the-art machinery covering all kinds of common manufacturing techniques. The visitors were given the opportunity to watch the machines in action in an impressive display put on by the IMP experts, who also offered tours and speeches to bring the technology to life. Seminars on different processing techniques were also held. During the day, Prof. Dr. Karl-Heinz Meisel, rector of Karlsruhe University, highlighted how, "Karlsruhe University is now one of the strongest universities in Baden-Württemberg in applied research and technology transfer – which, according to state university statutes, are two of the central tasks of universities of applied sciences. We can already look back on years of successful partnership with Steinbeis, especially in the field of technology transfer. We're delighted that this now goes beyond close collaboration on an organizational level and is now also in spatial terms."



Steinbeis Transferzentren GmbH, Karlsruhe University of Applied Sciences

Steinbeis has been operating in Karlsruhe since the early days of the Steinbeis Foundation in the late 1960s and enjoys a long and successful partnership with Karlsruhe University of Applied Sciences. This alliance resulted in a collaborative enterprise called Steinbeis Transferzentren GmbH, which was founded in 2008 at Karlsruhe University of Applied Sciences, thus fostering even closer collaboration on know-how and technology transfer. There are around 30 Steinbeis Enterprises at the university offering customized solutions primarily to SMEs. Steinbeis also helps professors, students, and university staff to transfer their specialist knowledge into business applications in keeping with their scientific interests. This is of equal benefit to the university and commerce: Business relevance ensures teaching and training is topical, while scientific progress at the university directly fuels the competitive advantage of companies.

The doors were also opened to the laboratories of the Faculty of Management Science and other departments of the university that have now moved into two stories of the building. Other tenants who opened their doors were cellent AG and Harms & Wende GmbH & Co. KG. In the afternoon, two concepts were brought together: transfer and studying. Steinbeis invited students at the university and their relatives to interactive workshops on developing innovative business models. There was also an innovation and brainstorming workshop to toy with business setup ideas, exploring how to use "design thinking" methods in a creative and interdisciplinary way in the quest for innovation.

Working together can also be followed by celebrating together, so after a day packed with plenty of variety, Steinbeis invited students, staff at Karlsruhe University, and tenants of the building to a barbecue. Judging by the numbers and the time spent sitting together, it became quite clear that knowledge-sharing and transfer also works well when you're celebrating!

The machine hall at Karlsruhe University of Applied Sciences

The Institute of Materials and Processes (IMP) at Karlsruhe University of Applied Sciences gives students and student assistants a chance to gain important practical experience in applied research (in parallel to study programs), mainly through experimentation in the labs and project work. The new IMP machine hall is used by the Steinbeis House Karlsruhe to provide plenty of room (503 m2) for all kinds of machines, and there is also a measurement, welding, and storage room, plus an electronics and mechanical workshop. There are also open-plan offices and places for students to work. By moving to the building, the IMP is ensuring that there is a fast-moving production and technology environment that will benefit students, research, and external partners.

Production methods offered in the IMP machine hall

- CNC milling/turning
- Wire, sink, and drill eroding
- Micro-water jet cutting, laser jet cutting
- Ultrasonic machining



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



Pencil, Paper, Programming

Steinbeis experts for app development

To develop software and ensure it's extremely user-friendly, it often makes sense to use prototypes early in the development process. Especially at the beginning, simple paper prototypes are excellent for demonstrating the underlying interaction concept and getting signoffs from others. This was also confirmed by a recent collaboration between the Steinbeis Transfer Center for Usability and Innovative Interactive Systems for Information Logistics and the Aachen-based company Utilitas GmbH.

Vacations can cause a lot of work, as Prof. Dr.-Ing. Thomas Ritz, director of the Aachen Steinbeis Center, knows from a collaborative project with Peter Haupt, managing director of Utilitas. Together they worked on the development of a smartphone app for managing annual leave. The software developers at Utilitas provided the technical know-how while the Steinbeis experts were responsible for usability engineering. "For the use of a mobile app, there are no training courses!" – and according to Peter Haupt, this was the precise motivation for the collaboration with the Aachen-based Steinbeis experts, who attach great importance to user-based development and employ different usability engineering methods for mobile software development.

Developing mobile apps means taking a large number of special requirements into consideration, especially the usage environment of users on the move, but also the style guides of different operating systems, since users are accustomed to their operating principles. When it came to the development of the vacation management app, another requirement was to maintain consistency between a desktop application, which already existed, and each mobile operating system. The interaction concept actually covered three systems:

iOS, Android, and WindowsPhone. Thanks to an intuitive interaction concept for all three platforms, which followed official style guides and also considered the interaction patterns of the previously developed desktop version of the app, the basis for a high usability and for the recognition of the original app was provided.

The functionalities of the existing web app for desktop use were reduced for the mobile version due to the different context of use. Using the desktop app while sitting at their workplace, users have access to a variety of functions such as detailed vacation planning and administration – for entire departments, from the perspective of the bosses and the HR department. The mobile app provides a reduced set of functions since people are "out and about." It merely allows them to quickly submit vacation or have it approved. To agree on the structure and interaction patterns of the mobile app, the Steinbeis experts started with simple paper prototypes, making it possible to quickly scribble down functions and overall screen flows. This way the basic concept could be modified without huge effort and approved quickly.



For the developers at Utilitas and the interaction designers at the Steinbeis Transfer Center for Usability and Innovative Interactive Systems for Information Logistics, initial technical requirements and design guidelines were determined by then. The next step was for the Steinbeis interface designers to create high fidelity designed screens for the most important parts of the app, such as the list overview of vacation requests and the different forms to submit and approve holidays. For the programmers at Utilitas, the screens designed in photoshop served as a template for the implementation. In general, whenever initial prototypes of an actual software need to be created, software tools for interactive prototypes are a good choice. Especially for apps mit more complex functionalities these tools can be recommended to create easy interactive prototypes and to increase the degree of complexity step by step. When developing user-centered software, the top priority is iterative usability testing. To do this, the Steinbeis Transfer Center performs usability tests with target persons and prototypes of different development stages. This approach makes it possible to optimize prototypes over several iterations, ideally until they hit a high level of usability. Each iteration can be assessed using previously defined benchmarks, such as the maximum time or the number of clicks a test person needs to perform a predefined task.

By integrating usability engineering into the entire development process – starting with the analysis of requirements and finishing with the implemented software – it is possible to develop highly user-friendly systems.

To implement the vacation management app, Utilitas decided on a cross-platform development with Xamarin. Compared to native applications, the advantage of cross-platform development is that apps do not have to be developed from scratch for each separate operating system. In the case of the vacation management app, all three versions (Android, iOS, WindowsPhone) are based on the same underlying template, adding special features for specific platforms. Cross-platform development is not always the best choice, but for apps destined to be used on several platforms it is often the cheapest option. By contrast, the advantage of native development is that most of the required components are available in a software developer kit (SDK) and there are no barriers to access hardware functions of the device. Multi-platform apps can be distributed through conventional app stores. The vacation management app will be available in the app stores of Google, iOS and WindowsPhone and the desktop version is already available as a web app through Utilitas.

Collaborative projects between the experts at Steinbeis and a medium-sized company like Utilitas show how valuable knowledge transfer can be, especially in the way it is offered by Steinbeis Enterprises – in different areas of expertise, directly from science to industry. To support SMEs, the Steinbeis Transfer Center for Usability and Innovative Interactive Systems for Information Logistics offers business-related training to service providers in the field of software development. The aim is to integrate methodological elements of usability engineering in their development processes in order to enhance their competitiveness, even versus large players. These methodological elements are part of a toolkit model developed by the Steinbeis Transfer Center for SMEs and they resulted from a research project called KompUEterchen4KMU funded by the Federal Ministry for Economic Affairs and Energy.

If you are interested in prototyping tools and their suitability for the development of mobile software, the book „Prototyping Tools for mobile Applications“ provides valuable information on important requirements of mobile app development as well as an evaluation of common prototyping tools.



Prototyping Tools for mobile Applications
(Sandra Bochmann, Thomas Ritz)
Steinbeis-Edition, 2013
ISBN 978-3-943356-45-8

Prof. Dr.-Ing. Thomas Ritz, Kirsten Siekmann



Steinbeis Transfer Center for Usability and Innovative Interactive Systems
for Information Logistics (Aachen)
thomas.ritz@stw.de, kirsten.siekmann@stw.de | www.stz-uis.de

Peter Haupt
Utilitas GmbH (Aachen)
peter.haupt@utilitas.net | www.utilitas.net

The Venture Development Model: Holistic Implementation of Innovation Projects

Filling the gap between business ideas, business models, and business plans

As part of a startup voucher project sponsored by the State of Baden-Württemberg and the European Social Fund, an enterprise in the Steinbeis Network called bwcon is helping businesses develop and implement innovation concepts. When developing a new business, there is often a conceptual gap between two central management models: the business plan and business model. The venture development model used by bwcon provides a holistic template to pull the two concepts together.

Management innovations explain many of the major variations witnessed in the ability of companies to innovate properly (Volberda, Van Den Bosch and Heij, 2013). The diffusion of concepts like ABC analysis, balanced scorecard and service engineering were disseminated over certain networks in the "management" innovation system, spreading out like waves (Ax and Björnenak, 2005; Free and Qu, 2011). Most concepts are a mixture of variation, selection and replication, resulting in the perception that management innovation develops over time (O'Mahoney, 2007). It is a similar story with the concepts of business planning and business models.

Because there is no general or official definition of the term "business model," startup teams without detailed management training are often confronted by conceptual constraints when it comes to their subsequent business planning. This conceptual gap is a particular problem when different innovation intermediaries (such as coaches or mentors, but also other team members from different areas) try to provide support. If the parties involved cannot create a common framework, the different conceptual approaches result in discussion on a purely conceptual level when doubts arise, rather than getting down to the specific content (Doganova and Eyquem-Renault, 2009; Teece, 2010).

Current literature only partially explains the differences between concepts and any overlaps that may exist. The concepts of business planning and business models already have certain overlaps in the manage-

ment literature, simply because they both contain the word "business," although this overlap is still highly skewed.

To support the new business developments of entrepreneurial teams (ventures) and make this support as holistic as possible, bwcon uses the venture development model (VDM). It was developed after analyzing relevant business planning concepts and the most common business models. It also took into consideration experience from over 50 man-years of management coaching, experience arranging over 280 million euros of venture capital, and experience supporting teams of entrepreneurs with the development of over 900 business plans. The theoretical foundations for the model were laid by Marc König (bwcon) in a variety of scientific publications. These revolve around a concept of entrepreneurship already developed in 1800 by the French economist Jean-Baptiste Say (Carpenter, 2011). The VDM recommends a three-phase process, starting with the business idea, followed by the business model and then finishing with the business plan to ensure that the venture is based on a coherent concept. This allows entrepreneurial teams to base discussion of their venture on a holistic interpretation of business and keep developing it. The venture development model shows that an entrepreneurial team can pull together available resources from low levels of production in a way such that, from the customer's point of view, the new combination of services answers a specific need significantly better than the alternatives provided by the competition.

Driven by the vision of the team of entrepreneurs, a business idea is derived to describe a product or service that answers a specific need of the potential client. This may be – but doesn't yet have to be – known by the client. If there is an exact definition of customers and their needs have been determined, it is possible to estimate the potential turnover, the possible market share and the general market. If the subjective opinion of the customer is that combination of product and need is addressed better than alternatives already available on the market, it is felt that this is an innovative business idea. The business idea is thus also central to any description of a business.

The business concept outlines in simple terms how the company functions. Differentiation from the competition and derivation of a USP provide a starting point for defining the unique benefits the company delivers versus the competition from the subjective view of customers. The next step is to determine which management team is going to share this promise to deliver in the market. This then dictates the market entry or marketing strategy in the next step and how the product should be positioned and launched for the target market. One of the things this involves is the definition of the marketing mix based on price, place, promotion, people, physical evidence and process, which all help make the product marketable. Afterwards, the business organization is defined. This includes all arrangements for conducting ongoing activities efficiently. A distinction is made at this point between procedures (business processes and procedures) and the organizational structure (business divisions, offices, departments, etc.).

Planning sets the activity of translating the model into a reality within a timeframe. This timeframe is typically an evolutionary part of the business model. It is never static, instead it moves step by step and develops over time. The implementation plan defines what the previous output of the company was and the milestones that should be reached in the future. These milestones make it possible to derive production plans from the turnover plan and then use these for procurement plans. This step-by-step planning is based on the value chain, providing a basis for financial planning. Afterwards, it is possible to plan the profit and loss, plan balance sheets and plan cash flows. Cumulative liquidity calculations are primarily just the most important key performance indicators during the early phases, but they do show when the company will need financial support from third parties, and in what form this might be. The model is rounded off by an analysis of the opportunities and threats of the venture. It is especially important to assess threats at this point, as previous work already involved going through opportunities in detail.

The venture development model provides a conceptual foundation for the bwcon venture development system. It comprises a venture development toolkit, a methods toolkit to go with the venture development model, venture development coaching from the bwcon Management Coaching Group and a kind of planning networking tool called the venture development platform. To monitor progress of ventures in the venture development system, supporting research is being carried out, headed up by Prof.-Dr. Ing. Guido Baltes, the director of the Institute for Strategic Innovation and Technology Management (IST) at Constance University of Applied Sciences, with the support of the well-known Kauffmann Foundation. Use of the concept is also being tested within

companies as part of an "excubation" project backed by the State of Baden-Württemberg and the system is being used with entrepreneurs as part of a startup voucher project backed by the State of Baden-Württemberg and the European Social Fund (ESF).

bwcon offers regular introductions to venture development. The introduction and an initial evaluation of the venture is free for anyone planning a full-time self-employed activity in Baden-Württemberg in the hi-tech industry. For other applicants, the introduction costs €200 plus sales tax (as applicable). For more information go to www.bwcon.de/6427.html?EtL=5

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Marc König, Martin Cremer
bwcon GmbH (Stuttgart)
koenig@bwcon.de | www.bwcon.de

Manager Personality and its Role as a Success Factor

Steinbeis analyzes the skills of managers

According to a 2014 Startup Guide issued by KfW, 868,000 entrepreneurs took the plunge in 2013 and embarked on a new career by becoming self-employed. There are many ways for business startups to find support. In fact, at times, the choice is bewildering. Just a glance at the long list of conventional options when it comes to receiving advice shows that the typical focal point of consultation is the underlying concept of the setup – the business plan. A business founder usually just comes along with their special skills. The Steinbeis Consulting Center for Strategic Skills Management has decided to do something about this. It offers pre-startup advice to analyze the more general skills (generic competences) of entrepreneurs drawing on the scientific methods of KODE®, the special instrument for assessing and developing skills.

It goes without saying that a startup needs a meaningful and viable concept. The concept is essential for finding funding and winning over business partners for the new venture. But what happens when the finances have been secured and the business owner has to start in their new role as a manager? Especially “one-man-band” startups often find it difficult to gain an overview of all the different areas involved in business and proactively move things forward. Entrepreneurs have to meet a variety of new challenges, that do not always match individuals' technical competence. It is relatively simple to work out the areas of deficit, but it is much more difficult to assess the demands place on entrepreneurs in terms of generic competences.

The reason why it is essential to understand generic competences was underscored by a study conducted by FOCUS-MONEY, which ascertained

that only 50% of vocational success is attributable to specialist skills and the other 50% lies in an individual's skills of a more general nature (FOCUS-MONEY online, Jan 26, 2007). The generic skills of business founders only play a secondary role in conventional advice on business startups – if at all. Yet it is precisely in the run-up to starting a new business that the skills and background of the founder are so important. If entrepreneurs are clear about their generic skills (and thus their strengths), they will be able to precisely define their own areas of core competence in the new company. This will result in a business concept like a made-to-measure garment, based on a dress-making pattern consisting of the individual specialist and generic skills of the founder. The entrepreneur can then consciously decide on the areas where he would like to expand his skills. Alternatively to address the necessary skills, he may decide to bring in third-party support, hire staff, or both.

The Business Start-up Steinbeis Consulting Center uses the KODE® diagnostic instrument to analyze the generic competences of business founders. A biographical evaluation provides entrepreneurs with a detailed overview of current skills. They also discover how they acquired these skills in the past. Entrepreneurs can then create a personal development plan by comparing findings with future requirements, thus equipping the business founder with the skills to prepare for their future as a startup manager. Bringing in third-party competence and receiving early advice on business competence makes it possible to make quick decisions and not wait until there are clear deficits because the business is failing.



Markus Riehl

Steinbeis Consulting Center Strategic Skills Management (Stuttgart)

su1667@stw.de | www.steinbeis.de/su/1667

Sustainable Business: More than Sorting the Wheat from the Chaff

Steinbeis provides training on sustainability coaching

To introduce sustainability management professionally and keep processes moving forward – in a circular process based on the PD-CA cycle – a company needs a highly skilled “carer.” This is a person who aside from technical skills, has a strong personality and particularly strong soft skills. To help in this area, the comet coaching – mentoring – training Steinbeis Consulting Center offers training for employees to become sustainability coaches.

Sustainable business has become more and more important to avoid or mitigate mishaps of a commercial, social, or environmental nature. Sustainability is considered by some to be the recipe of success for a global economy, focusing processes and human resources on targets aimed at safeguarding natural resources. Many companies and communities have already recognized this opportunity and assumed responsibility themselves by developing a sustainability strategy complete with sustainability guidelines, by introducing specific measures within the organization, and by signing off sustainability programs. One person to turn to for support with this is a sustainability coach.

The aim of training provided by the experts at the Heilbronn-based Steinbeis Consulting Center is to develop coaches with the personal ability to convince managers and workers at a company of the value of sustainable business, so they act accordingly. Sustainability coaches observe the behavior of workers without being controlling and become people to turn to with issues related to sustainability. They train and coach colleagues and managers on all issues relating to sustainability at the business. Sustainability coaches receive special training on coaching to acquire the learning, teaching, and communication skills of a coach. They also initiate and lead sustainability project – thus they play an important role in value creation within the organization.



Dr. Erik Müller-Schoppen

Steinbeis Consulting Center comet coaching – mentoring – training (Heilbronn)

su1910@stw.de | www.steinbeis.de/su/1910

Consulting and Coaching for Sustainable Energy Saving

Steinbeis assists with an energy-efficient construction plan

Injection-molded plastic parts are the core business of KU-TEC GmbH in Laichingen. Founded in 2004, the company is owned by Ulrich Schmid, who is permanently looking for new possibilities to keep enhancing his business. The qualified electrician trusted the advice given by the Steinbeis Consulting Center 4IES, during the planning phase of a new energy-efficient production hall with an attached office building.

The planning phase began in the autumn of 2012. Working together with local architects and heating specialists, Ulrich Schmid designed a new production hall with the objective of optimizing operating procedures. During a short consultation with a Steinbeis expert, Schmid took advantage of discussing and analyzing the extremely high energy costs at the time. The results of the analysis motivated him to adapt his plans, this time focusing more on aspects of energy efficiency. In an initial consultation, sponsored through a development program offered by the KfW Bank, the Steinbeis Consulting Center 4IES took stock of all energy consumers to then determine and point out potential energy savings. Heinz Pöhler, director of the Steinbeis Consulting Center 4IES, developed and implemented a sustainable energy supply concept together with heating and refrigeration engineers and electricians.

The installed solar panels supply the needed energy for cooling purposes in the production plant, especially during summer. The originally planned heating system was no longer required. Instead, waste heat from production is now stored in energy storage units. The underfloor heating and a newly installed hybrid cooling tower also regulate the necessary heat and



© KU-TEC GmbH

cooling requirements. The existing and energy-intensive compression refrigeration system will now only be used on really hot summer days. An energy management system monitors and optimizes energy consumption in production and secondary systems.

The new measures will allow KU-TEC to reduce energy costs by roughly 34%. Herewith the company also made an important contribution to safeguarding jobs in a rural area.



Heinz Pöhler
Steinbeis Consulting Center 4IES (Laichingen)
su1624@stw.de | www.steinbeis.de/su/1624

Welcome to the Steinbeis Network

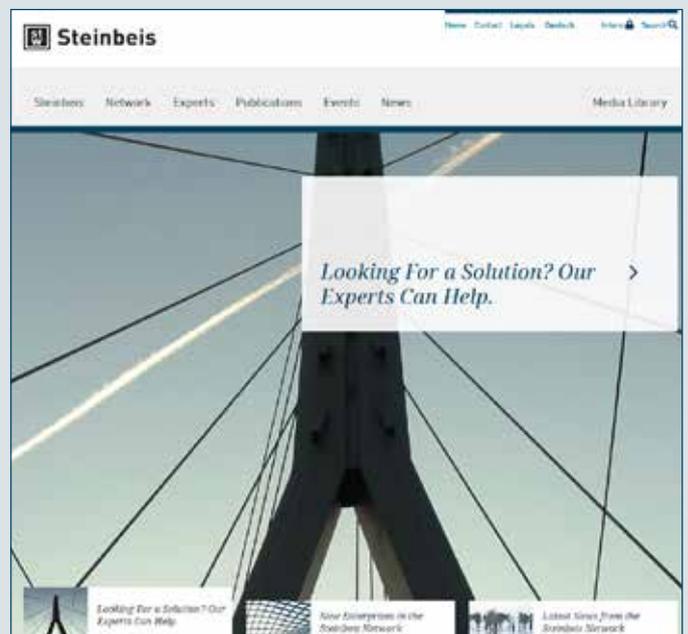
Steinbeis know-how: There are currently more than 6,000 experts actively involved in knowledge and technology transfer at around 1,000 Steinbeis Enterprises. The portfolio of services offered by the Steinbeis Network ranges from research and development to consulting, expert reports, training, and continuing professional development for all fields of technology and management. And this network continues to expand. For an overview of the most recently founded centers go to www.steinbeis.de/en/news. Welcome to the Steinbeis Network!

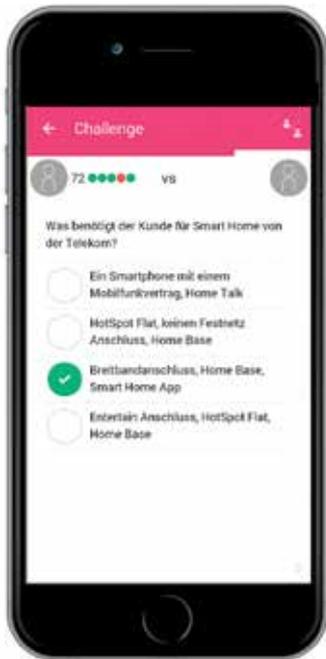


Information on recently founded enterprises in the Network on www.steinbeis.de



More on recently founded enterprises in the Network on www.facebook.de/Steinbeisverbund





Sales Quiz App: A Novel Way to Train Employees

Modern teaching methods using a quiz app

Most companies train workers in the classroom or through e-learning. Classroom instruction is a good way to get close to participants but it's relatively costly and time-consuming. Online training is less expensive and can be used with larger groups of people with less time investment. But it does not always go down well with staff as they are often expected to complete a large number of online modules. To add variety to staff training, Cora Schaal developed a sales quiz app for her company sponsor, Telekom Shop Vertriebsgesellschaft mbH (Sales Company / Deutsche Telekom). The project was part of her master's degree at the School of International Business and Entrepreneurship (SIBE) at Steinbeis University Berlin.

According to a 2013 study called Initiative D21, 33% of German workers access their employer's IT systems when away from the business. Despite this, only 17% of major companies use mobile teaching methods as part of their company training programs. This gap has now been filled by Cora Schaal at the sales company Telekom Shop. Schaal works in the company's HR Development department and is currently studying at the Steinbeis School of International Business and Entrepreneurship at Steinbeis University Berlin. Her sales quiz app was developed as part of a degree project in collaboration with a new startup company from Berlin called qlarning. Schaal is responsible for planning, piloting, and implementing the app.

The app is an innovative way to check and consolidate people's knowledge, to share knowledge playfully, and to revise specific areas of training relating to the activities of the German sales department. Employees work in pairs to collect points on their smartphones by answering sales questions. This also bolsters their knowledge. The app can simply be downloaded from Google Play, App Store, and Amazon Store, but it requires user registration (closed group use) and a quick verification process.

The app gives company staff access to a variety of features on sales topics. It gives them the choice of starting a duel on a specific topic or accepting a challenge from another user. Alternatively, users can browse rankings of the best scores, view the top 20 scores by topic, and send a challenge to a colleague. Challenges consist of five questions, each of which has to be answered in 30 seconds. To enhance the learning experience, after each challenge players see their own scores and the scores of their opponent. They can also go back through the questions and answers and review explanations of the answers. If a new topic is made available through the app or a user receives a challenge, users are sent a push notification directly to their smartphone.

The sales quiz app was launched at the beginning of this year as part of a six-week proof of concept trial. Five hundred external sales partners were asked to use and test the app on their smartphones. The feedback was so positive – not just from managers but also from other people in sales – that it was decided to keep using the app for internal training. Following a couple of technical enhancements, a second proof of concept phase started in July, which involved 100 employees. The plan is to make the sales quiz app available to all sales people working at Telekom Shop and negotiations are already underway with the works council.

Thanks to the sales quiz app, it's now possible for staff to learn new facts whenever they feel like it and control the process. This modern angle on teaching is going down well with workers and managers alike. The sales quiz app works especially well as part of "blended learning" methods and can make a significant contribution to staff training initiatives by complementing classroom training sessions and internet-based instruction, ensuring content is remembered in the long term with fun reminder questions.

The sales quiz app won second place in this year's HR management awards organized by the Federal Association of German HR managers (BPM).



Patricia Mezger
Steinbeis School of International Business and Entrepreneurship
Steinbeis Universität Berlin (Berlin/Herrenberg)
su1249@stw.de | www.steinbeis-sibe.de

Cora Schaal
Telekom Shop Vertriebsgesellschaft mbH (Bonn)
cora.schaal@shb.stw.de



Focusing on Practical Application

Steinbeis advises Normal University in China

Steinbeis goes deeper into China: Prof. Dr.-Ing. Peter Eichinger and Prof. Dr.-Ing. Ulrich Schmitt, experts at the Steinbeis Transfer Center for Mechatronics at Aalen University of Applied Sciences, have been providing support and transfer advice of an international nature to Normal University in Tianshui, in the Chinese province of Gansu. The two experts received an invitation from Chinese colleagues to draw on their expertise and practical experience for recently redesigned degree programs in automation technology, automotive engineering, and mechatronics.

Tianshui lies in the northwest of China around 1100km (680 miles) south west of Beijing. Normal University has 17,000 students and a variety of faculties such as civil engineering, electrical engineering, education, and mechanical engineering. It is a wish of central government in Beijing that around half of university degrees currently offered should be restructured according to the model of German universities of applied sciences. The overall aim is to provide training matched to practical needs and business requirements by offering industry-based projects, modern teaching methods such as problem-based learning, degree modules based on the Bologna Process used in Europe, and a general overhaul of degree subjects.

It is in this area, and in forging networks in industry, that the Steinbeis experts from Aalen have a valuable contribution to make, thanks to decades of experience with industry. And it was this specific background that they were looking for in Tianshui, not only for the faculty of electromechanics and automobile engineering, but also for degree programs in automation technology, automotive engineering, and mechatronics. It was the university that approached the Steinbeis Transfer Center, inviting Peter Eichinger and Ulrich Schmitt to take a look at the Chinese laboratories and equipment, and discuss possible concepts for the future with professors and lecturers.

The two experienced experts from Aalen spent a week in Tianshui to take an objective look both at the situation in the faculty and the degree programs. The laboratory setups are completely different from equipment found in German universities because there is absolutely no contact to organizations in industry. In contrast to German practice, in China students go on a pre-study internship before attending university. The material testing, metallography, and sensor system laboratories are on a par with standards in the fundamentals laboratory in Aalen.

The students in China are given no tasks to work on as part of a project, something where they have to use their own initiative. Instead, they are usually given strictly defined experiments to carry out step by step. The professors from Aalen made it clear to their colleagues in China that there is an extremely limited amount to learn from such methods, recommending a distinction between fundamentals and in-depth learning. After basic training on certain techniques and methods, the students now work in small teams as part of in-depth modules, solving tasks related to modern topics. The professors watch and act as mentors or coaches. This approach to problem-based learning is used widely on the mechatronics degree program at Aalen University of Applied Sciences. Students gain a much better grasp of topics and find it easier to implement ideas in their subsequent work environment.

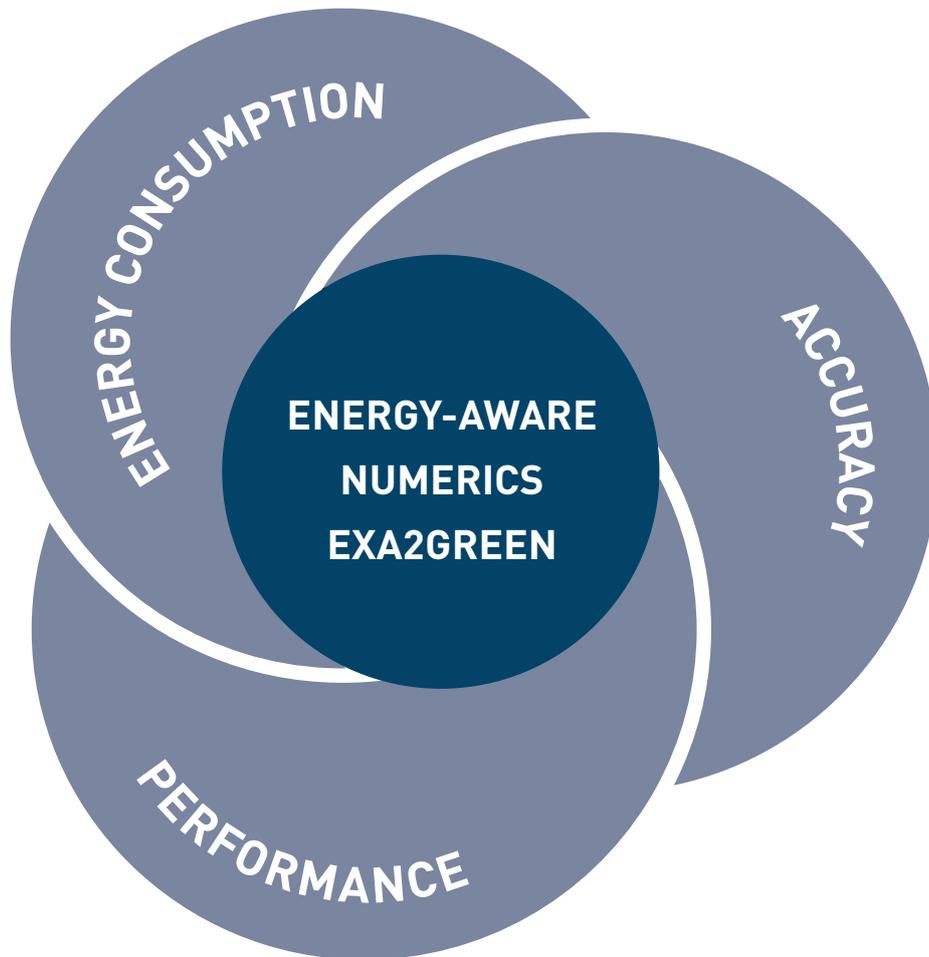
The recommendations made by the German professors also include setting up a new degree in mechatronics and automation technology in order to focus on future fields. Academic training should always establish a solid basis and training on the essential fundamentals plus method skills. Hot topics such as product lifecycle management (PLM), additive manufacturing (3D printing), and smart production (Industry 4.0) should be included in the curriculum as this will prepare graduates better for the future, give them up-to-the-minute training, and prepare for mastering future challenges. The Steinbeis experts from Aalen explained to their colleagues in China that modern and practice-based education is only possible with contacts in industry, applied research, and technology transfer, urging the professors in Tianshui to seek contact to local companies and get to know their problems and challenges. This fuels new ideas and impetus, also for teaching at the university.

Thinking about the trip, Peter Eichinger says, "The interest and the thirst for knowledge about the system at German universities and the technology transfer model advocated by Steinbeis was unbelievably strong here at Normal University Tianshui. We'll be interested to see how our Chinese colleagues take our recommendations forward and implement them." His conclusion: "This won't be our last visit to China."

Image: Prof. Dr.-Ing. Peter Eichinger talking to Chinese students



Prof. Dr.-Ing. Ulrich Schmitt
Steinbeis Transfer Center Mechatronics (Abtsgmünd)
su1055@stw.de | www.tz-mechatronik.de



Paving the road towards Exascale Computing

A project team works on improving the energy efficiency of supercomputers

Data simulation has an important role to play in many areas of science, in order to learn new things. But increasingly, sufficient supercomputer capacity is needed to lay the right foundations for scientific advancements. The next step up in computational power is exascale computing. It promises to enable simulations with incredible accuracy, providing detailed insights into many important processes. These supercomputers of the future will be able to carry out at least 10 trillion operations per second. But achieving such computational performance using conventional technology is only possible with extensive electricity consumption. As a result, not only is computer performance becoming a critical factor in supercomputers, so is energy efficiency. This is the starting point for an European project called Exa2Green, which is being implemented by Steinbeis-Europa-Zentrum (SEZ) in collaboration with other scientific partners.

Under the coordination of the computing center at Heidelberg University, a team of mathematicians, IT experts, physicists, and engineers is looking at the challenge of improving the energy efficiency of supercomputers. The aim of the project is to develop energy-saving computation methods and corresponding technologies. The main areas of emphasis in research are: the development of tools for monitoring energy consumption and creating profiles; the development of a new measurement technique for use in the quantitative analysis of the energy profiles of algorithms; the application of energy-aware, elementary system kernels; the development of program libraries for energy-efficient linear algebra; the implementation of an energy-aware simulation plan for supercomputers.

The project is just about to draw to a close after almost three years and the team of researchers has much to show for its efforts. Over the

course of the Exa2Green project, a new kind of measurement device was developed which makes it possible to measure the energy consumption of individual components inside computers. Previously it was almost impossible to assess the power consumption of parts like processors, memory, hard drives, or graphic cards. The new measuring device is compact enough to fit inside the housing of a computer yet still delivers accurate results. This will help scientists and technical experts to localize inefficient energy consumption and optimize application codes. The team also developed a model for mapping and predicting the time, power, and energy requirements of several elementary computer kernels, also examining the energy consumption and performance of a weather forecasting model called COSMO-ART on a variety of supercomputers. The knowledge the experts acquired as a team on the development of energy-aware applications was then used to apply corresponding algorithms. The team developed techniques for measuring and minimizing

the energy consumption of individual computers as well as major computer centers. It also investigated a platform that measures electricity performance to understand energy use of the COSMO-ART modeling system in an attempt to use a more energy-aware procedure.

Prof. Dr. Vincent Heuveline, coordinator of the Exa2Green project at Heidelberg University, emphasizes how important collaboration has been for the success of the project until now: "Our interdisciplinary project consortium comprises partners from the fields of High Performance Computing, computer science, mathematics, physics, and mechanical engineering. By each contributing their specific skills, these partners are making it possible to tackle key research topics." The project team is confident that their work is making a valuable contribution to improvements in the machines of today and the realization of energy-efficient exascale computing in the future. "Besides the obvious intrinsic value of new, energy-aware algorithms, which make it possible to solve the same problems only with lower levels of energy consumption, this work is also extremely important when it comes to a new, holistic prospect of creating energy-aware computer systems. Our prime goal is not just to be able to make better use of existing machines but also to develop hardware and algorithms of the next generation and point this in the right direction to spawn the exascale supercomputers of the future," continues Heuveline.

SEZ assisted Heuveline during the project bidding process and the contract negotiation with the European Commission. As project partner, SEZ is also responsible for the project and knowledge management partner and looks after issues relating to intellectual property rights and training within the consortium. It also helps with the dissemination of project results.

The Exa2Green project is part of "Proactive Initiative: Minimising Energy Consumption of Computing to the Limit." It is co-funded under the 7th Research Framework Programme of the European Union.

A number of partners are involved in the project, from Germany, Switzerland, and Spain, including Karlsruhe Institute of Technology, the ETH in Zurich, Universität Hamburg, Jaume I University Castellón and IBM Research Zurich.



Prof. Dr.-Ing. Dr. h.c. Norbert Höptner, Dr. Sandrine Doretto, Lena Ohlig
Steinbeis-Europa-Zentrum (Stuttgart)
sandrine.doretto@stw.de, lena.ohlig@stw.de | www.steinbeis-europa.de,
www.exa2green-project.eu

Seeing the Light with Photonics4All

Steinbeis coordinates EU project promoting optical technologies

The Steinbeis-Europa-Zentrum (SEZ) has initiated a new project called Photonics4All to introduce more people – especially children, adolescents, startups, and SMEs – to the field of photonics. The project brings together ten partners from nine European countries, who will share 1 million of funding from the EU to help develop innovative communication instruments.

The SEZ is using the Photonics4All project to organize a variety of events to mark the International Year of Light and underscore the potential offered by optical technologies. So far, this has involved the first Photonics Science Slam in the early summer, which was attended by around 100 youngsters at the Baden-Württemberg Stiftung, a foundation based in Stuttgart. The national science slam event was organized by OptecNet Germany, one of its members Photonics BW and Baden-Württemberg Stiftung. Carsten Reichert, who is studying toward a master's at Stuttgart University, won the first prize for his presentation on an optical technology that can be used to convert a mobile handset into a "microscope to go."

Children and adolescents in the state of Baden-Württemberg could also use their summer vacation to explore the technology behind light at a special Children University at the Karlsruhe Institute of Technology. The SEZ ran six events in August 2015, in which the Photonics Explorer kit from the company Eyst was used, allowing roughly 30 students at a time to conduct experiments in small groups.

In September, also a photonics "boot camp" for entrepreneurs and startups took place at the Vienna University of Economics and Business. Students, doctoral candidates, and startups at the boot camps discovered more about starting a business. The boot camps also allowed participants to network and exchange notes on innovative business models. This was made easier by the interactive nature of the event and team exercises. The boot camp was organized by Photonics Austria.

Aside from the SEZ, which is coordinating the project, other German partners include OptecNet Germany and one of its members, Photonics BW. There are also other photonics experts involved from France, the UK, Italy, the Netherlands, Austria, Sweden, Slovakia, and Spain. The project has received EU funding since January 2015 and was launched to coincide with the International Year of Light.



Nadja Just
Steinbeis-Europa-Zentrum (Stuttgart/Karlsruhe)
nadja.just@stw.de | www.steinbeis-europa.de | www.photonics4all.eu



Pinpointing the right location

Steinbeis experts help company find the right business location

It is often difficult to strike the right balance between the need for fast-moving companies to innovate and the requirements laid down by local politicians, who – some managers may tell you – fail to look at the long-term perspective and are clearly inflexible, thwarting companies' efforts to exploit their full potential to innovate. It doesn't have to be that way, as demonstrated by a successful project at Infothek, the Steinbeis Transfer Center in Villingen-Schwenningen. Wolfgang Müller and his team have been working for several months with MCAT GmbH on a relocation from Constance to Donaueschingen.

MCAT had been looking for a suitable location for a long time, as part of the life sciences, polymer and organic chemistry firm's drive to build momentum and expand, something that was no longer possible at its premises in Constance. Following a strategic review, an area not far from Lake Constance became the focus of attention: a district in the eastern Black Forest called Schwarzwald-Baar. Not only does it offer an excellent transportation network, it lies in a favorably central location between the university cities of Freiburg, Constance and Stuttgart, in keeping with the visionary expectations of innovative companies. This will make it possible to forge ahead step by step with research into chemical specialties in new and improved laboratories. The company is also planning to fundamentally expand its services, among other things, by carrying out analytical measurements and experiments in its own analytics lab. These will be promoted heavily throughout the area, since MCAT not only uses standard analytical instruments such as a melting point apparatus and refractometers, but also HPLC devices. One particularly innovative system the firm offers, which is thus a mainstay of its technology base, is a 400 MHz nuclear magnetic resonance scanner. This can be used to determine the purity of a myriad of materials.

Another key motivation for resettling in Donaueschingen was the frequent contact with business partners and the desire to share research insights more directly. MCAT solutions are extremely important to the medical technology business cluster, which is highly focused and spans a large number of companies. One essential realization, not long after Steinbeis started working with MCAT, is best summed up by Wolfgang Müller: "Lots of key players will benefit in the long term from MCAT setting up its business next door in the Schwarzwald-Baar area." As talks progressed between Wolfgang Müller and MCAT's founder and managing director Dr. Markus Ringwald, they went through a variety of scenarios. "The Black Forest area is not just important for the future of our company, but it's also the ideal location for the families of our employees. This was one of the insights derived from the meetings with Steinbeis," adds Ringwald.

Going ahead with the move was made a lot easier for MCAT by a shift in thinking in state policy. In 2014, the state of Baden-Württemberg set up a funding project called Spitze auf dem Land! ("The Best in the Countryside"). Aimed at technology leaders in Baden-Württemberg, it was initiated by the Ministry of Rural Affairs and Consumer Protection to safeguard and improve the innovative power of rural areas. The regional state government provides small and medium-sized enterprises with financial support for the innovation programs in order to encourage firms to stay or settle in Baden-Württemberg.

Before any funding is awarded, the company applying for support has to provide suitable evidence, which was where the professional support of the Steinbeis experts came in with a business plan. This included a detailed analysis that clearly showed, "that this company had to come here ... [and] ... it would be a significant gain for the local infrastructure," underscores Müller. The experts from Villingen-Schwenningen spearheaded the application process and provided expert advice as required.

Looking to the future, an aspect reflected by the design of the business premises in Donaueschingen, everyone involved in the project agrees on one thing. "Sustainability, energy efficiency, and environmental production are our guiding principles," highlights Ringwald, confirming that his company was practically predestined to benefit from the recently introduced state funding program. The local atmosphere also played an essential role. From the outset, Ringwald felt like a welcome visitor to Donaueschingen. This positive perception is also confirmed by Josef Bea, who works for the local authority: "It was self-evident for all of the local administration departments that were involved that the company should be shown how to relocate in Donaueschingen so we could walk the path ahead together. It was particularly pleasing to see the results of our joint efforts and get funding from the 'Spitze auf dem Land' program; it was the icing on the cake."

Aside from their strategic interests of a commercial nature, Ringwald, Müller and representatives of the city of Donaueschingen also share common values relating to infrastructure priorities. "People and the economy are inseparable and they will remain that way," emphasizes Müller, also pointing to the entrepreneurial responsibility that Ringwald and his colleagues are happy to bear, for example with their plans to keep growing and thus create new jobs and provide a future for people living in the area. Local measures aimed at shaping the future are not just about existential issues, however. More and more thought goes into the work-life balance in strategic planning. As Bea highlights, it is the stated aim of the Donaueschingen authorities is to heighten such thinking: "By optimizing location factors, the town makes an important contribution in this respect. A major share of fees is invested every year in education, cultural events, sports, and leisure activities." Making rural areas more attractive is a key instrument for Donaueschingen in safeguarding the future.

Urban areas have an almost magnetic appeal for young people, but rural areas also have some major advantages to offer. Explaining the mechanics of the real estate market, Dr. Magnus Schmidt, a senior employee at MCAT, says, "In my family, we'd always wanted to have our own house but in Constance that would have remained wishful thinking. We're already enjoying the feeling of owning our own house in Donaueschingen. With the company also moving here now, this will be a huge improvement in our quality of life as I won't have to drive so far to work."

When companies settle in or relocate to an area, it is always a complex issue that depends on many factors, so a flexible outlook and openness make a big difference to innovation. To achieve objectives as planned, it is also necessary for knowledge to be pooled and for networks with lots of different people in them to pull together. This was demonstrated clearly by MCAT's move to Donaueschingen. Markus Ringwald's plans not only benefitted from the professional advice provided by Steinbeis, but also from change in state policy and the open attitude of the Donaueschingen authorities, which was very different in other communities. Summarizing the innovation process, Müller says, "It takes open dialog between everyone involved in a partnership of equals to reconcile all key aspects and define common areas." When different parties are willing to compromise, despite their differing interests, it takes careful negotiation. It's the only way to safeguard and shape the future – innovations in business also need innovation on an emotional level.

Image: © shutterstock.de/Olivier Le Moal



Wolfgang Müller
Steinbeis Transfer Center Infothek (Villingen-Schwenningen)
su0252@stw.de | www.steinbeis-infothek.de



Prof. Dr.-Ing. Nikolaus Kappen

Obituary

Steinbeis mourns the loss of Prof. Dr.-Ing. Nikolaus Kappen, who died on June 28 at the age of 70 following a serious illness. Nikolaus Kappen was a long-standing director of several enterprises in the Steinbeis Network.

Nikolaus Kappen's outstanding commitment and specialist knowledge was honored by Steinbeis in 2009 with the bestowal of the the Lohn Award, the Steinbeis Foundation's Transfer Award. In 1986, he became director of the Steinbeis Transfer Center for Computer Applications at Esslingen University of Applied Sciences, which was renamed STZ Rechnerinsatz GmbH in 2013. His role at both enterprises was to support extremely successful companies in the automotive industry, drawing on his expertise and many years of experience in the development of computer network concepts, as well as software and tool development.

Nikolaus Kappen studied electrical engineering at Stuttgart University before earning a doctorate at the Institute for Control Technology. He embarked on his career at AEG Telefunken in Frankfurt. Until 2011, Kappen was a professor in the faculty of Information Technology at Esslingen University of Applied Sciences, where he was the degree program director for computer engineering.

We are deeply moved by the loss of a dear colleague who was a close companion over many years. Nikolaus Kappen was profoundly reliable, modest, and held in high esteem by clients and colleagues alike. Our deepest sympathy goes to his family.

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

Hybrid Operations – the Future of Surgery

Steinbeis offers training as “Hybrid OP” technicians

Surgery is undergoing change. Fuelled by rapid developments in new materials and imaging techniques, there is an increasing shift toward a combination between interventional and open surgery techniques. Hybrid surgery is an ideal way to achieve this, both for technical reasons and in spatial terms. To make strategic investments work in the long term with respect to clinical and financial considerations, a decisive factor will be the training of specialist staff. The Steinbeis Transfer Institute for Medical Innovations and Management at Steinbeis University Berlin has developed an innovative method for training Hybrid OP Technicians (HOT).

Hybrid operations (Hybrid OPs) require a fully equipped operating room (OR) with the very latest imaging systems. With the right equipment, an excellent basis can be established for minimal invasive interventions. There are already around 200 such ORs in clinical use in Germany, with this number growing all the time. Despite the high initial outlay of up to €5 million, an increasing number of small and medium-sized hospitals are planning an investment. That said, in practice more and more surgeons are finding that expensive, state-of-the-art ORs are not always put to full use as sometimes there is a lack of specialists with the right training, or people are afraid of trying out the new technology.

This is why training is required before such situations arise. Specialists working in these types of ORs face a number of new challenges including special, complex routines, different equipment, and interdisciplinary procedures. The technology and clinical procedures also develop incredibly quickly making it necessary for specialists to receive regular training to keep them up to speed. The Steinbeis Transfer Institute for Medical Innovations and Management (MIM) is now working with the JR OP Academy to offer previously unique continuing professional development courses to become a Hybrid OP Technician (HOT). Their aim is to give medical staff training on the special demands placed by modern imaging-based treat-

Premium Accreditation for SHB Degree Programs

SIBE is awarded the coveted FIBAA certification

The Master of Arts in General Management and Master of Science in International Management programs offered by the School of International Business and Entrepreneurship (SIBE) at Steinbeis University Berlin have been awarded premium certification by the international accreditation agency FIBAA.

Following the successful re-accreditation of its degree programs, SIBE has been awarded premium certification by FIBAA for the quality of its degrees and instruction. This places SIBE in an exclusive circle of universities which have been bestowed premium certification by the FIBAA organization. Out of the more than 300 master's programs accredited by FIBAA, only 2% have been named premium programs. For students on the program, this means that their degree program not only fulfills quality requirements, it actual exceeds them – by a long shot!



A modern hybrid OR run by Kliniken Nordoberpfalz AG in Weiden

ment in the surgical environment. Training also covers the fundamentals of modern imaging and processes, as well as different ways to provide radiation protection and position patients in the right way. There is also scientific instruction on materials and instruments, providing the required basic understanding of a variety of different medical aspects relating to procedures. The aim is for course participants to understand the interplay between the radiology and cardiology specialists on the one hand, and surgery staff on the other.

The HOT training will start in April 2016 and is offered as a modular certification course. Each module is run with different university and hospital partners, including The Charité hospital in Berlin, the German Heart Institute Berlin (DHZB), Otto-von-Guericke University Magdeburg, Weiden hospital, and Ludwigsburg hospital. The program is also supported by leading medical technology firms such as Siemens Healthcare GmbH, Philips Health Tech and GE Healthcare. The emphasis of instruction lies in the practical aspects of Hybrid OPs, so training includes live operations. E-learning modules and webinars are also being offered to build on practical modules.



Prof. Dr. med. Oliver Meissner
Steinbeis Transfer Institute Medical Innovations and Management
(Thannhausen)
oliver.meissner@stw.de | www.steinbeis.de/su/1778



Prof. Dr. Werner G. Faix, Sonja F. Reichert, Stefanie Kisgen, Hanna Bollmann (all from SIBE) receiving certificates from Daisuke Motoki from FIBAA (right)



Patricia Mezger
Steinbeis School of International Business and Entrepreneurship
Steinbeis University Berlin (Berlin/Herrenberg)
su1249@stw.de | www.steinbeis-sibe.de

Deep Insights into Materials Science Executive master's degree in Materials and Processes

Saarland University (Saar-Uni) is offering a master's degree program in materials and processes in collaboration with Steinbeis University Berlin. The degree is aimed at people in full-time employment and was designed to prepare students working in industry for development challenges. Companies participating in the program benefit from knowledge and technology transfer in two ways. Their employees receive high-caliber education and during the course of their studies, they work on a project related to a materials issue at the company. The students also receive support from materials scientists at Saar-Uni, who offer training on behalf of Steinbeis University Berlin in research-related topics throughout Germany.

"According to an academic study on the technology sciences, around 70 percent of German exports are successful in international markets because they include innovative materials," explains Prof. Dr.-Ing. Frank Mücklich, Director of the Steinbeis Research Center for Materials Technology (MECS), director of the Steinbeis Transfer Institute caMPlusQ, professor for functional materials at Saar-Uni, and director of the new degree program. "Our aim over the four semesters of the new master's degree in materials and processes is to teach specialists from industry about the latest developments in materials science and materials technology research, with a leaning towards process engineering. They benefit from a wide scope of teaching areas and research topics, plus the diversity of laboratory technology on the Saarbrücken university campus," continues Mücklich.

Working with material researchers at Saar-Uni and other research establishments based on the campus, students attend classroom session modules lasting two days, looking at a broad selection of topics which are supplemented by e-learning modules. To be eligible for the degree, students require a bachelor or equivalent in an area relevant to engineering or science and should be working for a manufacturing company or similar organization. The new degree program is based on project skills concepts developed by Steinbeis University Berlin.

The degree and research activities at the university are subject to university fees of €5,000. The master's degree will be launched as soon as at least 10 people have registered for the program. "There are so many small and medium-sized companies in Germany involved in the development of tailor-made materials for industry, but often they haven't got their own development departments or highly specialized lab equipment," explains Mücklich. By working closely with the university, research findings can be applied more quickly to products and this also helps the companies involved gain not only competitive advantage but also developed, qualified personnel.

 Prof. Dr.-Ing. Frank Mücklich
Steinbeis Research Center Materials Technology (MECS) (Saarbrücken)
Steinbeis Transfer Institute caMPlusQ (Saarbrücken)
frank.muecklich@stw.de | www.mec-s.de

Re-thinking Leadership Steinbeis experts plan new strategy for developing managers

These days it's all about fast-moving business and complexity. Companies and the business environment are changing at unprecedented speed. Managers are expected to rid themselves of the shackles of over-specialism. What's needed is a revolution in management development. The Steinbeis Transfer Institute of Systems Science, Management and Consulting Services, part of Steinbeis University Berlin, has taken on the task of making management development more innovative and effective.

What's the difference between a leader and a manager? What's the best way for managers to organize their work in order to avoid an uninterrupted string of meetings? And what do managers need when they lose their status as the only expert on a given topic? One thing is certain: leadership is multidimensional and not to be underestimated, similar to organizations and how each part interacts. This systemic approach to companies and the people that work for them places new demands on strategies and business instruments, as well as the issue of what good management development actually is or how it should work.

Re-thinking leadership is a challenge posed to participants of a new certification course on leadership and a culture of innovation offered by the Steinbeis Transfer Institute for Systems Science, Management and Consulting Services. Over the course of several months, students on the program examine leadership, communication, management culture, business culture, team development, conflict management, innovation management, and knowledge management. Each session starts by looking at individual practice to allow course participants to work through their own personal topics. The aim is to understand just how empowering new knowledge can be, and to integrate this into people's situation at work. The students can use the time between classroom sessions to check their own progress using templates and think more about their experiences with leadership. This is important, given the way leadership sometimes happens "in the background." Attention is directed toward leaders' own actions so that conscious thought is given to their management style in everyday business.



 Karola Jamnig-Stellmach
Steinbeis Transfer Institute Systems Science,
Management and Consulting Services (Berlin/Bremen)
karola.jamnig-stellmach@stw.de | www.syswis.eu

An Interdisciplinary Approach to Stress and Burnout

Meet-up of the Hospital of the Future Network

"Stress, exhaustion, burnout. Hidden dangers, opportunities, and new options." This was the day's motto for a meeting organized in Kupferzell by the Hospital of the Future Network. The gathering, part of a collaboration with network partners, revolved around interdisciplinary dialog. The network's members include competence institute unisono, a Steinbeis Transfer Institute belonging to Steinbeis University Berlin (SHB).

"You have to think outside the box. The different disciplines that can be part of preventative health care and healing have to come together. If you turn to the Hospital of the Future Network, you can assume that everyone playing an active role in the network as an expert also knows about the methods used by their counterparts," explains Werner Tafel, the initiator and organizer of the Hospital of the Future Network.

Dr. Albert Lederle, a pharmacologist and an alternative practitioner from Herrsching, showed the guests in Kupferzell how immediate interactions are between mind and body. When the soul suffers, the body suffers too, and vice versa. The environmental analyst Dr. Dietrich Moldan showed the audience simple experiments that demonstrated how people can protect themselves from electric smog at home and in the office. The Freiburg-based physiotherapy and psychiatry specialist Dr. Stefan Dressler examined burnout from the angle of transpersonal psychology. In the same way that fairy tale heroes have to walk a path and pass tests, it is important that people "find their path to recovery." Cutting corners or straying off the path in fairy tales and recovery takes you in the wrong direction. The strategic consultant and airplane pilot Willi Bayer gave a talk on "crash landing burnout" and how pilots now learn how to cope

with pressure. Even in the most dire situations under tremendous time pressure, it is important to have your wits about you and contemplate. There is a simple model that, if taught professionally, can help people master situations of acute stress. Susann Richter, deputy head of nursing management at the Clinic of Psychosomatic Disorders, which belongs to Ostalb Hospital in Aalen, outlined scientific insights into the inhalation of scents. An experienced aroma therapist, Richter showed the proven effects of aromas and gave the audience a chance to inhale different samples and experience these effects for themselves. Sabine Hoffmann, the co-initiator and organizer of the Hospital of the Future network presented a technique she has developed with Werner Tafel called bottleneck-centric stress coaching. This is based on causes, split on five levels, which also correspond to solutions for stressful problems: The body reacts stressfully to deficits in essential substances. Werner Tafel gave a talk on insights into managers and how they can use a model incorporating several methods called Integrative Mediation (iM) to motivate people to work together. His talk also raised a thought-provoking question: Do managers want to assume the role of a sweating cart horse or be carried by their colleagues. If everyone wants to feel "carried" to the same degree, the iM method helps in four steps.

The Hospital of the Future initiative is an informal network that promotes interdisciplinary exchange between different experts, supports a culture of integrated communication, and paves the way for holistic projects that place emphasis on modern and traditional techniques.



Gudrun Jürß, Marion Barthel

Steinbeis Transfer Institute competence institute unisono (Ulm)

su1534@stw.de | www.steinbeis.de/su/1534

Learning the Ropes of Business Etiquette

New certification courses on business etiquette

Working in cooperation with the TAKT & STIL Seminar Institute and Dragon Business, the competence institute unisono (a Steinbeis Transfer Institute at Steinbeis University Berlin) has developed new certification courses.

Certified Etiquette Trainer – Hospitality Industry in China (SHB)

China is one of the world's biggest economic powers and has overtaken Germany in a number of areas. But when it comes to quality and etiquette, Germany often has the upper hand. Now many schools and hotels in China believe in western etiquette. In response to this trend, the competence institute unisono is working with business partners to take its training directly to the Chinese. To provide workers and managers with instruction on western etiquette, people working in the hotel business receive professional training resulting in a university certificate. The course consists of a series of modules covering manners, appearance, service and table manners, communication, modern adult education, and intercultural skills.

Skills Trainer for Business Etiquette (SHB)

This innovative concept is a reaction to the growing demand for training

on self-portrayal and the need for a uniform, national standard for trainers in this area. Practicing instructors can also book this course as top-up training to gain further qualifications and specialize in a specific field. It is also targeted at firms wishing to train their in-house image experts.

Skills Trainer for Intercultural Etiquette (SHB)

Intercultural skills have been a core competence of global business for a long time. To work constructively and successfully at an international level, people need to be sensitive to different countries and cultures. Culture-specific behavior can quickly result in misunderstandings. People erect barriers and chances to work together get missed. Yet the techniques of making a good impression and dealing with others can be learned. Instructors trained in intercultural etiquette can try out the essential tools during their own training sessions before passing their understanding of international values, cultural idiosyncrasies, and standards within different groups of countries on to others. The instructors also learn different methods and presentation skills.



Peter Schust, Susanne Helbach-Grosser

Steinbeis Transfer Institute competence institute unisono (Ulm)

su1534@stw.de | www.steinbeis.de/su/1534



A Winning Innovation from the Black Forest

What does a Black Forest Gateau have in common with market leaders from the Black Forest?

The makeup of German business is unique. In no other country are there so many small and medium-sized enterprises that are also market leaders – so-called hidden champions. Essentially, these unseen winners are actually a shining example to others and they totally deserve to be given special attention in the media. It was this idea that inspired Claudia Koch, Director of the Steinbeis Consulting Center for Change Management in Freiburg and the photographer Miguel Babo. The duo embarked on a mission to turn the spotlight – in an unexpected way – on small and medium-sized technology enterprises in the Black Forest, and in the area of the Upper Rhine valley.

There are little pockets of extremely successful technology companies tucked away in all parts of Germany, often in small clusters. It's a bit like the world-famous Black Forest Gateau, where it's all about magical ingredients applied in the right layers. There are mutually dependent factors such as the local geography, history, established companies, and educational establishment – all playing a key role in the success of these hidden champions. Apart from these ingredients of success, these companies stand out for being self-starters and for their innovative flair. They just keep going and, on average, they have already been a market leader for 22 years. They also dare to keep changing. To do this, they create highly innovative solutions based on world-class quality. They invest in people and skills, and they are extremely good at keeping customers. Other key attributes include tremendous self-will, they believe in themselves and they are resilient to crisis.

When they talked to these companies, plus key influencers and economic development agencies, Claudia Koch and Miguel Babo heard some amazing opinions. One question that kept coming up was how these hidden champions do it in practical terms, what's their recipe for success? And what can other firms learn from this? They discovered an exciting mixture of different recipes and the same applied to the unique personalities who invented the recipe. These are exemplary businesses that others have much to learn from, not just in technological and commercial terms, but also on a personal level, because each person is unique, part of real life, an original soundtrack.

The wish of many of these companies is to be better known, not just locally but also beyond the region. Naturally, this is to attract new custom to their leading products, but it is also to improve their image as an appealing employer who takes special care of its workers, encouraging trainees and other workers to play an active role in innovation. The reason for this is that it can sometimes be difficult to recruit skilled workers in rural areas.

The company portraits created during the project are unique and sometimes unorthodox, and they are featured in a publication called Schwarzwälder- InnovationsGewinner (Winning Innovators from the Black Forest). The book will be published by Steinbeis-Edition in early 2016.

Image: © shutterstock.de/lwsf-s



Claudia Koch
Steinbeis Consulting Center Change Management (Freiburg)
claudia.koch@stw.de | www.claudiakoch.eu

Miguel Babo
miguelbabo-photography (Freiburg)
foto@miguelbabo.de | www.miguelbabo.de

Web Browsers in the Third Dimension

Just one more try, but this time so it works?

Hardware acceleration is a key factor in rendering 3D computer graphics. All calculations needed to portray an image have to run separately on a graphics processor. To do this, standard graphics drivers are required, like the ones that have been in widespread use in desktop applications for years. The situation is different with Web applications. Until now it has not been possible to access graphics cards via Web browsers because of the lack of interfaces. Help is here with the introduction of WebGL, a 3D programming interface. In the future, hardware accelerated rendering of 3D content will be possible, even with Web browsers. The Göppingen-based Steinbeis Transfer Center for Microelectronics (TZM) developed a Web2Print platform to examine the application possibilities of the new standard.

The idea for the project stemmed from a collaborative project with Hinterkopf GmbH, which has a new digital printing process that fulfills the right conditions for inexpensive printing on individual cylindrical objects. The focus is on designing unique bottles, tubes, and even cans. To build

on the design process, the experts use a 3D model that can be turned and viewed from all angles. By rendering views in real time, design changes can be recalculated during runtime and depicted in an updated version in the model. Not only does this mean that the end product can be displayed almost exactly the way it will look, but it also opens the door to interactive product presentation in Web browsers.

The results achieved by the Steinbeis experts have shown that WebGL is much more than just another attempt to make Web browsers suitable for the third dimension. Most browser providers have already recognized the potential of this technology and almost all modern Web browsers now support this new open standard.



Johannes Haas

Steinbeis Transferzentrum Mikroelektronik (TZM) (Göppingen)

Johannes.Haas@dstw.de | www.tzm.de

Well Protected

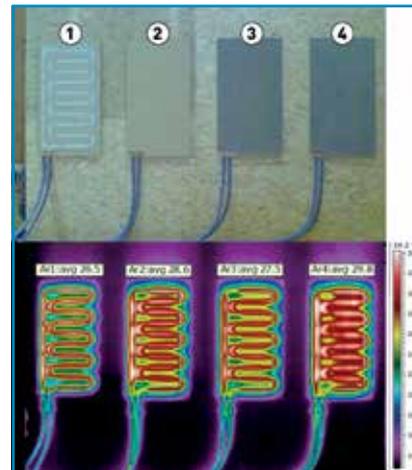
Steinbeis experts develop dry mortar with excellent thermal conductivity and shielding properties

Working in collaboration with the Balingen-based company Casa Natura and environmental analysts from North Rhine-Westphalia, the Steinbeis Transfer Center for Plastics and Composites Technology has developed a clay-based dry mortar that offers up to 25% higher thermal conductivity compared to conventional dry mortar.

Following a recommendation by the Federal Office for Information Security (BSI), another objective of the project partners was to find a way to optimize the "eavesdropping security" of rooms and raise the data security of wireless communication to at least 99.9 percent. Conventional dry mortar provides almost no protection from such intrusion.

The experts achieved their objective by adding graphite powder to the dry mixture. The thermal conductivity of dry mortar with added graphite is 1.08 W/mK, which is roughly 42% higher than standard clay-based dry mortar. The shielding property of a standard 14mm-deep layer of mortar, based on a frequency of 450 MHz, is about 99.97% (36 dB). At a frequency of 9.8 GHz, it is around 99.995% (53 dB).

The new product opens up new markets for the production of clay putty and plastering systems, the production of heat storage units and building elements, and the temperature control and shielding of buildings. The high thermal conductivity of the new dry mortar should improve surface temperature regulation systems, improving thermal distribution between heating pipes under plaster and thus allowing isotherms and heat energy to spread more efficiently within walls.



A surface temperature regulation system showing the excellent thermal conductivity of clay-based dry mortar with added graphite

© Casa Natura

- 1) Standard plaster surrounding and covering heating pipes
- 2) Plaster with added graphite surrounding heating pipes, under standard plaster
- 3) Standard plaster surrounding heating pipes, under plaster with added graphite
- 4) Plaster with added graphite surrounding and covering heating pipes

The project partners are already enjoying the fruits of their success. They have received the first queries from architects on interior design with added protection from electromagnetic radiation ("electro-smog") and more modern planning of surface temperature regulation systems.



Professor Dr.-Ing. Christian Kipfelsberger

Steinbeis Transfer Center Plastics and Composites Technology (Naila)

su0832@dstw.de | www.steinbeis.de/su/832



Steinbeis-Europa-Zentrum Marks 25 Years

Steinbeis experts help SMEs navigate their way through funding programs and implement projects and innovations

It's been 25 years since Hermann Schauffer, the former Minister of Finance and Economics of the State Baden-Württemberg, decided more money from the European Union should be channeled into small and medium-sized enterprises – the famous German *Mittelstand*. So he set up a department for a Commissioner for Europe and established a link between its office, the Steinbeis-Europa-Zentrum (SEZ), and the Steinbeis Foundation for Economic Development. Managed by three Commissioners for Europe – Prof. Dr. Hans J. Tümmers, Prof. Dr. Peter S. Niess, and Prof. Dr.-Ing. Dr. h.c. Norbert Höptner – the SEZ has undergone successful development and this year it looks back on a quarter of century as an organization.

As an institution of the state of Baden-Württemberg, SEZ acts as a lynchpin between business, science, and academia in all fields of technology across Europe. Its focus lies in involvement in research and innovation programs in order to foster innovation in the state. SEZ supports SMEs, research organisations, universities, and public bodies in Baden-Württemberg, providing support preparing for and conducting European research projects, activities related to technology transfer, and networking.

It now employs over 50 people to work on behalf of companies, researchers, and politicians in Baden-Württemberg. Their core task it to help SMEs involved in European innovation projects and EU funding programs, a role that has not changed over the years. SEZ also helps com-

panies with innovation management and internationalization strategies. Seventy-five percent of the funds that SEZ lines up are acquired directly from EU projects. Around 25% of funding comes from state coffers. For consultations given to SMEs, especially if they involve SME instruments related to the Horizon 2020 EU framework program for research, support comes from the Ministry of Finance and Economics; for universities of applied sciences, support comes from the Ministry of Science, Research and the Arts.

SEZ has been a partner of the European Consulting Network since 1993 and since 2008 it has been part of the Enterprise Europe Network alongside roughly 600 organisations in over 50 countries. This network helps SMEs bolster their competitiveness and potential to innovate in Europe. To mark its anniversary year, the SEZ has issued a brochure featuring 25 shining examples of European collaboration. Titled "25 cooperations from Baden-Württemberg – Researchers and Entrepreneurs successful in Europe," the publication contains good practices of the Enterprise Europe Network. The brochure in German and English language is available online.

Image: The SEZ management team: Dr. Jonathan Loeffler, Dr.-Ing. Petra Püchner, Prof. Dr.-Ing. Dr. h. c. Norbert Höptner



Anette Mack
Steinbeis-Europa-Zentrum (Stuttgart/Karlsruhe)
anette.mack@stw.de | http://download.steinbeis-europa.de/publikationen/25-cooperations_bw.pdf



Nice Help from Naetty

Online support with business psychology

Companies are defined by the people who work there, individuals with their own personal goals, needs, and motives. Every individual has contributions to make at work each day, based on their talents, abilities, and commitment, bringing socio-psychological and industrial-psychological benefit to others. It is not always possible to avoid personal and commercial conflict during such interactions. The Steinbeis Transfer Center for Economical Psychology has now set up an industrial psychology website for managers working at companies and people working at small and medium-sized enterprises (SMEs) to explore issues relating to business psychology.

The website features a character called Naetty who draws on an expert team of intercultural and international experts with experience in consulting on business psychology and social psychology matters, as well as international corporate management. The Naetty team helps with issues relating to leadership, business conflict, stress, burnout, anxiety, and occupational health care. The experts examine correlations and suggest training strategies.

The aim with Naetty is to provide a first port of call for issues relating to business psychology stemming not only from individual and personal times of crisis, but also from issues encountered in teams, which potentially result from tension or workplace bullying. Personal problems, emergencies, and help issues can disrupt business and even bring it to a halt, so it makes sense and is often necessary to draw on psychological support.

Abb.: © fotolia.de/lasseedesignen

 Prof. Marieluise Salman
Steinbeis Transfer Center
Economical Psychology (Ludwigsburg)
su1165@stw.de | www.naetty.de



Technology Transfer at a Glance

Closer collaboration between the NMI and Steinbeis

The Natural and Medical Sciences Institute (NMI), a research institute at Tübingen University and member of the Innovation Alliance Baden-Württemberg, is involved in application-oriented research at the interface between the life sciences and material sciences. Its services are delivered through NMI Technologie Transfer GmbH (NMI TT), supporting all kinds of innovation activities from initial developments to product launches by drawing on suitable technology offerings and services. After many years of close collaboration between the NMI and Steinbeis, Steinbeis is now becoming a shareholder of NMI TT.

At the NMI, an interdisciplinary team of scientists works on accessing and developing emerging technology on behalf of companies and public research sponsors in the areas of pharmaceuticals and biotechnology, biomedical technology, and surface and materials technology.

To expand the services offered by the NMI, a wholly owned subsidiary was set up in 2002 under the name NMI TT GmbH. This company currently spans three divisions: pharmaceutical services, a testing laboratory for medical products, and microsystems. The institute draws on know-how gained through its research projects in order to develop services for local and international clients in industry.

The alliance between the NMI and Steinbeis is built on a common desire to work in partnership and exploit specific experiences and synergies in order to generate the desired added value. As part of this collaboration, support will be given to investments made by NMI TT GmbH into the expansion of its NMI TT pharmaceutical services division, which set up a new subsidiary at the beginning of this year in the CoLaborator complex on the Bayer HealthCare campus in Berlin. This involved an investment in new lab equipment, technical infrastructure, and staff at the new unit in Berlin, whose aim is to keep raising the professional profile of NMI TT as a respected international service provider. The move will also help expand NMI TT activities aimed at pharmaceutical and biotechnology clients.

Steinbeis will also support NMI TT with its experience, skills, and instruments in the field of knowledge and technology transfer.

 Thomas Janzen
Steinbeis Headquarters (Stuttgart)
thomas.janzen@stw.de | www.steinbeis.de



A Perfect Combination of Innovation and Quality

The next round of the Baden-Württemberg Competence Prize

The Baden-Württemberg Competence Prize for Innovation and Quality will be awarded for the ninth time in 2016. The award goes back to 2008, when its initiators – the Steinbeis Enterprise TQU Business GmbH and the trade show company P. E. Schall GmbH & Co. KG – started recognizing companies for successfully overcoming the exciting challenges that come with dovetailing innovation with quality.

Despite many hurdles and obstacles, it is no coincidence that more and more companies enter the competition each year. "This proves once again that the Baden-Württemberg Competence Prize for Innovation and Quality has not just firmly established itself, it has become one of the most important honors of outstanding entrepreneurial contributions to business in the state," explains Helmut Bayer, CEO of the TQU Group and co-initiator of the award.

The Baden-Württemberg Competence Prize for Innovation and Quality honors entrepreneurs, companies, and other establishments in the state of Baden-Württemberg for their outstanding ability to bridge sometimes challenging gaps between innovation and quality within their field of business, resulting in measurable and sustained business success. To ascertain whether these criteria have been fulfilled, a jury consisting of selected experts go through submissions and documents on-site at the businesses.

Applications for the 2016 Baden-Württemberg Competence Prize can be requested since September 2015 and submissions must be finalized by February 8, 2016. As is tradition, the award ceremony will take place at the International Control trade show in Stuttgart on April 26, 2016. The prize is sponsored by Steinbeis and is awarded in cooperation with the Südwestmetall Employers Association, the Association of Industry in Baden-Württemberg (LVI), and the Association of the Chemical Industry (VCI).

The Competence Prize Jury

- Helmut Bayer; Managing Director, TQU Business GmbH
- Prof. E.h. Senator E.h. Klaus Fischer; Managing Director, Fischerwerke GmbH & Co. KG
- Martin Hochmuth; Director of Products at HAHN+KOLB Werkzeuge GmbH
- Reiner Marquart; Managing Director, CDE Management GmbH
- Gitta Schlaak; Project Manager, Trade Show Control, Schall GmbH & Co. KG
- Steffen Schoch; Managing Director, Heilbronn Marketing GmbH
- Kai Schweppe; Director of Labor Policy, Südwestmetall Employers Association
- Prof. Dr. Heinz Trasch; Former Chairman of the Steinbeis Foundation
- Senator E.h. Wolfgang Wolf; Managing Director, Association of Industry in Baden-Württemberg (LVI)



Ulla Bläsing
TQU Business GmbH (Ulm)
ulla.blaesing@stw.de | www.kompetenzpreis-bw.de

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Minimizing the Timescales of Restructuring Audits Through Stakeholder Management

Markus Pfalzer

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ISBN 978-3-943356-73-1

About the author

Markus Pfalzer studied business and economics. Since training as an industrial management assistant, he has worked in a number of management roles in the construction industry, despite its chronic margin problems. During this time, he was responsible for the successful business field of turnarounds and business restructuring. He graduated from Steinbeis University Berlin in 2015 while still working in full-time employment.



Business Process Management from a Holistic Standpoint

Steffen Moser, SCMT GmbH (publ.)

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About the author

Steffen Moser (MBE) studied for his master's as part of a collaboration between Steinbeis Center of Management and Technology GmbH and universities in Berlin, Sweden, the United States, Japan and South Korea. During his three years as a student on a dual bachelor program sponsored by a south German manufacturing company, he looked at company-wide production and process management systems, as well as the integration of scientific models in business operations.



Genetic Diagnosis and the Law in Europe, Germany and Hungary

Heinrich Hanika, Gergely Sótonyi

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About the authors

Professor Dr. iur. Heinrich Hanika is an institute director and lecturer at Steinbeis University Berlin, a visiting professor at Semmelweis University in Budapest and Professor of Law in the European Union and commercial law at the University of Applied Sciences Ludwigshafen am Rhein.

Dr. iur. Sótonyi is a practicing attorney specialized in medical law, civil law and labor law. After studying law at Eötvös Lóránd University in Budapest and earning a doctorate in 1999, he studied for a masters (LL.M) at Albert Ludwigs University of Freiburg under Professor Dr. h.c. Manfred Löwisch (2001).



Fundamentals of Business Arithmetics

Marco Wölfle

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About the author

Prof. Dr. Marco Wölfle is a scientific coordinator at the Steinbeis Transfer Institute of Applied Statistics and Political Economy, the Center for Real Estate Studies and VWA Business School, where he is also a junior professor for financial and real estate markets. He previously served as rector at International University of Cooperative Education Freiburg. His current research focus lies in the efficiency of energy improvement measures and the efficiency of different market strategies in the real estate industry.



Steinbeis Entrepreneur Forum 2015 Networking Platform for SMEs | Proceedings

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About the Steinbeis Entrepreneur Forum 2015

The Steinbeis Entrepreneur Forum took place in June 2015 and focused on the topic of recognizing and developing core competences at SMEs. The Steinbeis experts and project partners at the forum examine this topic not just from a theoretical angle but also in terms of practical business aspects. The proceedings include summaries of the speeches made.



STAWA Tool – Business Locations Made Easy!

**Uwe Dittmann, Alexander Göhler,
Hans-Georg Köglmayr, Alfred Schätter**

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ISBN 978-3-95663-047-7 (without software)

About the authors

Professor Uwe Dittmann a professor for business engineering at the Pforzheim University of Applied Sciences and director of two enterprises in the Steinbeis Network.

Alexander Göhler (B. Sc.) is director of purchasing and logistics at Go-Tech CNC GmbH in Mönsheim. His role revolves around strategic purchasing, supplier management, and the development of logistical solutions.

Professor Dr. Hans-Georg Köglmayr is a professor for logistics, marketing and quality management at Pforzheim University of Applied Sciences, with an emphasis on the selection of business location, purchasing, trade and marketing.

Professor Alfred Schätter is a professor for informatics at Pforzheim University of Applied Sciences. In his work he focuses on IT systems analysis, software engineering, Web development, and content management systems.



Workbook of Management Techniques

**Peter Dohm, Wolfgang Neuser,
Barbara Schellhammer,
Edda Schönberger**

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About the authors

Prof. Dr. Peter Dohm is a professor of business administration at the University Policy Academy in Villingen-Schwenningen and director of the Steinbeis Business Academy (SBA). He has been teaching business administration, economics, cost and performance calculation, and management in tertiary education since 1988.

Prof. Dr. phil. Neuser took an MBA degree at the Steinbeis Academy of Management. He has been working as a freelance consultant to church and social services organization since 2013. He also works as a guest lecturer in ethics and management.

Barbara Schellhammer is a lecturer in adult education at the Munich School of Philosophy and the Associate Faculty at Royal Roads University in Victoria, BC, Canada. She is particularly involved in issues relating to intercultural education and conflict transformation.

Edda Schönberger is a research assistant at the Steinbeis Business Academy. Previously, she assisted with the organization of seminars and lectures on Romance linguistics at the University of Giessen. Schönberger has specialized in knowledge generation and knowledge sharing since 2009.



Public Business Development in Times of Change

Albert von Wallenrodt

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ISBN 978-3-95663-037-8

About the author

Albert von Wallenrodt was born in 1964 and studied mechanical engineering in Munich and New Jersey. After completing his MBA studies in Switzerland he initially worked for leading consulting companies and in-house consulting departments in a variety of European cities. He has focused solely on public subsidy consulting since 1998 and has set up several specialist consulting agencies. The well-known publicist and speaker currently heads up the Steinbeis Consulting Center for Innovations and Subsidies Management in Stuttgart and Munich, a leading company providing advice on public funding. Albert von Wallenrodt is currently specialized solely in leveraging public subvention policies for investment and innovation projects at companies and institutions.



InnovationQuality The Value of the New

**Werner G. Faix, Jens Mergenthaler,
Rolf-Jürgen Ahlers, Michael Auer**

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ISBN 978-3-95663-063-7



About the authors

Werner G. Faix, Jens Mergenthaler, Rolf-Jürgen Ahlers, and Michael Auer work in a variety of areas for Steinbeis. In their book on InnovationQuality, the authors examine the twin/coupled phenomenon of innovation and quality, posing the question: What is the value of the New?

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

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Steinbeis GmbH & Co. KG für Technologietransfer

Willi-Bleicher-Str. 19

70174 Stuttgart

Fon: +49 711 1839-622

Fax: +49 711 1839-700

E-Mail: stw@steinbeis.de

Internet: www.steinbeis.de

Editorial coordinators:

Anja Reinhardt, Marina Tyurmina

E-Mail: transfermagazin@stw.de

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