

TRANSFER

The Steinbeis magazine

Electronics in Automobiles

Virtual development

The virtual engine test stand eases the burden on development

Teaching your car to feel

Internal and external proximity sensor technology for cars

Putting car development under the quality microscope

Steinbeis student provides central QM support

Enlighten the darkness

State-of-the-art LEDs enhance peak performance

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Editorial

The Steinbeis Symposium on Electronics in Automobiles

Dear Readers,

As coordinator of the "Baden-Württemberg State/Kettering-University Exchange Program" for the Ministry of Science and Culture, I accompanied Prof. Dr. Harris, Vice President of Academic Affairs at Kettering University, to the Mechatronics Department on the Göppingen campus of Esslingen University in early 2008. As on many previous occasions, I found that many people are still not entirely sure what "mechatronics" actually means and it is interpreted quite differently between countries.

The semantic origins of the word mechatronics lie in Japan. Although there are many definitions of the word, on our visit to the Göppingen campus we focused on three. The German handbook "Kraftfahrtechnisches Taschenbuch" states that, "Mechatronics is an engineering science centering on the functionality of a technical system through the close interplay between mechanical, electronic and data-processing components". Expressed in more general terms this means, "Mechatronics is the functional and spatial integration of systems". Then there is the definition offered in 1995 by John Millbank of the University of Salford: "By definition, then, mechatronics is not a subject, science or technology per se – it is instead to be regarded as a philosophy – a fundamental way of looking at and doing things".

Mechatronics is a portmanteau of **Mechanics**, **Electronics** and **Informatics**. In my work as a control engineer, I was already conscious of the underlying meaning even before anyone had coined the term mechatronics. Modern control loops controlled by electronic regulators are usually a mechatronic device.

So does this mean a vehicle is a mechatronic device? Is there truth in the widely held belief that 90% of future automotive innovation will be shaped by electronics (80% of this due to software)? And that with around 30% of value-added in cars already coming from electrics and electronics this tendency is likely to accelerate? Not entirely – due to environmental factors, such as the need to reduce CO₂ emissions or build lighter, energy-saving cars. It will be just as important to work on innovative materials and new drive concepts, although even here mechatronics has a role to play.

The Steinbeis Symposium on Electronics in Automobiles takes place from 8 - 10 April 2008 in the "Haus der Wirtschaft" in Stuttgart. It is a direct response to this electronic and mechatronic challenge. As a long-standing organizer, it would be a pleasure to welcome you to the Symposium on behalf of the entire Steinbeis organization. To find out more, visit our website at www.stw.de.



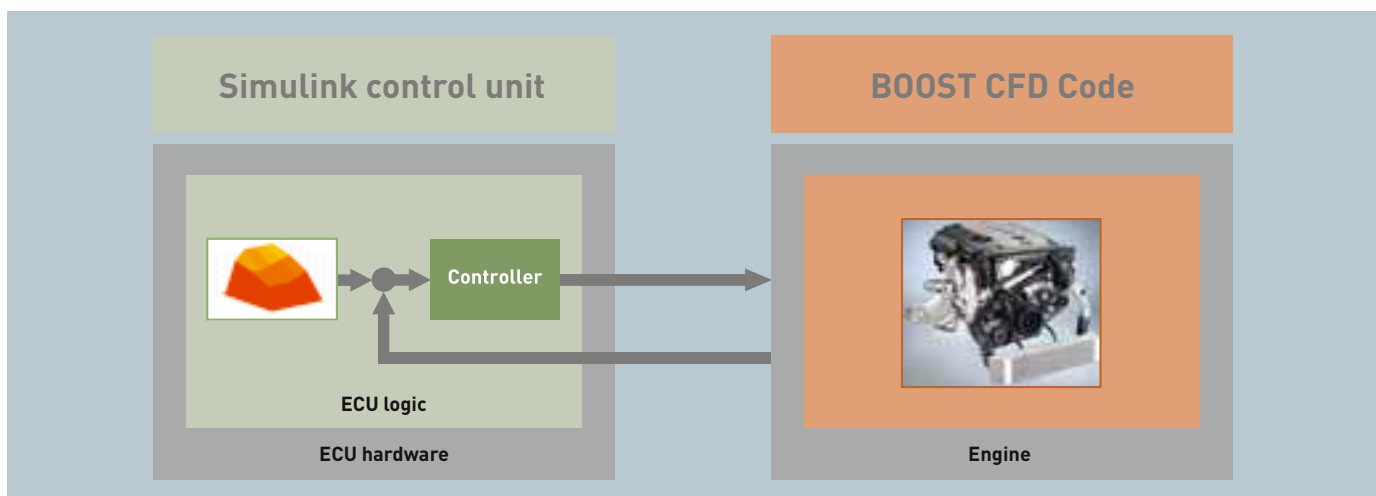
Sincerely,

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The virtual engine test stand eases the burden on development

Virtual development

Developing powerful, environmentally-friendly diesel engines that can reduce emissions and fuel consumption requires increasingly complex logic functionality and ever-more complicated control devices in the engine control module. On top of this, engine prototypes have to go through more and more rounds of testing, raising costs and the time invested. A major problem for engineers is gaining access to testing facilities. They are often fully booked – a curse when trying to shorten development cycles. To develop control concepts and calibrate control parameters in parallel with engine development, experts at the Esslingen Systems Technology/Automotive Steinbeis Transfer Center looked into ways to simulate and integrate function and control developments.



A software engine control concept for diesel engines

In a joint project carried out with Glasgow's Caledonian University, Steinbeis specialists designed a "virtual test stand" as a development environment for putting diesel engine control unit software through its paces. The aim of the cooperative development was to create a diesel model that would be more accurate and versatile than phenomenological models (OD), yet still faster in reacting flexibly to new projects. The solution should also reduce simulation time and improve user-friendliness by linking with established development tools.

To save development time and reduce future development risks, the research team tapped into commercially available simulation products. The environment developed was based on BOOST, an engine cycle simulation code made by AVL List which is used for computational fluid dynamics (CFD) in diesel engines. For the control function and prototype language, the team used a package called MATLAB/SIMULINK made by The MathWorks.

In a series of experiments on the virtual test stand, the team simulated the function of a 3 litre V6 cylinder diesel engine featuring a common rail direct fuel injection system with two turbochargers. The turbochargers worked in parallel, maximizing performance and dynamic properties. A known drawback with this setup is that the characteristic of the less effective turbocharger reduces towards the limitations of the pump, similar to the effect of ageing. To get round this, a variety of control concepts were investigated for compensating the amount of intake air in both turbochargers, using tools such as industrial and adaptive PID controls, FUZZY control systems and Smith predictors with artificial neural network models (ANN) as black box observers.

There were many physical similarities between the parallel simulations on the virtual test stand and real engines. This was especially the case in the pulsating air system,

triggered in the crankshaft angle, typical with the latest technology and this compares well with results from phenomenological models. Compared with a real engine and a real car, rapid prototype development of air controllers confirms that, even if there are no prototypes available for testing, the parallel function development of electronically controlled diesel engines can facilitate improved engine performance, reduce development time and minimise development costs as originally hoped.

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A development platform for networked drive systems

Developing control devices for vehicles

Modern vehicles contain an increasing number of electric actuators. Apart from standard actuators which are mainly used for driving comfort, increasing numbers of actuators find their way into the engine compartment, with a direct bearing on the function of the combustion engine. The underlying reason for this? The need to develop clean, efficient and powerful engines.

The Ilmenau-based Steinbeis Transfer Center for Mechatronics develops magnetic actuator systems for a variety of automotive suppliers. To develop functioning test samples quickly, it is essential to have an end-to-end right hardware and software platform. Typical examples of their output are actuators used in air management systems (electric valve controls, air timing valves, electrically driven exhaust gas recirculation valves) or operating material pumps (water pumps, fuel pumps). The actuators concerned are used in systems featuring a high degree of mechanical influence (e.g. valves, pumps or fan wheels), electric actuators (brushless DC motors or solenoid actuator with reciprocating movements and controllable dwell) and control devices.

For each group of functions, the Steinbeis experts created circuit plans which could be reduced easily into a control device using a simple common circuit layout frame. To provide working samples they normally use a 19 inch cassette module. To create prototypes they develop a circuit frame tailored to the specific application before integrating it into the housing of the actuator system. At the heart of each device lies a digital signal controller belonging to the Freescale MC56F83xx and MC56F80xx group of products. These components offer the benefits of a digital signal processor and a micro-controller with a peripheral module optimized for actuation control tasks.

A number of derivatives exist with a range of peripheral and storage device options. Programming is carried out in ANSI-C with graphical support in an integrated development environment (CodeWarrior devel-

opment studio for Freescale DSP56800/E hybrid controllers). As before, software modules can be used in variety of other applications. Development is made more comfortable by linking into PC host systems with a graphical interface. The controller can be designed and put through function prototyping by using tools such as the Matlab/SIMULINK group of products. The team also uses universal control circuit boards and evaluation boards for initial function testing. To network the system, they developed their own CAN protocol.

For developers, the hardware and software platform setup offers a range of benefits. For example, control device development can be incredibly quick and there is much less redesigning. Also, as they use the same tools they quickly accumulate knowledge and can exchange ideas within the team. Further, it is easier to standardize development documentation and sharing information with customers is much more straightforward.



A control device for BLDC engines with a control circuit board (left) and a power board

System control devices typically fulfill the following groups of functions:

- Provision of supply voltage (electromagnetic tolerance activation, protection activation, auxiliary power generation and backup)
- Communication interface including, driver circuit (CAN or LIN bus, PWM interface)
- Embedded controller
- End amplifier (MOSFET bridge with protection and measurement circuit)
- Interface electronics for sensors (energizing circuit, measurement amplifier, ADC)

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Internal and external proximity sensor technology for cars

Teaching your car to feel

A study carried out by the Steinbeis Transfer Center for Automotive Engineering examined and evaluated the key sensory principles involved in monitoring car body openings. Cars are becoming increasingly complex, not just in the way they are made and work: drivers and passengers expect more comfort and safety. This means that "man and machine" will have to communicate with each other more often. One way to accomplish this is with proximity sensors.

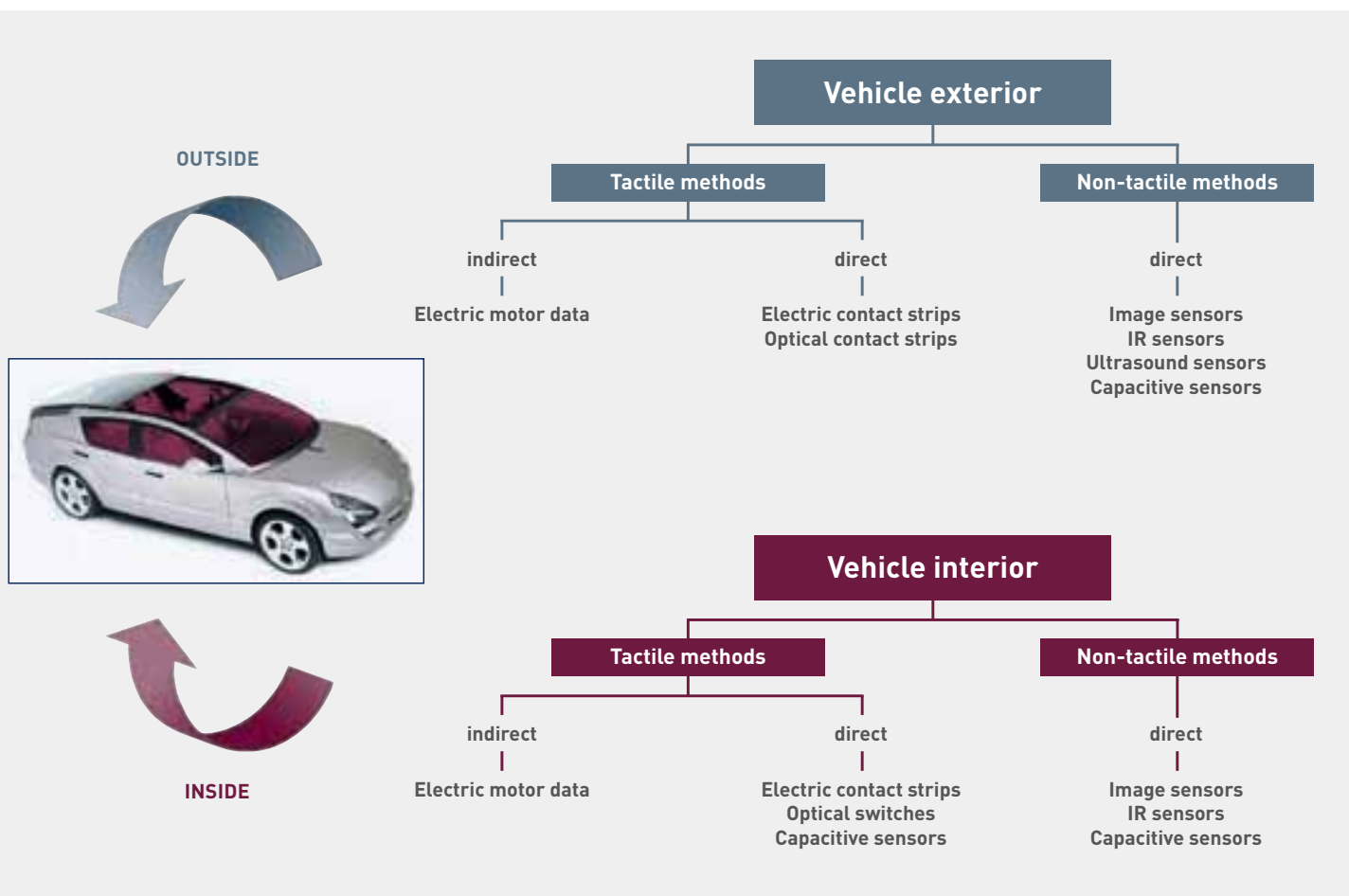
The five senses allow us to see, hear, smell, taste, and feel. Sitting in your car, you probably don't think about all the new perceptory functions cars have been gradually introducing. For example, cars now use ultrasonic sensors to "see" the best way to maneuver into a parking spot. Crash sensors "hear" impacts. Air conditioning systems can "smell" harmful fumes outside the car and regulate fresh air. An increasing number of car makers are now looking at proximity sensors and contact sensors. Components are being developed that can sense a person or a part of their body approaching and detect even the

slightest touch. They do this by generating physical parameters and converting them into electronic signals that are translated into actions by a control device.

The aim of the study into proximity sensors was not to look at things happening away from the car with video and radar technology. Instead it was all about looking at things in close-up: car body surfaces, inside the cockpit – movements only inches away from the car's "skin". The reason it's important to monitor movements just outside the car, or in openings – places where automatic elec-

tronic motors open and close doors or any type of "shutter" – is that people should not get hurt. Inside the car the priorities are ease-of-use and ergonomics – making it easier to select or set comfort and safety features. In principle there are two key aspects to sensor technology inside and outside the car: tactile and non-tactile perception.

Tactile perception outside the car is central to anti-trap protection (ATP) on automatic windows and sunroofs. The standard (indirect) approach until now has been to work out what is happening to the current or



speed of the electronic motor. This keeps international safety regulators happy, but there is still plenty of room for improvement as the static and dynamic properties of car bodies have a major influence on actuation power and malfunctions.

The more direct approach involves detecting trapped parts electronically with a contact strip inside rubber liners. The advantage is that the car can react to small movements much more quickly and reliably, but integrating the technology into linings and incorporating sensors in the right way is a complex process. Engineers are currently working on "seeing" intrusions using optical fibers built into a contact strip: when you touch the sensor it changes the electromagnetic properties.

There are a number of ways to monitor car openings with non-tactile sensors. In principle, to detect intrusions all you need is a video-based optical sensor. But installation and computation requirements make this approach costly; so automotive engineers are placing their bets on IR beams which can be used to monitor movements around folding roofs and sliding doors. Ultrasonic systems emit pulses and detect echoes before comparing movements with stored references, if necessary triggering a control device. Direct detection using capacitive sensors – examples of which we see in keyless access systems such as "Keyless Go" – are already in limited use in serial production. As somebody approaches, an electric field between two electrodes changes within the sensor system altering the capacity. To monitor complex 3D modules more development work is needed as measurements are easily influenced by environmental factors. Precisely because this approach is so dependent on environmental factors development is still in the early stages.

Modern car interiors are packed with more and more buttons and switches. They may make it easier to control comfort, safety, information, and mobility features but what

drivers actually want is more simplicity: enhanced safety and intuitive controls. This is where the new generation of tactile and non-tactile sensors comes in. As well making things simpler, overall they present the passenger with a much more user-friendly driving environment.

To control adjustments to electronic vehicle fittings (such as seats and loading surfaces) using indirect detection, car systems monitor the electric motor and interrupt the movement when they sense a collision.

Some car manufacturers already have electric contact strips in serial production. These are used as an active tactile component to monitor sliding parts and although they can sense intrusions directly they are often expensive to fit. Optical switches which activate at the slightest touch and generate a signal without using electricity – and without wear – are still under development. In the future capacitive touch sensors or multidimensional touch pads will make controls more intuitive by linking operating panels, displays and functions. Many often complex turn/push controls will be enhanced or replaced.

Non-tactile sensors inside the cockpit can work in a number of ways. There are image sensors that are used in intrusion or theft warning devices, occupant detection systems that control safety and comfort features, and switches that activate after evaluating hand and body movements. Infrared and capacity sensors are already in use in serial applications for controlling cockpit illumination, offering a variety of new design options, programmable sensitivity, and zero wear and tear.

Even though tactile and non-tactile sensors inside and outside the car have some way to go, there is little doubt that they will work their way into overall vehicle sensor systems. As car bodies become more complex and more and more cars are fitted with motorized doors, folding shutters, and roofs,

we will need higher standards of operating comfort and anti-trap protection around the vehicle. And this can only be achieved by merging proximity sensors that operate through several channels in three dimensions.

Because vehicles now incorporate so many features, car cockpits are continuing to fill up with controls. Probably one of the best ways to reduce the complexity of the dashboard is to introduce these new tactile sensors and especially non-tactile sensors as they will allow us to monitor features automatically and control settings intuitively just by moving our hands – or maybe even via wireless data transmission.

Proximity sensors have the potential to turn vehicles into intelligent beings that can feel, recognize and assess changes or instructions. This will bring benefits to car safety and comfort and, ultimately, major benefits to the passenger. It will also have a tremendous influence on the way drivers communicate with the car, so one thing engineers will need to think about is that this will take some getting used to and will demand a lot of understanding.



Photo: Daimler AG

Quality is a key success factor. The quality of a product depends essentially on perception and the customer's opinion of your product. Mercedes-Benz has charged the central quality management department in its car division with the task of designing and setting up an end-to-end QM system. The priority will be to improve product and process quality across all Mercedes-Benz models, particularly in product development. Cars are becoming increasingly complex, there are more types of models, the pressure to innovate is intensifying, and last but not least customers are becoming more quality-conscious meaning quality management has to be taken extremely seriously when it comes to product development. By identifying the source of faults in the first place, as early as the development stage, they can be eradicated saving money wasted on rectifying errors and last minute changes just before or after cars go into full production.

Steinbeis student provides central QM support at Mercedes-Benz

Putting car development under the quality microscope

Car giant Daimler employs more than a quarter of a million people in 90 countries. Its car portfolio ranges from small cars to HGVs as well as upstream and downstream value chain activities such as financial and support services. Global companies like this wouldn't be able to survive without quality management but it's not without its headaches. Verena Schabernack, a student on the Master of Business Administration program at Steinbeis University Berlin (SHB) is examining central QM on specific car models with the aim of pinpointing improvements. Her project will help managers define QM guidelines for the next generation of the Mercedes-Benz GL-Class.

This applies equally to the development of the next Mercedes-Benz GL-Class. The news may be filled with items on CO₂ emissions, but the sport utility vehicle (SUV) market is still growing. As a result, development projects are becoming increasingly important to the company – which is where Verena Schabernack, a student at Steinbeis University, comes into the equation with her degree project. Verena has been asked to analyze the optimization potential on the existing GL class. Her topic is a key strategic issue as the success of the new model depends on it.

The QM managers in the development department have already defined the goal: to improve quality in the long term product development process for vehicles, motors and electrical/electronic systems. The company already has established techniques and processes for improving the standard of concepts, manufacturing and on-going car quality. All product and process related activities are clearly documented in quality handbooks and coordinated by a quality project manager during the product development process. As a member of the project management team, the quality project manager is involved in planning and supervising the new car project. Quality management chiefly focuses on two aspects during the development process. First: improving the quality of the initial concept. Working with

Verena Schabernack, the quality project manager is evaluating quality sensors used on the existing model and is responsible for identifying potential improvements and introducing them to the new model. This removes conceptual failings with the previous model even before the next model takes shape. The second priority for QM is to safeguard – early – what the company calls the car "maturity level" as it is prepared for serial production. This is achieved through continual assessment of the maturity level and translating findings into actions.

The next GL Class model is still at the beginning of the development process so one of the main challenges for quality management, and Verena Schabernack's degree project, will be to ensure that the potential to improve quality actually filters through to the development process and hopefully beyond. Resulting in even more satisfied customers driving the GL class.

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Managing, budgeting and analyzing projects via the Internet

Calculating offers the intelligent way

The German car industry is undergoing sweeping changes. The OEMs are offloading complex development and production tasks onto their tier 1 suppliers. The result: more demands being placed on suppliers who not only find themselves having to make bigger and bigger modules, they're even being given the work of development or project management. As competition in the market is intense, it is crucial for companies to keep a close eye on costs.

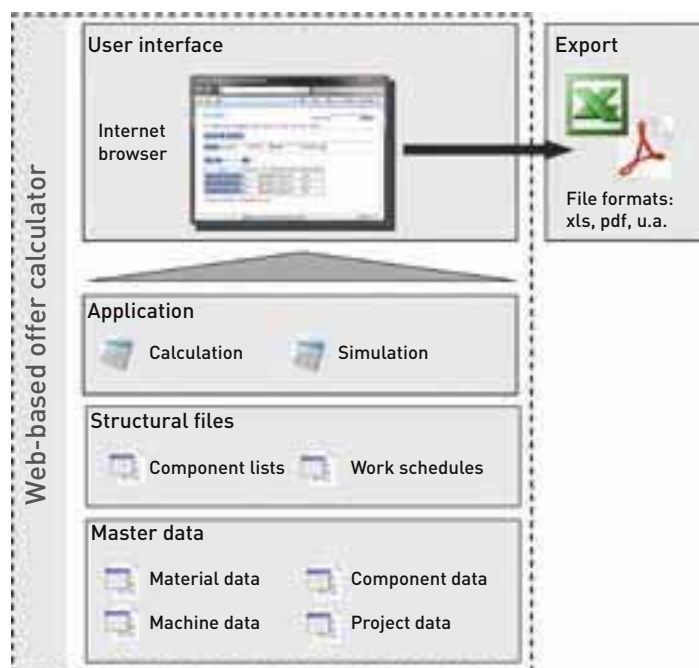
When a company submits an offer or a proposal for a project, it normally does this before it embarks on development. But it can be difficult calculating offers early in a meaningful way for customers, precisely tailored to their needs. The reason: standard IT systems don't provide the right tools. Based in Weingarten, the Steinbeis Transfer Center for Business Processes and IT Systems (BITS) has now come up with a solution which uses the Internet. Staff at the center looked at ways to improve business processes and map them in business applications. Their work resulted in the development of a special web-based system environment which allows companies to set up business applications quickly using simple and versatile methods. The system allows users to develop diverse solutions directly through a browser. The system developer is given a series of tiny standard components which can be assembled into forms. After only a few days' training, users (and not programmers) can start piecing together their own applications.

The BITS transfer center used the system to create a web application for automotive suppliers to calculate offers. As well as displaying the usual type of data and creating financial reports, the system is a versatile tool for estimating projects as it encompasses a master data management tool. Automotive suppliers can manage project data before or during the development process, draft component lists and work schedules, and of course calculate detailed offers. The component lists and work schedules can be drafted early on in the process as a qualified estimate. Then as things develop they become more detailed.

The web-based system offers clear benefits. By using an Internet browser there is no need to administer software locally. Any authorized user with access to the Internet can administer the project and managing data is flexible and decentralized. The system also allows experts to make adjustments directly via a browser. This cuts time and money spent for customizing to an absolute minimum.

The system offers project managers a highly useful and versatile platform for managing business processes. The applications it provides are totally user-friendly and integrating the system into existing company IT architecture can be carried out using standard database interfaces. For the first time medium-sized companies with limited financial and team resources can engage in Rapid Enterprise Application Integration (rEAI) in upstream business systems and create applications without longwinded programming.

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Schematic representation of the offer calculation tool

Calculation program functions:

- **Project management**
Management and administration of offers via a project database
- **Data migration from the old system**
Master data can be imported from old systems (e.g. ERP, PPS) and compared periodically.
- **Master data administration**
Input and updating of project master data directly via browser and storage in a database. Project data can be edited at any time and changes tracked versus previous versions.
- **Calculation of offers**
Calculation of project proposal based on master data. Changes can be made at any time.
- **Export into specific data formats**
All data used to make calculations can be exported directly into Excel and from there transferred into a variety of (OEM) customer specific formats for offers.



Starter pack opens the door to the new FlexRay™ bus system

Gently does it

FlexRay™ technology is enjoying growing acceptance in the automotive industry. The number of converts familiarizing themselves with this relatively young bus technology is steadily rising. But FlexRay™ is by no means simple, making it all the more important to go tread carefully.

The amount of time it takes to get your mind around unknown bus technology and work out just how things function depends partly on the development platform involved. In the perfect world you would be dealing with an end-to-end solution which is easy to grasp and does not take long to become familiar with. It should encompass all the components you need to take your first steps. To understand FlexRay™ technology, it is important to present beginners with a clearly expressed concept before they start to master each component.

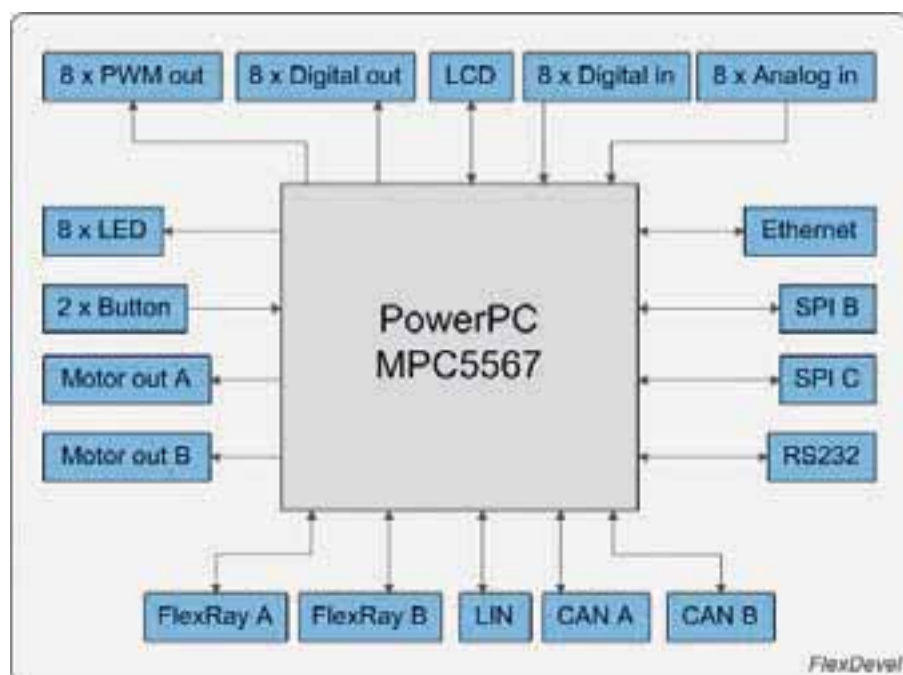
Once they understand the overall concept, design engineers like to get to know FlexRay™ network technology quickly by setting up a sample network and seeing how it communicates – but even getting to this point means overcoming obstacles. The first thing they need is at least two suitable hardware platforms to work as a FlexRay™ node. To work with the platform they then need a computer, programming hardware, and a debugger. But the biggest hurdle to overcome when starting out with FlexRay™ is to configure the FlexRay™ controller. Before

configuring a FlexRay™ bus you have to be clear about when a message is sent or received. Because everything is timed, things need to be planned in advance by laying down parameters for each bus element. It's almost impossible to do this without the aid of special configuration software, apart from which the developer has invested a great deal of effort getting to know the hardware platform as the system does not usually come with a program for running the FlexRay™ controller.

Now help is on hand from products developed by the Microelectronics Steinbeis Transfer Center (TZM) in Göppingen. They have developed a low cost solution based on a FlexDevel platform using an MPC5567 processor from Freescale. The platform offers a variety of interfaces. The board already comes with integrated bus drivers for the two FlexRay™ and CAN HS channels as well as the LIN, Ethernet and RS232 interfaces. Two h-bridges allow you to connect two DC motors which can be run on separate current supply connections. An optional LCD module can be connected via an interface on the FlexDevel board. Each FlexDevel platform comes with a comprehensive library of ANSI C software allowing for low-level functions on every interface of the processor to start operating interfaces quickly and without hassle. As the library is delivered in source code it can be adapted to individual needs.

Sample software comes with each of the library modules using simple applications to demonstrate how to use the modules. For example to start operating the FlexRay™ interface there are two sample programs which are both based on the FlexRay™ library module that comes with the system. The sample software is installed with the programming adaptors on the two FlexDevel platforms that come with the system, so FlexRay™ communication starts straight away.

You can track data being transferred via the serial interfaces. Based on the sample software it does not take long to create your own applications. The user manual is broken down by hardware and software. The hardware section contains detailed information on existing interfaces and which steps to go through to start operating the FlexDevel platform. The software section goes into detail about the installation of the necessary programs held in an installer (Eclipse, GNU compiler, P&E debugger, manuals, data-sheets, library, examples).



The TZM offers two FlexDevel starter packs. The first, "FlexDevel Kit", contains FlexDevel cards including two FlexRay™ connection leads for setting up a basic FlexRay™ network. To configure the network the package includes FlexConfig demo software. This tool allows you to lay down the bus-specific parameters for timed FlexRay™ communication. To simplify system specifications, the pack includes some useful features, such as plausibility checks or threshold measurement of the selected parameters. Once the configuration set has been prepared, the bus components can be configured by integrating the generated configuration files into the software application.

The other pack, "FlexDevel Starter Kit" offers all the elements found in the "FlexDevel Kit" as well as a bus interface card called "Flex-Card Cyclone II" with accompanying software. This hardware allows you to analyze FlexRay™ communication on a PC. The analysis software that comes with the package, "FlexAlyzer basic" enables asynchronous or synchronic monitoring of data flows. The kit also includes other functions such as generation of different trigger signals or filtering functions. If needed, data can also be recorded (data logging) and stored in a file.

To complete the package, the "FlexDevel Starter Kit" comes with a two day FlexRay™ seminar on the theoretical and practical aspects of bus technology.

FlexDevel technical data

- Freescale PowerPC MPC5567 with integrated FlexRay™ controller
- 2 FlexRay™ channels (A and B)
- 2 CAN HS bus interfaces
- Switchable termination resistance for CAN and FlexRay™
- Wakeup/sleep support
- 1 LIN
- 1 RS232, 2 SPI
- Ethernet
- 8 digital input and outputs
- 8 analog inputs
- 8 PWM outputs
- 2 h-bridges for controlling motors
- 8 individually controlled LEDs
- 2 individually controlled buttons
- 1 connection for an LCD module
- Voltage range: 8-16V

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Steinbeis helps company achieve IT safety standards

Safe and sound

Utility companies have to be 100% sure that their systems are reliable, safe and secure – for IT, this is often a bit of a challenge. The network control center at **Energiedienst Netze GmbH** submitted its IT system to strict 27001 certification at the **German Federal Office for Information Security (BSI)** becoming one of the first companies ever to receive official approval for "ultimate safety". To ease the process, **Energiedienst Netze** called on the advice and support of **Steinbeis** experts at the **ManagementCockpit Transfer Center**.



The man responsible for managing the entire power network at **Energiedienst Netze** – as well as overseeing the company's hydroelectricity plants – is **Friedhelm Bäumer**. His job entails supervising the network, planning, and coordination along with switching systems on and off, optimizing switching and malfunction management. Every process is underpinned by a highly complex IT infrastructure adhering to state-of-the-art security standards. In the data processing rooms (DP) the company also has an oxygen reduction machine aimed at nipping fires in the bud by suffocating the supply of oxygen. Smoldering fires are signaled to the center by smoke detectors. To keep them separate

from operating equipment, the DP rooms are fitted with F30 fire doors.

Each part of the IT system is backed up to avoid single points of failure and ensure 100% availability. If any part of the system suffers an outage, the DP center in **Rheinfelden** jumps in. In the event of a major fault (such as the entire DP center breaking down), entire operations are relayed to the secondary center in **Donaueschingen**. The company even has a contingency plan for both DP centers breaking down: operations normally carried out in the network control center are kept going in a "tracking station".

"In the interest of our customers we must ensure that our systems offer 100% availability and safeguard the integrity and confidentiality of our data."

Friedhelm Bäumer, Head of Information and Measurement Technology, Energiedienst-Netze GmbH

"One of the aims of the project was to show third parties, in understandable terms, that we fulfill the strict safety requirements laid down under ISO 27001."

Andreas Kandula, ED Project Manager for the Certification Process

"It was tremendously important to us to capture IT security processes within the organization as part of overarching risk management and network control center management."

Walter Ganzmann, Safety Officer, Energiedienst Netze GmbH

"All technically feasible security measures were implemented to the very highest standards and are now being operated professionally. The use of the company-wide Intranet system for documenting, training and sensitizing staff to issues is exemplary."

Dietmar Tribess, external auditor, IABG

To safeguard data security, the company has an almost entirely automated data security system. The only manual operation is when data storage equipment is transferred to separate fire-proof rooms. Data integrity is safeguarded by an end-to-end virus protection system, firewalls on all external interfaces, an intrusion detection system that signals unauthorized access attempts, and central processing of log files.

Overall, this provides the technical systems needed to provide top quality security. But ISO 27001 certification under the auspices of the Federal BSI scheme goes way beyond these security levels. For example, the com-

pany must be able to prove not only that it has all the right systems in place, everything within the security system has to be monitored – constantly – and improvements made as necessary.

To ensure the company lives up to this expectation, senior management has captured the importance of IT safety in internal security guidelines which was signed and published and now forms the backbone of all subsequent guidelines. IT safety processes now come under the umbrella of overarching network control center security procedures. In turn, these procedures loop back continuously according to Deming Cycle principles (plan-do-check-act).

During certification, Energiedienst Netze received professional advice and tangible support from Steinbeis experts. The entire project was steered into harbor by a "Fundamental IT Safety Catalog" provided by the BSI. The document provides waypoints for analyzing the current status systematically and comprehensively and uncovering po-

tential gaps within the security system. The government department also provides software to simplify the complex analysis.

The project already got off to a good start thanks to Friedhelm Bäumer's involvement in a 2006 project looking at network control center management and risk management. The project resulted in MS Standard Network Operation certification from the German Technical Inspectorate (TÜV) and established a template for the systematic categorization of future IT security management processes. This made it possible to make use of tools such as a safety directory, fault tree analysis (FTA), and blackout analysis, and adhere to established schedules for implementing the project and gaining certification.

The result of the project: higher safety standards and enhanced transparency. Also, customers, suppliers and the general public can now see that the company has gained internationally recognized certification, even if the overall IT safety process is still subject to continuous improvement processes.

Energiedienst AG

Energiedienst AG is an energy services company based in south west Germany and north west Switzerland. It operates a variety of electricity and water supply networks along the German-Swiss border as well as hydroelectricity plants. Its catchment area measures 3816sq km. Its electricity network spans 135km of 380/220 kV cables, 537km of 110 kV cables, a medium voltage network of 4118km and 8997km of low voltage cables. Energiedienst has approximately 290,000 electricity customers and 20 redistributors.

The company was founded on 1 January 2007 under energy laws dictating ownership unbundling.

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Steinbeis looks back on a successful 2007

2007 was another successful year for the Steinbeis Network. Its four core services – research and development, consulting, training and employee development, and evaluation and expert reports – generated sales topping 109 million euros.

The number of specialist centers founded last year came to 83, expanding the Steinbeis Network to 739 units. Depending on the emphasis of services, units either count as legally dependent Steinbeis Transfer Centers, Steinbeis Research Centers, Steinbeis Advice Centers, Steinbeis Transfer Institutes or even legally independent companies.

The success of Steinbeis is thanks to the commitment of the employees in each unit. In 2007, Steinbeis' 739 centers were managed by 805 managers working in unison

with 1340 employees and 3348 freelancers. Steinbeis employed 957 professors.

We welcomed more than 800 visitors to a variety of centrally organized events in 2007 and further events are planned for 2008: from 8-10 April, the Steinbeis Symposium on Electronics in Automobiles takes place at the Haus der Wirtschaft in Stuttgart; this year's Steinbeis Day is on 19 September in Stuttgart's Alte Reithalle.

Information on other Network events, Steinbeis services, and ongoing projects is provided to customers and business part-

ners in this quarterly Transfer Magazine. The same information is available on the Steinbeis website at www.stw.de.

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State-of-the-art LEDs enhance peak performance

Enlighten the darkness

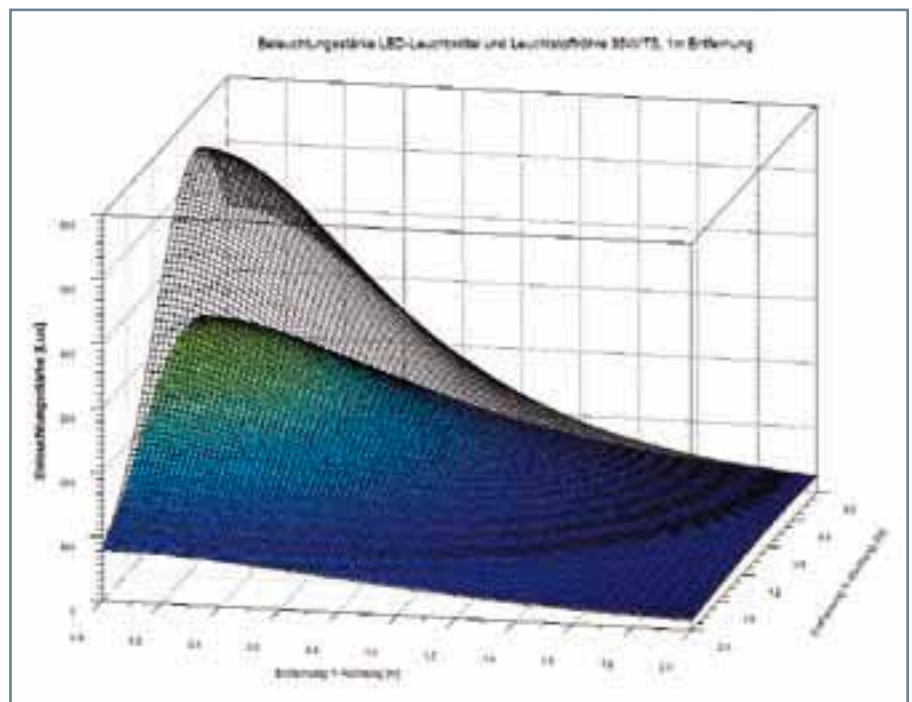
LEDs (light emitting diodes) have been used in electronics for a good three decades. In fact they are everywhere now. As well as using up low levels of energy, LEDs cope consummately with shocks and vibrations – and they last a long time. On the downside however, until a few years ago blue LEDs did not even exist and luminous power was relatively weak. Also, LEDs did not yield much light making it difficult – or even unthinkable – to use them in large areas. Until recently.

Relatively powerful LEDs – offering up to 130 lm/chip – have been on the market for around five years, but now there are a variety of monochrome LEDs (red, green, blue etc) as well as white-light LEDs yielding high levels of luminosity. Put enough of these types of LEDs together and you can now illuminate practically anything.

White-light LEDs in particular are an attractive option for illuminating objects. Apart from the electrical and optical benefits of white light (light yield, in lumens per watt of power), this is due to two key factors. The first is luminous color. For this we use a reference point, taken as the light spectrum of a black light source at a given temperature. Accordingly, the luminous color of white LEDs falls into three main areas:

- warm light, i.e. light dominated by red and green tones; the temperature of the black light: around 3000K
- neutral light, offering a light blend in the red and blue light spectrum. The temperature of the black light source for this type of light: around 4500K
- cold light (sometimes called daylight white), which is predominantly made up of blue light. The corresponding radiation temperature of the black body: 6500K.

The second factor affecting light quality is the Color Rendering Index, or CRI. This shows the color rendered by the object being illuminated. The reference point for this is sunlight with an index of 100 CRI. Artificial light sources can not exceed 100 CRI. The CRI of today's LEDs can be as high as 93, the equivalent to the color rendered by a



A comparison between the illumination performance of an LED at 55W and a 35W T5 fluorescent tube (both without reflector and lens).

top-of-the-range fluorescent tube or halogen lamps (which use much more energy).

From an economical point of view, electrical and optical effectiveness is the main motivation when using LEDs, apart from the initial outlay and light quality. Halogen lamps achieve luminous flux levels of around 20lm/W whereas modern LEDs range from 50-80lm/W although fluorescent tubes can go as high as 100lm/W. Under laboratory conditions, however, LEDs do hit more than 100lm/W, making them the most efficient technology we have to create light.

The only problem is, the cost of the types of LEDs needed to provide sufficient illumination under modern conditions exceeds

the purchasing cost of fluorescent systems. Nevertheless, depending on the application, there are times when it really does make sense to use LEDs rather than conventional lighting systems based on fluorescent tubes – despite the initial outlay. There are a number of reasons for this, including:

- long service life (up to 80,000 hours)
- variable dim without compromising service life and efficiency
- shock and vibration resistance (suitable for automotive use)
- very low power requirements, now making it possible to make extremely compact lighting units
- luminous color variation according to needs or the time of day (mood lighting)

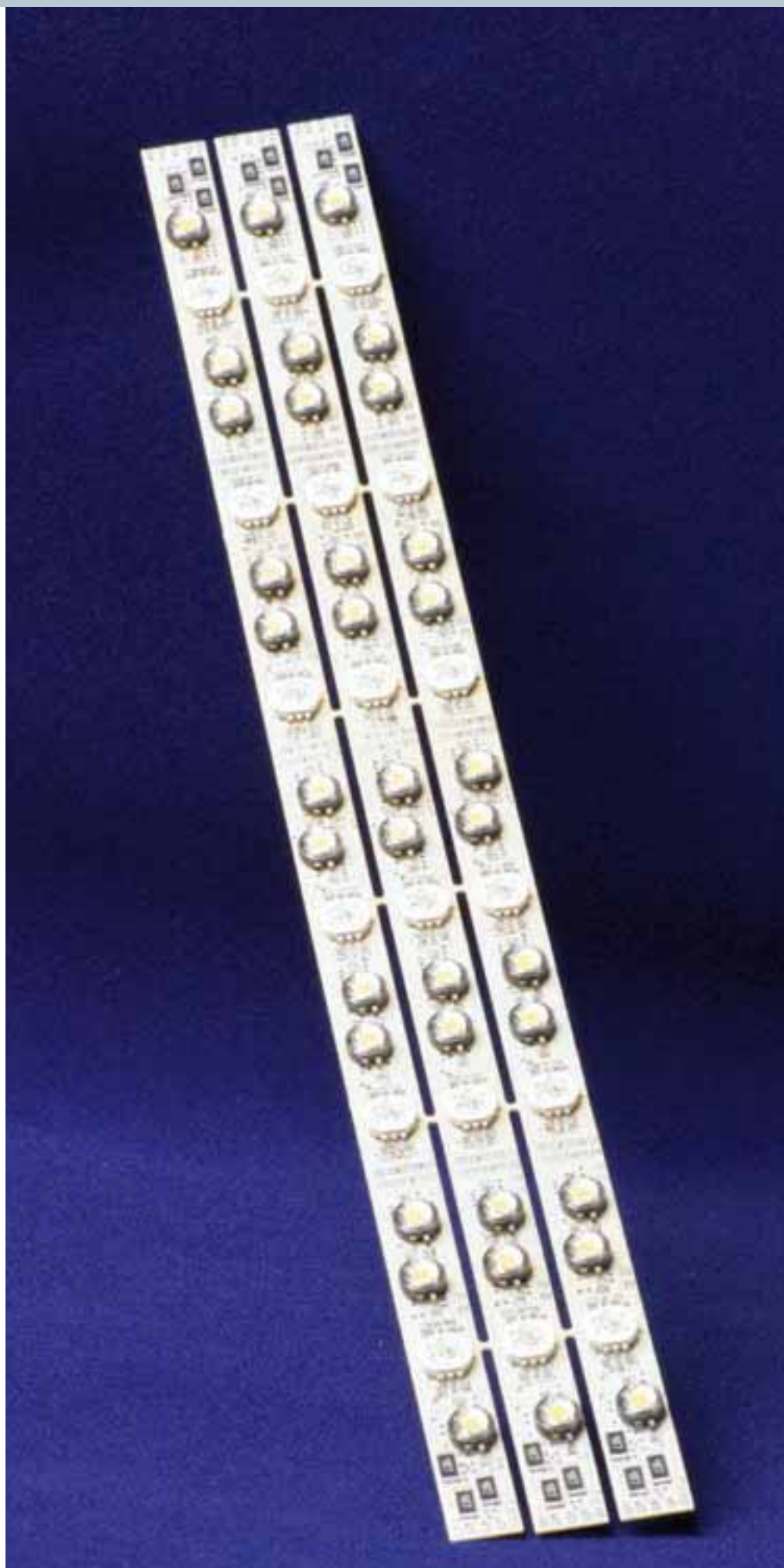
Performance electronics for the 24V supply of LEDs (150W)

Staff at the Heilbronn-based Steinbeis Transfer Center for Applied Electronics have been working on the development of customized LEDs for many years, as well as related power electronics. The graph on the left shows a lighting unit developed by the transfer center using LED technology instead of conventional T5/35W fluorescent tubes. When you plot the illumination provided by the LED unit on a 3D graph, the illumination that would be provided by a fluorescent tube is shown in blue. As the graph shows, LED illumination is no longer second-best compared to fluorescent tubes, especially in terms of effectiveness and yield.

The illumination unit itself – as well as the performance electronics needed to work the unit – is highly compact and thanks to the effectiveness of both, units do not overheat. Once special lenses are added to the LED illumination unit, lighting can be optimized on a minimum amount of power. In fact, with the right lens the amount of light lost can be minimized making it possible to design the LED unit any way you want. It is even possible to achieve the levels of performance previously only offered by systems equipped with fluorescent tubes – and sometimes even outperform them.

Of course there is still plenty of work to do in developing high efficiency LEDs, but progress is rapid. In the years to come we should expect to witness a rich variety of highly interesting and innovative LED lighting solutions – all of which would have been scarcely possible (if at all) using previous technology.

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Opportunities and threats in modern HR work

Fostering staff development and the role of IT

Technology, organization and human resources are no longer separate business issues; linking them is not an artificial exercise. On the contrary, in recent years HR management and employee development in particular have both profited from the rapid expansion of high-performance IT solutions, as well as organizational diversification. These trends offer businesses a number of opportunities but also pose threats to modernizing HR work. Professional support from experts at the Gottmadingen-based TOP Steinbeis Transfer Center (for Technology – Organization – Human Resources) helps provide projects with a framework, overcoming implementation barriers for companies to realize their true potential.

Over the last decade, information technology has been dictating the pace of transformation in the field of human resources. Hardly any area of HR development has remained untouched, from coordinating individual development plans to competency management, the administration of training programs, Balanced Scorecard implementation in the HR department and even complex eLearning scenario setting akin to "Second Life". The specific nature of IT depends on the individual needs of the business and of course budgets but ideally HR

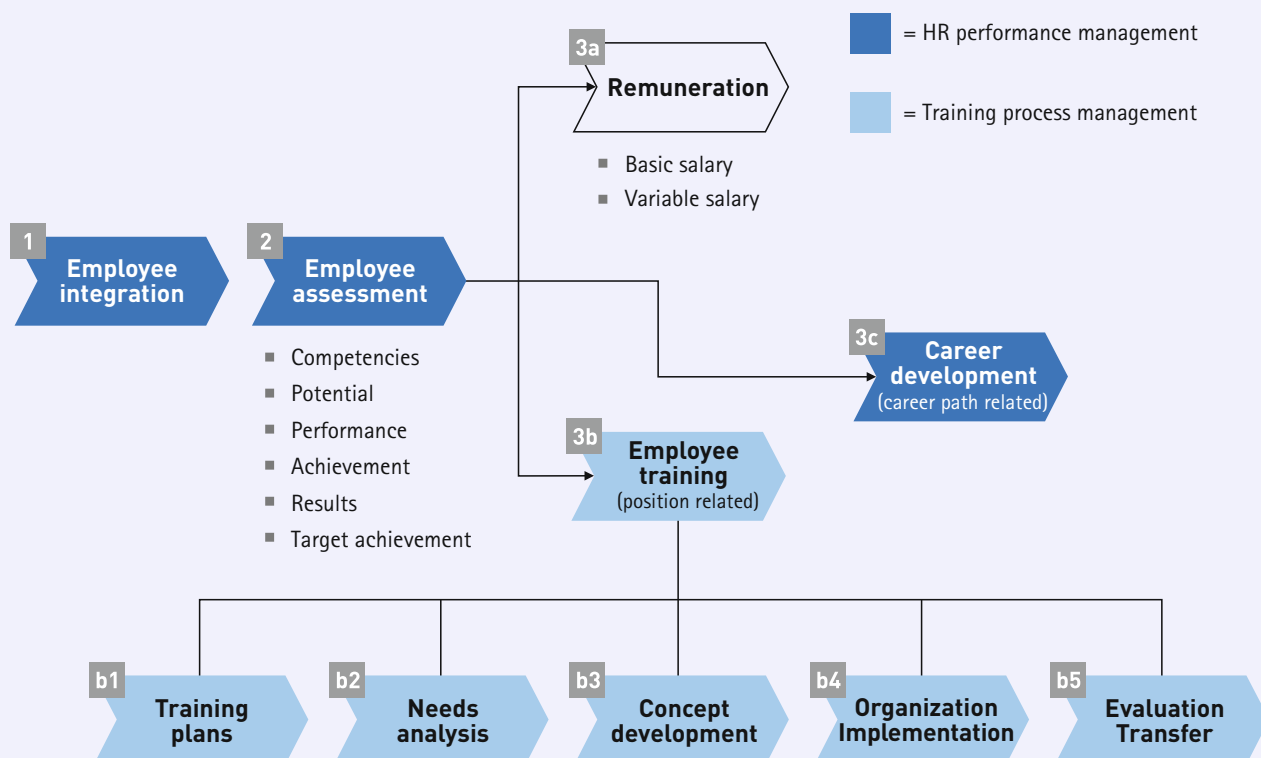
development can be divided into two sub-processes: HR performance management on the one hand (such as skills measurement, performance assessments, goal setting, and development planning) and the narrower sense of employee development on the other.

The IT market has plenty of solutions for each of these processes, as well as services and service providers. Solutions vary in terms of depth and breadth. Some packages center on HR performance management and

incredibly powerful applications such as SuccessFactors and ET-Web, others are more all-encompassing and intuitive with a leaning towards employee training – "learning management systems" such as Plateau and SumTotal.

The offering has become somewhat cluttered and bewildering. The already saturated software market is expanding, with outsourced solution providers and IT specialists offering a variety of consulting and system integration services. Consultancies with a

The process landscape of HR development



strong leaning towards HR are also entering the scene. So depending on the location, size or specific functional or technological need, businesses have a range of possible solutions to choose from as well as niche providers and support services. It is precisely here that the specialists at the TOP Steinbeis Transfer Center come in, with a methodical framework for selecting and evaluating IT products and services.

One example of the work carried out by the Steinbeis consultants involved a German company offering a complete range of financial services. It needed an effective IT system to integrate into its HR performance management and training processes. The main aim of the project: to harmonize the extremely heterogeneous application landscape and set up a user-friendly, intuitive application which would allow employees to carry out many functions themselves (self-service).

The project involved a number of stages, starting with a preliminary study to assess overall feasibility, budget implications and specific system requirements. The team then drafted an IT and departmental concept before carrying out pre-testing, operation testing and pilot testing. Finally the project was implemented and rolled out. The internal customers and stakeholders were involved throughout the entire process, occasionally supplemented by external experts. The role of the Steinbeis consultants in this complex project was to accompany the process and input with guidance and conceptual support. They also coordinated the results of sub-projects, assessed external notions and tracked progress.

There is no doubt that the process support gained from such IT projects goes a long way towards enhancing the professionalism of HR development and modernizing working practices. This applies in particular to the reduction of media gaps and disparate systems. But it also affects a company's ability to speed up administration, improve

reservation systems, communicate, and provide the data needed for reporting at all levels of management. Finally it can be central to communication with target groups and optimizing learning processes in the workplace. All of this largely depends on system improvements in terms of user-friendliness, utilization levels, improved control procedures and back-checks, and the degree to which self service employee/manager functions can be integrated.

Naturally, the huge potential to rationalize and upgrade IT also poses significant threats to HR development. This applies primarily to the threat of substitution in HR areas through information technology. Sometimes people "delegate" meetings with employees to an electronic system, much needed training sessions are handed down wholesale to web-based training systems, and even recruitment decisions are replaced by eAssessment tools. Of course business needs new systems and technology, of course HR development processes and training programs need streamlining, but unwittingly this has and will continue to result in the means becoming the end – unwittingly HR development will become an issue of technological capability.

There is enough received wisdom to know that this can not be right. One is the subsidiary principle in HR development, according to which HR development is primarily a process between staff and managers and between managers and company bosses. What also needs to be taken into consideration is the functional, process-related dimension of HR development. From this point of view, HR development should be a derived, supporting function within company processes, acting economically and efficiently, conserving time and resources.

It is this HR development aim, within the overall concept of business processes that warrants the type of systems outlined above and the use of service providers. Solutions should provide a homogeneous IT infra-

structure, linking media and systems without interruption, dovetailing with ERP and HR systems. Preceding this, another of the priorities is to improve structures, processes and services. Systems and processes should also be made flexible and individualized or personalized. Finally, in the ideal scenario, long-winded peripheral tasks and routines with little contextual relevance should be automated – and everything should be user-friendly.

When companies take these ideas to heart, IT has a meaningful role to play in supporting the aims and requirements of HR development. Whatever the nature or scope of HR, IT can make processes more economical and more effective. Despite this, one should always tread carefully. The aim is not to do this through technology. This might seem desirable from a HR point of view but it should only be done if it makes a tangible contribution to management and HR work and it can be warranted as an investment from an economical point of view.

According to studies and ongoing market research, all information technology solutions used or generated by HR development and providers:

- stem from highly disparate functional and technological configurations such as ERP systems, applications used to recruit employees, or systems used to assess employee performance
- extend or have extended functionality beyond original core processes (such as performance assessment, HR development, and staff training) into the steering of performance, successor planning, multi-source feedback and employee remuneration.

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A technical trading company moves on, methodically

Successor successfully selected

According to research at the Bonn IfM (an institute for medium-sized business research), every year 70,000 companies have to work out who should next head up the company. The number of family firms recruiting a successor within family ranks is declining. And more and more firms are closing down. But there is an alternative, as a technical trading company discovered. By thinking ahead, it secured jobs, its future and its next chief executive.



Photo: photocase.com/zettberlin

According to the IfM in Bonn, between 2005 and 2010 some 350,000 family companies will be looking for a successor to head up the business. The IfM estimates the number of family businesses seeking a successor in 2005 at 70,000. These firms employed around 680,000 people and only 44 per cent found a successor within family ranks. Some eight per cent had to close down operations in 2006 solely because they could not find a successor. According to a current DIHK survey, one third of all senior managers ques-

tioned said that they could not find a suitable successor.

The problem does not only lie in the lack of family successors – the specific nature of many sectors of industry works against an elegant solution. For example: technical trading companies, the link in the chain between production, processors, trade and industry. The backbone of any such business is years of intensive networking, relationships that go beyond the price of a com-

ponent, key aspects (often more important than competitive pricing) such as constancy of supply, meeting deadlines, trust, and an ability to respond to individual requests and special needs. Lots of technical supply companies are medium-sized by nature with several generations of a family working side by side. Lose the head of the business and in one fell swoop you lose acquired knowledge often going back decades – as well a network of personal contacts.

The only alternative is to seek a successor from outside the family. The key to success will then be the matching process between the business manager and the business. Without external input, scouting for recruits is generally haphazard and unmethodical so the success rate is usually very low. Under increasing time pressure, companies even start considering the merits of financial investors who may well look after the personal interests of the owner but will tend to neglect the ongoing interests of the company – to say nothing of the ongoing employment of staff. Pure financial investors often expect such inflated returns that it weighs heavily on the medium and long-term survival of the business.

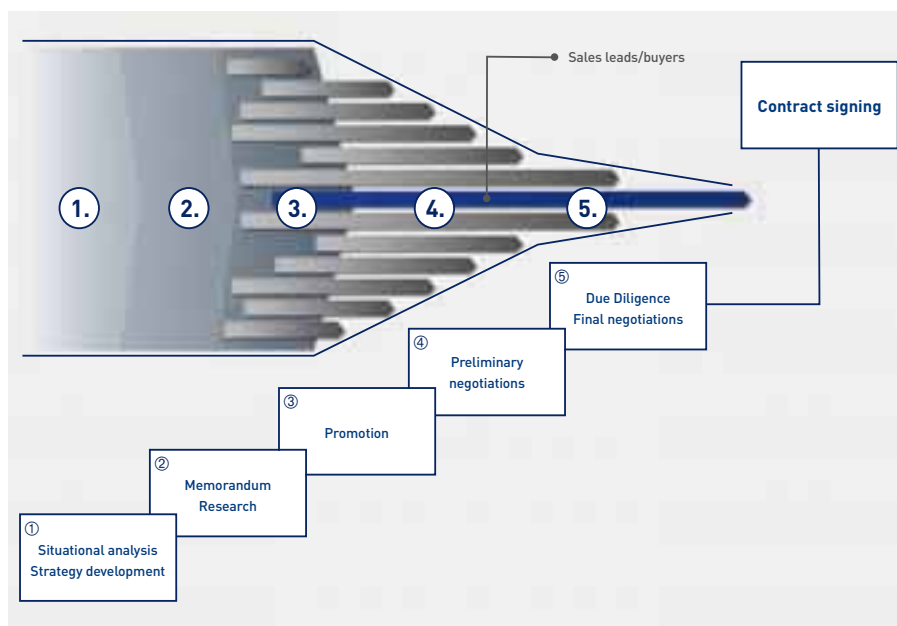
Johannes Bogner (name changed), was a 62-year-old sole trader looking for a successor for his second-generation technical trading company. His aim in identifying someone to take over the business was to sell his own share of the company for the best possible price (especially as this would affect his financial situation in retirement), but also to safeguard the jobs of staff who had been working for the company for years. He was also keen to keep up the good work

of his parents and the strong image of the traditional company. Bogner wanted the sale to be over and done with quickly as he was nervous about the economy, saying, "If sales and margins went down it would lead to a devaluation of the company. Apart from which workers wanted some medium-term security."

Bogner's first, almost arbitrary attempt cost him valuable time as the broker he went through was not familiar with the industry. "He spent more time thinking about the value of fixed capital and stock; he hardly looked at our reputation and the years of contacts we'd built up," recalls Bogner. The broker also failed to approach enough potential buyers and cut too many corners when researching buyers. The result: not enough meetings and presentations.

The second time round, Bogner was more methodical. Having already worked with Steinbeis on a material testing project and a market and technology evaluation, he was familiar with the workings of its network. What he did not yet know about was Steinbeis Mergers & Acquisitions, a transfer center specialized in consulting in the technical equipment trade with a long list of reference projects to its name. No sooner had he called in the experts, he knew things would be totally different from his first attempt. "We started with a detailed analysis of the current situation looking at the company's strengths and weaknesses. This was important for later negotiations as knowing your strengths and weaknesses makes it easier to deal with the buyer," explains Managing Partner, Steffen Lohrer. The team also drafted a résumé on the company to provide potential purchasers with a quick overview.

Next the Steinbeis experts conducted market research and pinpointed 80 potential buyers or investors. Bogner continues: "After detailed discussion with me they then drafted a short list of 30 key contacts who Steinbeis M&A got in touch with. Parallel to this the team sank its teeth into the company evaluation." One of the Steinbeis experts, Jürgen



Methodical sale process

Rehberg, explains the sector-related evaluation criteria: "At the moment sector-specific factors are given a score between 4 and 7, depending on the product portfolio, growth rates, returns and overall turnover. The second and more detailed evaluation is carried out using "discounted cash-flow methods". Naturally, during negotiations we use the method that gives us the higher value."

The investors on the shortlist were approached through an anonymous invitation to tender which was followed up quickly in person. The outcome of telephone calls went into a status report which was sent to Bogner every weekend with comments. At the end of this two month process, eight meetings had been requested by potential buyers. Two of these – direct competitors – were approached, very carefully, using the argument that the company was looking for a strategic expansion partner. The team was delighted with the results, as Johannes Bogner explains: "After three months we had received six offers, three of which were highly interesting."

The team quickly agreed a statement of intent with one of the bidders capturing all key aspects of a takeover. "But things got quite interesting again as the bidder started backtracking. Apparently the sec-

Commenting on the buyer market, Steinbeis expert Jürgen Rehberg says

"As the German economy is flourishing, there are currently some 30 to 40 technical trading companies actively seeking to buy, of which a good ten are major investors.

It's an ideal time to sell as selling prices are still high.

The question is how long the economy will stay healthy. Things have been buoyant for five years but in the past, few economic cycles went on longer than that. Apart from which, since mid-2007 buying prices at larger companies have slumped around 25 per cent because of the subprime crisis in the United States. Generally speaking, prices at smaller companies react the same way six to twelve months later."

ond level of management was not up to managing the company," says Bogner. The team soon worked out a solution, as Steffen Lohrer concludes: "Thank goodness the selection procedure on the last three bidders was so systematic. After the first candidate withdrew we shifted straight into final negotiations with the second. Interestingly, it turned out to be a local direct competitor which was able to build on the most number of synergies, so it was willing to pay a good price."

After detailed price negotiations, the buyer then carried out due diligence checks, which usually involve a close examination of the business by chartered accountants, lawyers

and tax consultants. As all data and facts were in order and available and no unexpected risks could be identified, both parties progressed to the final contract.

Despite this there were a number of hiccups which almost led to a breakdown in negotiations. Explaining his mediation role, Steffen Lohrer says: "After protracted discussions, as mediators we found time and again that we could get to win-win. When discussions take place directly between the buyer and the seller things don't always work out for the better." Within eight months, Johannes Bogner had achieved what he had set out to – an ideal selling price, secure jobs and the continued existence of the company. The buyer also finally accepted his concerns

about the location and guaranteed job security for all employees – and made that part of the agreement.

Summing things up, Steffen Lohrer notes: "To maximize the selling price and find the right buyer, it certainly makes sense to be methodical. The selling process has to be clearly defined in terms of timing and you need to negotiate with several potential buyers at the same time to optimize synergies and the price paid by the buyer." In the case of the technical trading company, Bogner was highly satisfied with the outcome which even exceeded initial expectations. He can now sit back and pass on his life's work to his successor.

Steinbeis Mergers & Acquisitions (M&A) offer a comprehensive range of services tailored to the needs of company transactions. Covering all stages of the transaction process, these range from market research to process control. Technical trading companies and service providers in particular benefit from the sector-specific experience offered by the global Steinbeis Network. Based on the application of internationally recognized methods for selling and buying companies, this combines M&A experience of markets, industries and technologies with an accomplished team of specialists who understand M&As from personal experience (www.steinbeis-finance.de).

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Optimizing processes at an automotive supplier

Process management: fueling success in the real world

In order to tackle the market challenges on the horizon, a small to medium-sized automotive supplier decided to integrate its process management. With customers placing high demands on quality, the supplier needed to improve processes with immediate effect along the entire production chain. To safeguard functionality, the Stuttgart-based Steinbeis Transfer Center Management Quality checked and optimized each process.



Trim strips for car side doors

One of the SME's many products is aluminum trim strips for car side doors. Production steps span: grinding (over two steps), polishing (over three steps) and then adding a high gloss finish. And throughout all five steps, the products are tested at intervals to monitor and ensure quality. Then the strips are cleaned and given a final check using an illuminated magnifying glass before they're packed individually. All of these steps are done by hand.

To help structure its processes, the company joined forces with the Steinbeis Transfer Center Management Quality to reap the benefits in more ways than one. Processes saw sustainable improvements, and all were documented. The course of action planned earlier was put into practice. And since the

process management was tailored to the size of the SME, the company could react more quickly as a supplier, ultimately boosting its appeal in the automotive industry.

The restructuring improved the process landscape, playing a key role in optimizing the company's financial performance. And reducing material losses also cut costs by ten per cent. Thanks to this successful collaboration, the SME could once again focus on its core business – and continue to live up to its quality agreements as an automotive supplier, every single time.

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A plea for prevention in political and crisis management

Look a crisis in the eye

From corruption to cutting jobs, companies find themselves making headline news again and again, casting a negative image in the media. Major crises show how products and corporations are caught in journalists' crosshairs every day. And these instances also demonstrate how poor crisis management quickly allows a problem to escalate to catastrophe – significantly impacting a company's image and brand. Dismissing the manager supposedly responsible may effect short-term change, but a company's reputation will most certainly suffer long-term.

Every crisis is different. Each one is an intersection of ecological, economic and political interests which may or may lie outside the moral code. At the same time, today's consumers are more critical, more sensitive and more ready for conflict. If crisis management is insufficient, if inconsequential promises are made, if communications are steered to a disastrous conclusion – top managers are held personally responsible for the fallout. As a result, crises place an extreme burden on the psychology of those ensnared in them. Stressed and pressured by exceptional circumstances, people react spontaneously and impulsively when they can't tap into solid preventative measures. The question is, now what's to be done?

The growing number of crises in recent years and the prognosis that the trend will continue make it impossible for companies to ignore at least a cursory examination of the science of crises. Crisis management and crisis communications have evolved into one of senior management's central tasks. They must identify and anticipate potential crises, create infrastructures, rehearse courses of action and train employees. It's the only way companies can react to predicaments with grace under fire – instead of a full-blown panic attack. What's more, clearly designated responsibility plus a management model which perfectly balances improvisation and organization is a company's sole method of going on the offensive during a crisis and preventing it from reaching the next level – a catastrophe.

Crises have a way of creeping up. Issues deemed harmless yesterday evolve into today's flashpoints. So establishing an early warning system to spot and monitor possible risk-laden subjects are essential to managing crises successfully. This entails professional "issues management" by using media reports, relevant discussions, new directions in the company or government policy as well as legal battles, regular and focused monitoring of various platforms can be leveraged early to lessen the damage. And due to crises' growing significance as well as expanding mass media, the growing significance of professional crisis PR will also keep pace. Mass media, too, is subject to more intense competition, so it will invariably find itself embroiled in explosive subjects. To steer clear of them, organizations must address how the company sees itself by engaging with more discerning and demanding stakeholders and at least recognize their wishes and expectations. In the future, forceful and persuasive crisis PR will be what tips the scales. Communication which genuinely explains something helps align a company's self-image with how outsiders see it. The outcome: the foundation for a relationship in greater balance.

Another important component in sidestepping minefields is analyzing political and social activities which are germane to the company. Evaluating the interests of others as well as analyzing possible courses of action are essential in being able to respond as an early warning system in grave circumstances.

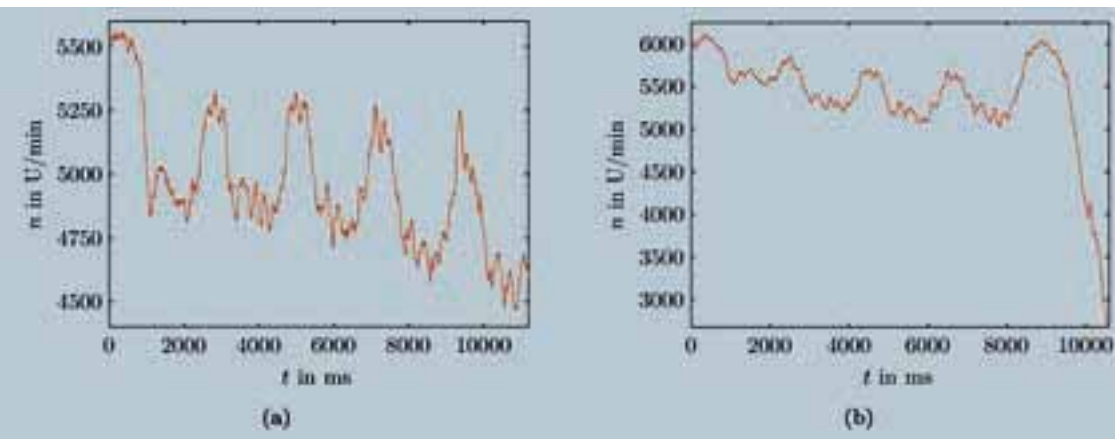
Political advisory services to help companies see that their interests prevail in politics have taken off in Germany. Lobbying behind closed doors – often met with criticism – has evolved into a professional, strategic tool to represent interests. Now, "how you do it" trumps "who you know". Laws pertaining to companies are harder and harder to keep track of, and the economic consequences of political decisions are, at best, difficult to gauge. Companies will need to act more quickly in the public eye to keep unwanted reactions at bay. Also key: watching relevant political developments and making positions heard.

Business managers at the Steinbeis Institute Political & Crisis Management at the School of Governance, Risk & Compliance at Steinbeis University Berlin receive thorough schooling in political communication and professional crisis management. Experts in science, academia, business and politics shed light on the entrepreneurial, legal and political side of "the weaponry" in political and crisis management. This imparts necessary, interdisciplinary expertise with twofold benefits. Managers are trained to react capably to both the media and in a political setting and can pinpoint possible political stakeholders as well as imbroglios.

Obstruction detection for power adjustable seats

Reliable help for obstruction conditions

To meet customer's growing expectations of cabin comfort and surpass the unrelenting benchmarks set by the competition, more and more automobiles today come equipped with power adjustable seats. With this feature in place, engineers are now devising a protective mechanism with which to prevent obstructions. However, making that safety measure a reality still poses difficulties.



Typical rpm progressions of an adjustment motor in a backrest incline, during a normal situation (a) and an obstruction (b).

Because of the costs involved, the technology in use must dispense with extra sensors and further hardware components wherever possible. In other words, the solution needs to be purely based on software. Existing sensor signals – such as rpm or the adjustment motor's current – must be made to relay parameters for situations in which an obstruction could occur. These would help pinpoint when a seat is actually obstructed. What makes the development work so complicated? Just some of the many issues include the wide range of power adjustment mechanisms, the different physiques of passengers and their unpredictable movements – not to mention all the kinds of situations in which seats can be obstructed.

One indication that the seat is being obstructed is a marked drop in rpm. This kind of drop is caused by blockage or by a heavy, abrupt and intense load placed on the adjustment motor (since the seat adjustment is moved against the person whose seat is being obstructed). The backrest angle adjustment often uses a mechanism which

would cause the signal flow in the adjustment motor to oscillate quite dramatically during normal operation. The basic problem, however, in identifying obstructions comes down to reliably differentiating the oscillations merely tapering off from the breaks in rpm which are characteristic of obstructions.

Steinbeis professionals at the Steinbeis Transfer Center Automotive Electronics and Mechatronic Systems in Friedrichshafen, Germany are devoting their energies to implementing a software-based obstruction sensor unit for power adjustable seats. Using a wavelet transformation of the rpm signal, these experts characterize the symptoms that accompany seat obstructions. The depiction of the parameters – in other words, making a decision based on symptoms indicating whether or not the seat is being obstructed – is augmented with a neuronal network.

Figure (a) shows a sample rpm progression for an inclination drive under stress. In con-

trast, figure (b) shows the rpm signal in a situation in which an obstruction might occur: at around 9300 ms the signal's trajectory drops continuously. This means that the engine is seizing up because an obstruction is occurring. Both test runs were performed with the same load placed on the seat and under 13 V.

Despite the low number of training data included for the neuronal network, the algorithm works very reliably. And thanks to the "taught" feed-forward network, it also correctly analyzes every test signal available. The benefits are twofold. Every situation in which an obstruction could occur is identified as such, and yet no situation during normal operation is incorrectly diagnosed as an obstruction. For every available test signal, the algorithm recognizes the lion's share of obstructions between 200 and 500 ms (at the latest). Obstructions are also typified independent of the present rpm range and current seat position. Even better: different loads on the seat do not impact the algorithm's analytic capacity.

Photo: photocase.com/sandan

A conflict management system for projects focusing on technology

The human element in R&D

When R&D projects grind to a halt, technical issues usually aren't the root of the problem. Project success hinges on "people factors" such as mutual trust and respect, equal share of power in the best interests of everyone involved as well as proper communication. This is especially relevant to projects which bring together multiple partners in industry, research and academia along with SMEs. A preventative conflict and contract management system can help build a solid and robust foundation on which relationships – both inter-personal and legal – can form. Set against the all-too-often high project costs and the risks of failure, setting up this kind of system often takes minimum effort and is worth the investment.

A range of studies has corroborated the impressive findings: many R&D projects in the technology sector fail not because of problems inherent in the technology, but "the human element". In other words, so-called soft factors. And they're often compounded by cryptic or erroneous contractual foundation.

Despite this, a number of R&D projects still do not pay enough attention to the human element. Most project objectives are trained on complex, technical objectives peppered with ambitious timescales and lean budgets.

Technology and the exchange of data are made compatible at great expense, yet the degree of compatibility between people is often overlooked, pushed aside or neglected; even though a project succeeds or fails on the human element. But if project managers can harness this power, they can check off one major marker on the road to success.

Against this backdrop, the Steinbeis Consulting Center Business Mediation specially

designed and developed an effective and integrated conflict and contract management system for projects focusing on technology. Its aim: properly factor relationships and the social setting into projects. It also places special emphasis on projects which involve small R&D-driven companies and major organizations, mainly in industry, research or academic establishments.

The conflict management system helps project managers analyze possible areas of conflict within the project as well as master intervention strategies to diffuse tensions, create communication techniques which still work when people are under stress, create trust – and ultimately integrate all of them into working processes. Another cornerstone is mediation – also preventative – a recognized, structured, and effective method to shaping communication and working through conflicts.

The Steinbeis Consulting Center Business Mediation team also called in solicitors specializing in technology to capture these soft factors in a robust contract management system, and in doing so laying the

groundwork for greater peace of mind, commitment and trust. Project partners now share one overarching objective: an equal split of the technical and financial risks facing them.

This collaboration also set aside resources to explain and document questions regarding the partnership between small R&D-driven companies and major organizations. The peculiarities of R&D contracts, change management and price adjustments were covered at length. The system also sets out ground rules for eventual advance deliveries, rights to research findings and how those findings are used. Rooted in each project's plan, this conflict and contract management system is transformed into an integral part of R&D efforts.

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Micro- and nanoscale structures in plastics technology

Molding makes miniature structures massive

Attached to Heilbronn University, the "Plastics Center" Steinbeis Transfer Center explores the replication of micro- and nanoscale structures on the surfaces of macroscopic plastic substrates. Take a cost-effective and efficient technology for special injection molding procedures – developed to shape the smallest structures as plastic components are being injection-molded. This opens up undreamed-of opportunities in creating the right structures when assigning functions to plastic components.



Display without anti-reflective coating (left) and with the moth's eye structure coating (right). AFM image of a moth's eye structure (front).

One potential area in which micro- and nanostructured surfaces could be put to use: applying anti-reflective coatings to plastic surfaces. The idea takes its cues from nature – a moth's eye, to be precise. A nocturnal moth's cornea has a very special kind of surface topography which features structures the size of nanometers. These structures produce a broad yet efficient anti-reflective coating. And the optical effect we see is because the structure bends the light hitting it.

Until now, scientists could reduce reflection only by way of thin layers of "interference". However, the relatively high costs (among other issues) proved the main stumbling blocks in applying this anti-reflective method

on a wider scale. Communications electronics in particular is experiencing increased demand for low-glare and cost-efficient display slipcovers which still allow for enough contrast – even in poor lighting – so users can read what's on their screens. Anti-reflective surfaces are also used in solar cell covers, projector lenses and illumination optics. Since these applications call for high translucency, synthetic glass with anti-reflective coating – like the one now being developed – could unlock a new dimension of efficiency.

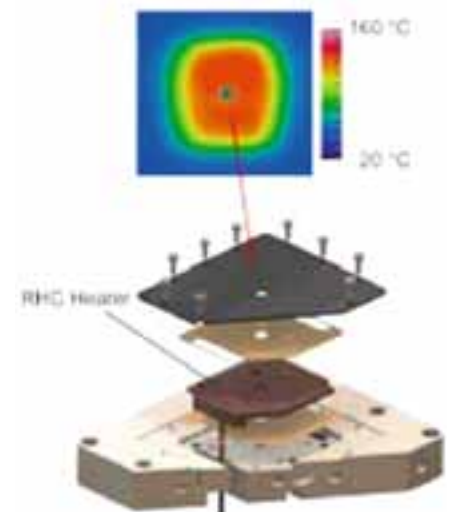
The key to making economical and flawless molds of these miniscule structures on substrate surfaces requires processes managed to perfection, complete with special machines and tool technology. One indispensable part is tempering the tool wall in a highly dynamic manner throughout the injection molding cycle. To accomplish this, employees at the Steinbeis Transfer Center Plastics Center developed just such a tempering system based on high-performance (Rapid Heating Ceramics) material.

Thanks to this technology, scientists were finally able to produce polycarbonate panes



Cleanroom with injection-molding machine at Heilbronn University

with an anti-reflective coating, generating a total reflection of less than one percent (compared to unstructured parts made of polycarbonate with a glare measuring 9.5 percent) – at a cost the market can bear. Fur-



Molding micro- and nanoscale structures in thermoplastics requires special tool technology that tempers the tool wall in a highly dynamic manner.

ther research has shown that this procedure will work both technically and commercially in producing plastic components with miniscule structures. Applications for micro- and nanostructures, though, are hardly limited to surfaces working at the optical level; this breakthrough opens up a number of related applications in medical technology, data storage and self-cleaning surfaces.

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Intelligent financing models for companies

Expert, integrated financial advice

Banks and investors of all stripes are noticeably tightening the reins when extending securities, covenants and spreads. The link between the subprime crisis and the more stringent requirements companies face to obtain credit is an open secret when speaking with a loan officer. The days of exorbitant liquidity and cheap credit seem to have passed. And just a few months old, the recent boom in the growth market of standardized "mezzanine solutions" for SMEs collapsed in mid-2007. The reason: mezzanine backers are experiencing some difficulties in refinancing the portfolios they structured on the capital market.

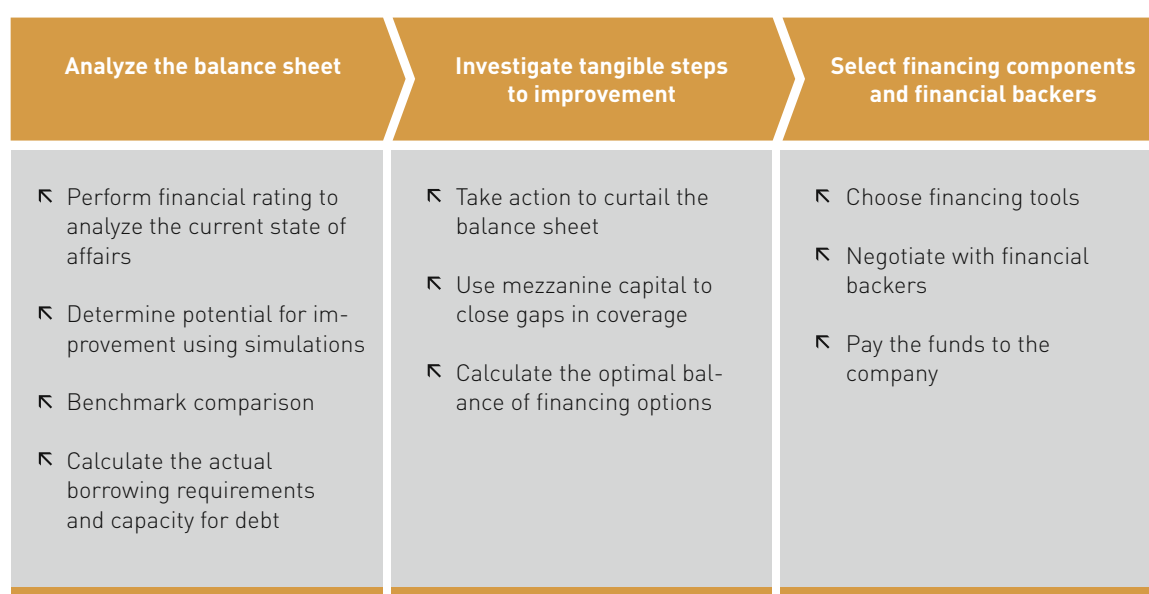
Then it's all the more important to consider every angle of financing a company. To be sure, there are plenty of lending components, but they don't always create a sound financial architecture when it comes to capital and cost structures.

In the last few years, the Frankfurt-based lending specialists at the Steinbeis Consulting Center SME Finance and Investments have thought in interdisciplinary terms to develop and put

into practice an array of "smart" financing models for owner-managed companies as well as those listed on the stock exchange. In their financial consulting work, the experts often adopt a multilevel approach.

The outcome: companies flexibly and cost-effectively secure loans on the capital market and through other financiers. Packages entail conventional, alternative and innovative forms of financing – each component perfectly balanced and matched to one another. Even customers in the automotive supplier industry reap the benefits.

Despite the passing clouds overhead, the global market for innovative electronics in automobiles will, over the longer term, continue to average high rates of growth since the use of electronic components in automobiles will only become more prevalent.



Normally, margins for electronic automobile equipment in the automotive supplier industry are slim, but suppliers will have to bear an even greater share of the development costs of new technologies – which means the need for financing will also increase. It's times like these in which companies rise or fall on a carefully considered financing package.

This was precisely the case with an automotive SME working with Steinbeis Consulting Center SME Finance and Investments experts to markedly improve the former's financial circumstances. Following an investigation of the financial structure and optimizing the working capital, the company was able to raise the mezzanine funds needed for sufficient growth capital. As a result, this boosted the company's equity ratio, thereby reducing short term lines of credit.

This action advanced the company's rating from "BB" to "BBB". Afterwards, interest rates offered by banks dropped and the company enjoyed more generous terms of credit in their current account (used to finance the additional growth). This partnership between Steinbeis professionals and the customer created much more than a financing model which helped the company meet its objectives – when looking at the bottom line, the model involved better terms of credit and a well-balanced financial architecture.

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A machine for every kind of container

You name it, it labels it

A company named etifix commissioned the Steinbeis Transfer Center Process Development to tackle a most unusual project: to develop a labeling machine for self-stick labels that accommodates all kinds of containers (such as bottles, cans, jars and tubes) without requiring major modifications.

The geometry alone is staggering. Containers with diameters measuring 20mm to 200mm, up to 500mm long and tubes with diameters spanning 16mm to 60mm, up to 300mm long. The task seemed unrealistic

and impossible: have one and the same machine run the labeling for both kinds. Until now, the great differences between the sizes of the containers and tubes meant two entirely different machines were required.

The background: in recent years, etifix has not seen significant growth in the quantity of containers it labels, but due to their contents, the company had to separate the containers into an extremely high number of groups. Another key factor is that the costs for these containers – which are, as a rule, disposable – are very expensive when compared to the costs of filling. So to keep costs down, it made sense to use empty containers every time and simply change the labels for the contents.

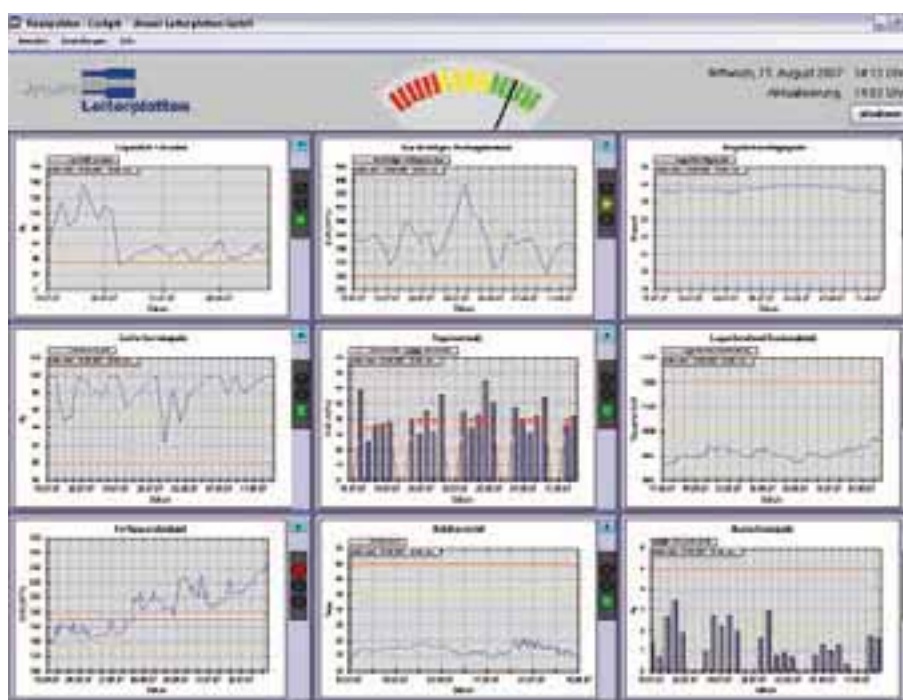
Using a design system, the experts at the Steinbeis Transfer Center Process Development in Reutlingen, Germany generated solution matrices and constructed an artificial machine model which met every requirement listed earlier. The labeling machine is equipped with two lifting units, one for containers and one for tubes. Containers are picked up by rolls arranged in "Vs" and tubes on a rotatable pin – and in both cases, they're pressed against a drive roll where labels emerge from a dispensing tip and are applied to the containers and tubes. And the most important part? It requires no molded parts specially designed for the machinery. This alone makes it like no other in the world. By now, the machine – available as a fully or semi-automatic system – has been granted IP rights.



Steinbeis student implements a financial management cockpit system

Corporate management at a glance

A graduate engineer and managing director of Jenaer Leiterplatten, Sven Nehrdich has a thirst for challenge – that's why he's also studying in parallel for an Executive MBA at the School of Management and Technology at Steinbeis University Berlin. Using a financial management cockpit, Nehrdich aims to shield his company from internal and external threats. The main ones: growing competition and pricing pressures in the electronics industry (due to the Asian market) and the competitive environment becoming more and more dynamic. The "ratios cockpit" is designed to help decision makers to react quickly and correctly to changes in the market and competition while taking the right countermeasures to alter the environment to the company's benefit.



The "ratios cockpit" for Jenaer Leiterplatten

Jenaer Leiterplatten specializes in manufacturing printed circuit boards (PCBs) in small quantities and short delivery times ("express services"). Thanks to a 33 year track record in PCB manufacturing and a seasoned group of employees and flat hierarchies, the company is perfectly positioned to offer technically sophisticated PCBs in a broad segment of the market – and putting them in customers' hands in the shortest time imaginable.

How well his company is doing at the moment financially, is not a reason in itself for Nehrdich to change management policy at the executive level. He realizes, however, that the market and environment are always

in flux, and this could have a huge impact on the company. So Nehrdich is using this time of prosperity to launch a monitoring system that's intertwined with the company's strategy – in fact, no such early warning system to track internal and external indicators had ever been deployed at Jenaer Leiterplatten before. Developing the management cockpit was also Nehrdich's project towards his master's degree studies.

Ratios could not be derived from strategic objectives or management structures, so Nehrdich also launched a risk management system as a basis on which to determine the ratios. Every risk which could affect the

company was pinpointed and graded on how severe the effect could be. With the ratios in hand, Nehrdich prioritized them and used several evaluations to establish ranges as well as warning and alarm thresholds for every ratio. Another side effect: the analyses also improved the company's information management.

Once the ratios were established, the next task involved simulating various kinds of damage-control actions and compiling a catalog of countermeasures. Nehrdich modeled the look of his financial management cockpit on a flight cockpit. During several test runs, he simulated ratios to trigger a deviation in threshold values and also experimented with different displays in a variety of situations. Having undergone many iterations and improvements, the system is now in use.

Equipped with his own financial management tool, Nehrdich can now size up how Jenaer Leiterplatten is doing at a glance. Should the ratios deviate, he can quickly activate pre-determined control mechanisms. What's more, the financial management cockpit acts as a model on which to launch customized cockpits in other areas of the company.

Rhetoric and communication in the lecture hall and in the office

"Rhetoric and communication in the lecture hall and in the office" – the focus of the Rhetorics Congress from 24–25 September 2008 at the Haus der Geschichte in Stuttgart. Sponsored and hosted by the Steinbeis Transfer Center Industrial and Organizational Psychology in Ludwigsburg, the event will help participants rethink the problems facing rhetoric in tertiary education.

Rhetoric and communication are found wherever, whenever people come into contact with one another. They are what bring different aims to light. In a university setting, these rhetoric and communicative processes work to meet educational goals. Companies, too, leverage these processes to achieve specific ends. Both types of organizations, then, are facing enormous pressure to perform. This Transfer Congress will address what can be compared in these scenarios, but will also highlight the religious foundation which gave rise to both. Given the efforts devoted to globalization, it makes good sense to embrace intercultural dialogue and reflect on backgrounds which still speak to us today.

The panel of speakers includes historian Dr. Jürgen Smettan (Association of German Psychologists) and His Imperial Highness Dr. Asfa Wossen Asserate. Congress partners are the Institute for Cognitive Management in Stuttgart, the Association of German Psychologists and the Ludwig Maximilian University of Munich. Held every year since 2000 at universities of cooperative education throughout Baden-Württemberg, this event is the latest incarnation of an ongoing educational program to raise awareness in and for communication and rhetoric. University and college-level professors will find this congress highly insightful, as will those who work full-time or in a more voluntary

capacity at institutions of higher education in Baden-Württemberg. Representatives from partner companies as well as business, centers of learning and interested industrial and organizational psychologists are also welcome to attend.

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Patents: no harbingers of marketing opportunities

At last year's Ingenia Forum on "Real-World Ideas – Patents" in Heidenheim, Germany, Ulrich Schmitt and Peter Gerloff – both from the Steinbeis Transfer Center Mechatronics in Abtsgmünd – taught participants the sense of ideas that make sense.

Using real-life examples, both mechatronics professors demonstrated that external consultants can make it easier to keep survey on technology overall and what patents are already existing. Why? Patents are not harbingers of marketing opportunities. In one example, the inventor had already found a licensee and two prototypes had been manufactured before it was discovered that the patent simply could not be marketed. The external consultant who was called in revealed the folly of the investment, thus avoiding additional and costly development work which would certainly not have met the desired objectives.

When registering a patent, Gerloff urged, it's an excellent idea to hire a patent attorney. Another example revealed how this proved to be the key in protecting a product which had already been manufactured. A competitor had wanted to showcase the new product at the same trade show at only half the price. It took a subsidiary claim mapped out by a patent attorney to clear his product away from the trade show immediately. What turned the tide? The patent claim. The solution set out in the first company's claim also described the product's design. Technicians, the speakers argued, would have considered the design so obvious that they

would have never included it in the patent, thus leaving the company on shakier ground. This reflected the evening's motto and sound general advice from the experts: "First care about the 'musts', then about the 'shoulds'". The Ingenia Forum convenes once every quarter and addresses topics specific to patents.

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Steinbeis alumnus named "Top 25 Manager"



Photo: Heuer

Managing director of Caritas Einrichtungen gGmbH, Marco Bambach graduated from the Steinbeis University Berlin's bachelor's and master's degree "executive program". He's even written a book. More than enough reason for business publication Handelsblatt to name Bambach one of Germany's top 25 managers in 2007 for "career of the year".

The sole representative from the not-for-profit arena, 36-year-old Bambach was lauded for "climbing the ladder quickly, his professional success and exemplary leadership and rooting his actions in responsibility". Starting with Caritas by fulfilling his na-

tional service requirements, Bambach rose to the position of managing director within 15 years, heading up 850 employees.

Bambach also attended the Steinbeis Business Academy at Steinbeis University Berlin obtained his bachelor's, then his master's in the Social Management degree program – with top marks. Having mastered the two-prong challenge of working while studying for a number of years, Bambach is delighted to be counted among Germany's top 25 managers. This is the fifth year of the Handelsblatt award.

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New releases from Steinbeis-Edition

Steinbeis-Edition publishes works mirroring the scope of the Steinbeis Network expertise – one of the many ways we share what we've learned. Our range of titles spans a broad spectrum of excellent single volumes and series on management and technology.

Im Zwischenraum – en el Intersticio – In the interstice

Ger., Span., Engl., 1st edition, 2007
ISBN 978-3-938062-08-1

Professor Dr.-Ing. Günter Köhler at the Steinbeis Transfer Center Processes in Jointing Technology in Jena, Germany has been championing younger artists and their work since 1995. He exhibits works and has published an accompaniment in the Steinbeis-Edition range. Currently, 36 exhibits have been held and seven works published. The latest project grew out of a collaboration with Argentine artist Mariela Limerutti.

Limerutti created this piece as a capstone for her master's degree at Bauhaus-Universität in Weimar, Germany. Designed to be shown in a public place, the work is entitled "In the interstice". For Köhler and Limerutti, this proved to be a trip back through time, back to Germany's divided history – to the year the Wall fell, to be precise. Köhler associates his earliest childhood memories with the



street in Weimar that is the focal point of the project; Limerutti expresses in her own way how human beings confront, and ultimately experience, freedom and foreignness.

Binding the cultures of Latin America and Europe are clouds in the sky, the very symbol of freedom and change. Limerutti took large-scale photos of clouds seen on house windows along Meyer Street in Weimar. The backs of the pictures bear the thoughts and hopes of the houses' inhabitants – from the time of the fall of the Wall as well as now. The project itself prompted the residents to meet each other and Limerutti, uncovering fresh interest in the old houses and the plethora of culture tucked away in Meyer Street.

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Steinbeis project now a UNESCO Decade project

UNESCO has recognized the Steinbeis project "Three Women – Culture and Sustainability" (see Transfer 4/2007) as one of its Decade projects. Ulrich Holzbour, director of the Steinbeis Transfer Center Applied Management in Aalen, Germany, developed this interactive project around three famous daughters of Giengen: Margarete Steiff, Lina Hähnle and Maria von Linden. The working title: "Sustainable Sisterhood".



Prof. Dr. Ulrich Holzbour, Franz Heger (mayor of Giengen), Jutta Heim-Wenzler (mayor of Aalen), Rudolf Kaufmann (head of the Agenda 21 office and Environmental Agency in Aalen). Image: Wörz/RTWE

UNESCO has declared the period between 2005 and 2014 a global Decade of Education for Sustainable Development. This initiative aims to anchor the principles of sustainable development in countries' educational systems. Selecting Decade projects at a national level acts as a decentralizing force and ensures local, on-the-ground support.

One of the 50 projects UNESCO recognized at didacta (trade fair on education) was a joint effort between the Giengen Cultural Office, the Giengen Cultural Foundation and the Steinbeis Transfer Center Applied Management. For two years, the projects holds

the title "Official World Decade Project". UNESCO emphasized the daughters' roles as models for finding one's own way and supporting the various aspects of sustainability. Now Holzbour and Uta Singer, Head of the Cultural Office in Giengen, plan on putting this focus into practice for Giengen and fashioning it into an important pillar in the town's new cultural development plan.

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Cross Media Publishing 2007 Market Study

The recently published Cross Media Publishing 2007 Market Study – co-authored by Steinbeis University Berlin, the Fraunhofer IAO Stuttgart, University of St. Gallen and e-pro solutions – pinpoints success factors in cross media publishing and how it's developing. Shedding light on the German and Swiss markets, the study analyzes nearly 150 company profiles and investigates both printed and electronic communication devices and processes.

International distribution, publications in local languages, a growing number of supporting publication channels, booming assortments of products – these continue to be the central driving forces behind cross media publishing and the use of product information management (PIM) solutions in companies. To cope with the rising complexity in international product marketing, companies will need to do two things: keep the flood of information in check and optimize their marketing processes over the long term – and in sync with external service providers. For cross media communications to be consistent and swift, product information, copy and translations need to be able to be used multiple times and through multiple channels in a highly automated

fashion. Strategic potential for success lies in effectively planning, implementing, and managing the cross media publication process while keeping an eye on cost, quality and time – which also steer success.

The Cross Media Publishing 2007 Market Study shows that 98 per cent of participating companies have an international presence, 68 per cent offer over 500 products and, taken together, everyone within their product range communicates in an average of five languages. Respondents also said that saving money is a secondary concern in cross media publishing. 69 per cent of enterprising building suppliers, for example, said they believed that their higher-quality cross media publications would also have a

greater chance of success with their customers.

This analysis of the market was conducted under the auspices of the Mobile Multimedia Multi-Supplier Distribution Information Systems (German abbreviation: M3V) research project with considerable backing from Germany's Federal Ministry for Economy and Technology. M3V aims to determine real-world situations where multimedia communication tools could be used for mobile distribution support.

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“Young Founders” winning team heads to Silicon Valley

Hailing from the Hansenberg boarding school in Hesse, Germany, four young men won last year's “Young Founders” competition (also in Transfer 3/2007), an initiative launched by Germany's Federal Ministry of Education and Research and organized and managed by the Steinbeis Transfer Center for Business Development in Pforzheim. Fabian Maier, Garry Spatz, Leonard Wein and Jonas Hausrucking scored points with the “Luminatio” product idea – a smart, energy efficient streetlamp system – enough, in fact, to beat out the competition in the final round. Steinbeis came through with a well-earned reward: a trip to Silicon Valley, where rags to hi-tech start-up riches stories unfold in style.

To experience a taste of things to come, the four fledgling entrepreneurs started with a visit to the Intel and Computer museums for an overview of how rapidly the industry is developing. And at Audi and VW, they got a glimpse of the day-to-day work at the company's design studios in Santa Monica – a perfect demonstration of how and where professionals can give their creativity free reign. “Never stop thinking” – so went the motto at Infineon, one of the world's larg-

est manufacturers of semiconductors. The students goggled at the company's portfolio – brimming with nearly 42,000 patents – and stopped by the head office for a thorough introduction to different approaches to work, career paths and, last but not least, essential skills for sought-after professions.

The opportunities and threats facing start-ups were the first issues to confront the Young Founders while at Jajah, a new Aus-

trian venture with a branch office in Silicon Valley. Jajah provides VoIP telephony that lets you use your telephone without tying you to a computer. And finally, at Detecon Consulting, a fellow German wished the winners “Guten Tag”. Managing director Daniel Kellmerit emigrated to the United States years ago and shared his thoughts on the differences between working environments in Germany and America.

The visit “across the pond” wrapped up with an outing to Yosemite National Park, a visit to the Independent Institute (one of the many think tanks of American politics) and guided tours of sights off the beaten track in San Francisco.

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From left to right: Barbara Sommer (Ministry of Culture of NRW), Jonas Hausrucking, Fabian Maier, Garry Spatz, Leonard Wein, Utho Creusen (Media Saturn Holding)

New Steinbeis Enterprises

Abbreviations:

SCC: Steinbeis Consulting Center

SRC: Steinbeis Research Center

SIC: Steinbeis Innovation Center

STI: Steinbeis Transfer Institute

STC: Steinbeis Transfer Center

FTC: Focos Transfer Center

The following Steinbeis Enterprises have been founded as of November 2007:

STC Process and Project Management (TPM2), Kötz

Director: Prof. Dr.-Ing. Helmut Hartberger

STC Health Promotion and Metabolism Research, Freiburg

Directors: PD Dr. Daniel König
Prof. Dr. med. Aloys Berg

SCC Science-Education-Business-Development – SEBD, Heidelberg

Directors: Prof. Charlotte Schulze
Dr. Klaus Plate

STC Chemistry and Polymeric Materials Technology, Esslingen

Director: Prof. Dr. Guido Wilke

STI SIMT Competence Center of Management and Technology, Stuttgart

Directors: Dipl.-Ing. (BA) Walter Beck, MBA
Dipl.-Ing. (FH) Rainer Gehrung
Dipl.-Ing. (FH) Peter Schupp

SCC Company Management, Gosheim

Director: Dipl.-Ing. (FH), Dipl.-Wirt.-Ing. (FH) Berthold Villing, M.Sc.

SRC Image Processing, Computer Vision and pattern recognition, Bonn

Director: Prof. Dr. Daniel Cremers

SIC Wine Economy, Heilbronn

Directors: Prof. Dr. Ruth Fleuchaus
Prof. Dr. Armin Gemrich

SCC Medium-Sized Businesses Financing and Investments, Frankfurt

Directors: Dipl.-Kfm. Christian Schulte
Betriebswirt Dieter Dorn

SAPHIR Kompetenz GmbH, Herrenberg

Directors: Prof. Dr. Werner G. Faix
Dipl.-Ing. (FH) Peter Wittmann

SAPHIR Deutschland GmbH, Herrenberg

Director: Dipl.-Verwaltungswirt (FH) Bettina Rominger

SAPHIR International GmbH, Herrenberg

Director: Annette Schulten

STC Power Engineering, Rostock

Director: Prof. Dr.-Ing. habil. Egon Hassel

STC Technology and Medicine, Villingen-Schwenningen

Director: Prof. Dr. med. Gerd Haimerl

STC Institute for Applied Psychology, Kehl

Director: Prof. Dipl.-Psych. Heinz-Joachim Feuerstein

STC Infrastructure Management, Bad Bergzabern

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Advanced Risk Technologies (R-Tech) GmbH, Stuttgart

Directors: Dipl.-Wirt.-Ing. Dimitrije Jovanovic
Prof. Dr.-Ing. Aleksandar Jovanovic
Dr.-Ing. Jörg Bareiß

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SCC Regional and Communal Development, Kaiserslautern

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STC Technology-Based Company Modeling, Darmstadt

Director: Prof. Dr. Erich Ortner

SCC MOBILE Institute for Systemic Dialogue, Böblingen

Director: Dipl.-Verwaltungswissenschaftlerin Verena Burgbacher

STI Public Health and Healthcare NRW, Berlin

Directors: Birgit Gaida
Dr. Herbert Hockauf

STC Lightweight Construction Technology, Meschede

Director: Prof. Dr.-Ing. Hubert Klein

FTC Research | Consulting | Studies, Karlsruhe University of Applied Sciences

Director: Prof. Dr.-Ing. Frank Artinger

SCC Marketing and Business Management, Geislingen

Director: Prof. Dr. Jörg Heinzelmann

SCC Management Consulting, Furtwangen

Director: Prof. Dr. Britta Bergemann

SCC Markets and Innovation Management, Erbach

Directors: Dipl.-Betriebswirt Heinz-Peter Aulbach
Dr.-Ing. Ulrich Lutz

STI Corporate Responsibility Management, Berlin

Director: Dr. Felicitas Mocny

STC Clothing Technology, Reutlingen

Director: Prof. Ing. Angela Maier



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