Bertrandt*magazine*

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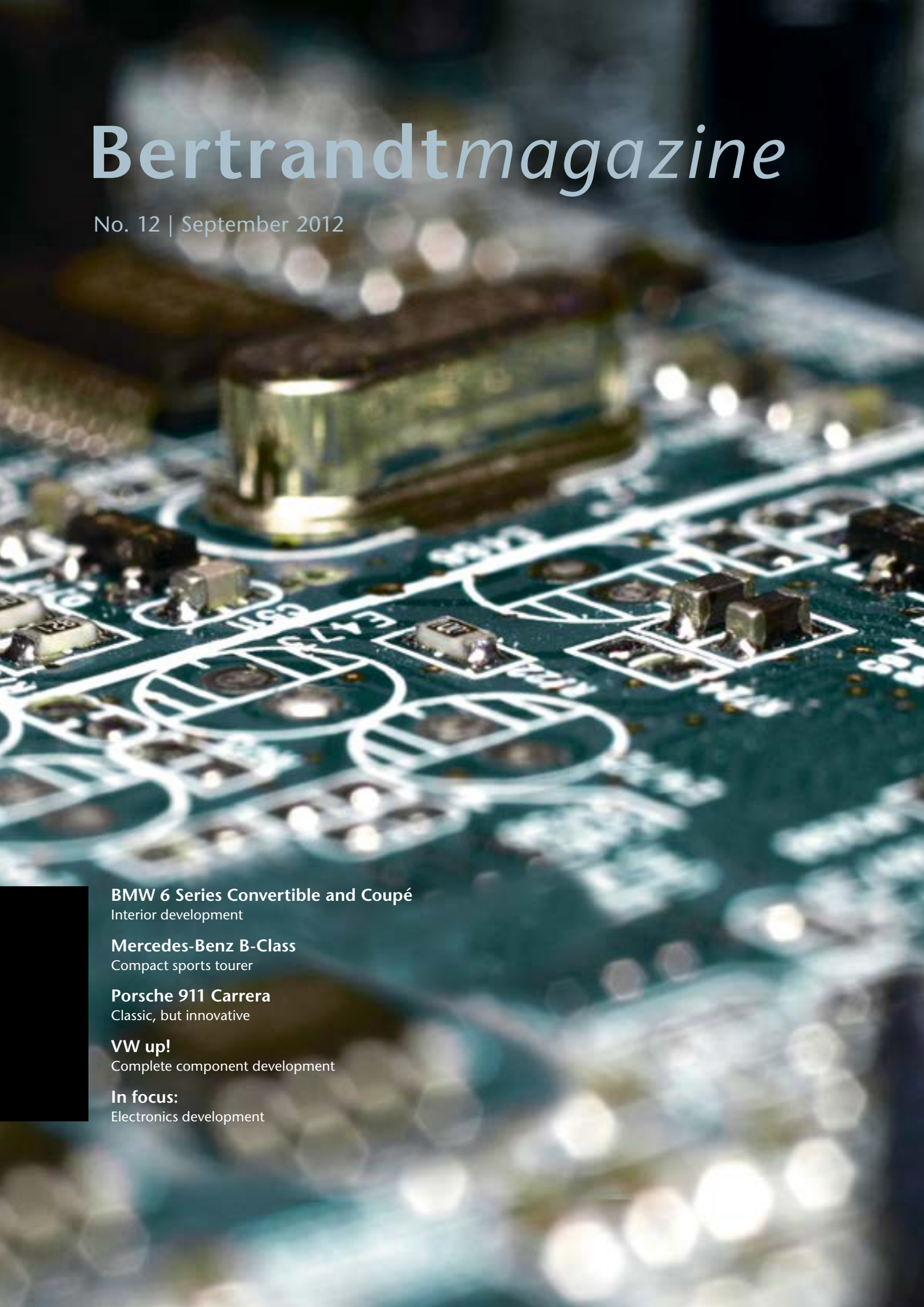

BMW 6 Series Convertible and Coupé
Interior development

Mercedes-Benz B-Class
Compact sports tourer

Porsche 911 Carrera
Classic, but innovative

VW up!
Complete component development

In focus:
Electronics development

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Editorial

We live in exciting times. The market is currently characterised by a wide variety of models and a range of new technologies. Manufacturers of pioneering products are moving into new niches in order to strengthen their position on existing and future markets. In many cases, they are commissioning external service providers to carry out the growing volume of development work. Bertrandt offers expertise covering the entire vehicle development process and provides support that market players can rely on.

This latest issue of the Bertrandt*magazine* will give you an insight into our portfolio of services. The focus is on our electronics development department, where engineers and technical specialists work on all aspects of electromobility, safety, comfort and connectivity, offering everything from individual services through to service packages with project responsibility. Our special feature on light and visibility covers lighting systems which fulfil a safety function and act as distinctive styling features. You will also have the opportunity to visit our endurance testing team who are in action on your behalf for 365 days a year.

Our comprehensive range of services also enables us to offer a broad selection of interesting jobs. We support and develop our junior staff and make available a variety of sandwich courses and apprenticeships for potential employees. We intend to continue producing individual solutions for our customers in future and we need the right people to help us to do this. Our employees are very important to us and we are pleased to be able to demonstrate this using examples of customer projects during which we have won our customers' trust and their approval to publicise the work we have carried out.

We are constantly investing in the latest developments, in order to enable you to overcome the challenges of the future with the help of our expertise and dependable support. Our spotlight feature gives an overview of some of our most recent investments.

Find out more about the exciting world of development services. More than 9,000 Bertrandt employees will take you on a journey through the Bertrandt Group and give you an insight into their work, which covers all aspects of the product development value chain.

Dietmar Bichler

In this Issue

In focus:
Electronic control systems

Safe, innovative
and flexible

A passion for aesthetics
and dynamics

Classic, but innovative

Top of the class in flexibility

Complete
component development plus
exclamation mark!

Spotlight

Bertrandt Munich

New test system saves time and money

In order to maintain their competitiveness on international markets, car manufacturers are constantly fine-tuning and improving their development processes. This applies in particular to real-life testing, which, in terms of time, is a critical aspect of the development process. The majority of the test rigs and benches used to validate bodywork components are individual solutions which have to be modified for each different test specimen in accordance with the regulations, a process which is highly time-consuming. In addition, the amount of electronic components in vehicles is constantly growing and these have to be included in the test procedure. Against this background, Bertrandt has developed a software-based test system to reduce the time needed to set up and run endurance tests and take individual measurements. The new system has already proved its worth in door, sun roof and seat endurance tests and in measuring component stiffness, saving customers both time and money. ■

Bertrandt Cologne

Climate-controlled testing

In two buildings the members of the Cologne testing team carry out tests in the fields of environmental simulation, vehicle safety, vehicle conversion, climate-controlled vibration and functional endurance. The new electrodynamic shaker with combined climate chamber, which for its size is one of the most powerful in the Cologne area, has generated a great deal of interest. The climate chamber that can be added to the system allows vibration tests to be carried out under specific climatic conditions, including temperature and moisture levels. The ability to combine vibration and climate tests enables components which are particularly sensitive to environmental conditions to be validated, such as electronic switches, wiring looms or complete seat modules. ■

Bertrandt Technikum, Ehningen

New laser tracker for mobile measuring

The purchase of the new Leica Absolute Tracker measuring system has enabled the Bertrandt Technikum to enhance its range of modelling services. The new system has a wide range of applications because it is mobile and can be positioned close to the component being measured. This enables the specialists in the modelling team to offer their customers the highest quality services using state-of-the-art equipment. The Leica laser tracker uses a laser beam to take accurate measurements within a spherical area with a volume of up to 160 m^3. The 3D data can be recorded in different ways: by following a small mirrored sphere, also known as a reflector, or by tracking a Leica T-Probe, a hand-held "walk-around" wireless contact. The tracker can also be used in tough conditions, including production environments, measurement labs, direct sunlight, welding areas and rapidly changing ambient light. The system is characterised by its dependability, stable operation, volumetric accuracy and ease of use. ■

Bertrandt Ingolstadt

Mobile testing system

The new b.wire system developed by Bertrandt is the first mobile test facility to enable reproducible, non-damaging tests to be run quickly and efficiently. It does not need a mains power supply or mountings on the road surface and can be set up on level test tracks within a very short time.
b.wire is a mobile longitudinal dynamics system which reproduces the speed profiles of impactors used for the development of active vehicle safety features. The shape, appearance and radar signature of the impactors can be designed to meet the needs of the specific test. In addition, the impactors are sufficiently lightweight to ensure that the test vehicle is not damaged during the testing process. The new mobile test system allows Bertrandt to meet all its customers' requirements and to offer a range of up-to-the-minute testing services. ■

Bertrandt Wolfsburg

Focus on testing electric vehicles

Following a year of construction work, the third testing centre in Wolfsburg opened in June 2012. The specialists in Wolfsburg are now fully equipped to offer additional testing functions in areas such as vehicle safety, acoustics, chassis and engine testing and electromobility. The importance of electric vehicle development has been highlighted by further investments, including a dynamic, high-speed test bench for electric motors which meets the latest international standards and a specially equipped safety area for high-voltage testing. Electronics testing labs with a comprehensive range of equipment for complete vehicle integration tests and a system for modifying applications, endurance tests and accompanying function tests add to the extensive portfolio of services. The Wolfsburg site has also focused on extending its environmental simulation area, installing a low-speed crash pendulum, doubling its servo-hydraulic testing capacity and centralising its shaker resources.

Bertrandt Ingolstadt

A new robot-assisted climate chamber 105 m³ in size enhances the portfolio of testing services

Robots are playing a growing role in testing and validating components in the automotive industry. The aim is to design and manufacture vehicles more cost-effectively and more ergonomically. In addition, the weight of components has to be reduced and the production processes improved. In order to carry out realistic trials and endurance tests covering areas ranging from the vehicle interior to the body-in-white, the latest testing systems are needed. As a result of growing demands from the automotive industry and in the light of the potential offered by new robotic systems, a new climate chamber 105 m³ in size has been installed at the Ingolstadt site. The chamber will play a decisive role in testing doors and closures under climatic conditions. Alternating climate tests in a temperature range from 40 °C to +140 °C with a temperature gradient of 2 K/min, controlled relative humidity of 95 % and test specimens weighing 4 tonnes do not present a challenge for the new system. It has a floor area of five by seven metres and is three metres high, which guarantees sufficient space for testing. It can be used, for example, to adapt test equipment on a complete vehicle for the purposes of door and closure testing. In addition to endurance tests, parallel tests can be carried out in the chamber in order to identify synergy effects. Eight large windows in the side walls and double doors give an all-round view of the test specimen and enable video recordings to be made of the tests.

Daimler EDM CAE Forum 2011
At the forum, specialists from the Bertrandt Technikum reported on their experiences of using the CAD system NX in the field of design engineering. The central themes of the forum were product life cycle management 2015 and Daimler's new EDM/CAD strategy.

Composites Europe 2011
Bertrandt presented three exhibits at the trade fair for CFRP technologies: a door shell, a cut-away door model with an advanced surface and an engine compartment cross member. The visitors to the exhibition responded very positively to the impressive expertise of the Bertrandt modelling department.

ISAL 2011
The team from Bertrandt's Light and Visibility competence centre exhibited for the first time at the 9th International Symposium on Automotive Lighting 2011, which took place at the Technical University of Darmstadt. For the industry visitors to the exhibition, the eye-catching feature of the Bertrandt stand was the rear light designed and manufactured by Bertrandt.

Electronic Systems for Motor Vehicles in Baden-Baden
At this event on the subject of electrics, electronics and the integration of mechanical and electronic systems, Bertrandt presented three exhibits in the field of connectivity which highlighted the growing importance of electronics in vehicles and demonstrated its role as a development service provider at the cutting edge of technology.

EuroCarBody 2011
Bad Nauheim was once again the meeting place for the worldwide network of vehicle body engineers. Bertrandt exhibited at the conference and demonstrated its competence in the field of car body development.

New Bertrandt website
The new Bertrandt website was launched in January 2012 to ensure that the company remains up-to-date with the latest technological developments. The modern, bright design reflects Bertrandt's contemporary image.

VDI conference on Plastics in Automotive Engineering 2012
For the first time, this conference in Mannheim focused on the opportunities for using plastics in vehicle lighting systems. The cockpit of the Audi A7 and the rear light developed by Bertrandt prompted a number of in-depth discussions.

Hannover Messe 2012
The interesting technical presentations given by Bertrandt und Bertrandt Services on the company's stand were very popular. The main highlights of Bertrandt's presence were the eQuad created by the electronics development department and several apps which make communication in and around vehicles easier.

Aircraft Interiors Expo 2012
Aircraft Interiors Expo 2012 was a big success for the team of aviation specialists from Hamburg, who were able to present and discuss with visitors their services in areas such as structures, stress and simulation, cabins, systems, manufacturing engineering, electrics, electronics and testing.

mic Automobil Forum 2012
The main spring meeting place for the German automotive industry focused on sustainable growth as the key to continuing competitiveness in the automotive industry. The specialists from the Bertrandt engineering services department were kept busy on their stand discussing their services with interested visitors.

Bertrandt Munich participates in the development of the BMW 6 Series Convertible and Coupé

Involvement in the concept phase of the development process for the latest BMW 6 Series models represented a challenge for Bertrandt Munich. We were the first service provider to be commissioned to develop several interior modules, which in the past had always been allocated individually to different suppliers. The process of developing the concept for the vehicle interior covered both the coupé and the convertible.

Inspired by a passion for aesthetics and dynamics

Interior fittings

Bertrandt acted as the central contact for all the interfaces and for the vehicle integration process. The Munich team also took responsibility for package investigations and concept designs, for evaluating possible solutions and for assessing the environment and the detail concepts at a component level. Other tasks included creating package specifications for the body-in-white, supporting the design process from a technical perspective and positioning and integrating add-on parts and components taken from other models, while taking into consideration legislative and ergonomic requirements. The team was also involved in the functional design of the test points for the head impact protection system, which forms part of the passive vehicle safety system, and in numerous other day-to-day activities. One new feature of the project was that the concept design of the modules was accompanied by simulation at this early stage in the project, with the same service provider being given responsibility for both tasks.

Specific challenges

During the bidding phase, Bertrandt was commissioned to develop the two derivatives one after another. After a short time, the plans changed and the decision was made to develop the coupé and the convertible in parallel. This reduced the amount of development work and, as a result, priority had to be given to exporting the prototype data. The goal of the project was to produce a self-contained con-

Bertrandt Munich participates in the development of the BMW 6 Series Convertible and Coupé

cept which took into consideration all the main production criteria and which could be handed over directly to the supplier responsible for manufacturing the components. The benefits were soon apparent and included a reduction in the amount of work needed and improvements in the technical consistency of the solutions. As the main contractor, Bertrandt's role also involved allocating projects to two specified subcontractors and managing and coordinating their work.
Introducing simulation activities at such an early stage in the project enabled all the specialists to network very effectively. Bertrandt needed in-depth and detailed knowledge across all the disciplines involved, which included concept design, simulation and testing.

Overview of customer benefits

- The customer was of the opinion that the central coordination of all the technical areas by one supplier and the reduction in the number of interfaces led to a positive outcome.
- Because the tasks were commissioned as a package, Bertrandt was able to provide a very quick response following the investigations that it carried out. This was the result of choosing an approach which covered all the modules.
- The cross-departmental investigations which took place in advance led to reliable results being produced much more quickly. In addition, the supplier enquiries involved a greater level of detail.
- The result of the open cooperation between all the stakeholders concerning the new methods used throughout the project was a higher level of quality and efficiency in the development of the head impact protection system (FVMSS 201u) and continuity in the provision of data on an ongoing basis in line with the schedule.

Lessons learned

- Despite the project being fully outsourced, there was no increase in the risks involved and no reduction in quality, because of Bertrandt's coordinated approach to the interfaces and to its bridgehead role with regard to the technical departments.
- The comprehensive preparation of the packaging system across all the modules included the complete bidding process.
- Transparent communication processes and the focus on Bertrandt as the customer's sole partner took the pressure off many of the structures involved.
- The interior projects could be implemented more effectively as all the stakeholders fully supported the bundled approach and made use of existing experience. This enabled Bertrandt to work more efficiently.
- The main success factors included linking the modules across the different derivatives, easy project scheduling and continuity in the commissioning process.

Summary

The varied challenges which the 18-month project involved enabled us to prove that we are a reliable service provider for packaged development processes and to demonstrate our expertise in developing complete modules. This was confirmed by the subsequent order for the same development tasks for the BMW 6 Series Gran Coupé, which will soon be launched, and overall project responsibility for the RR4 and X4 models.
Several well-known system suppliers are also making use of this knowledge and working together with Bertrandt Munich to develop modular components for the models referred to above ready for volume production. This brings the functional development expertise full circle. ■

Dr. Gerrit Schmidt, Alexander Pölt, Munich

In brief

From the initial idea to the optimum solution

Bertrandt's interior development services include design, concept development, functional design, design engineering, simulation, rapid prototyping and testing, right through to production start-up. Manufacturers have to take into account the wishes and requirements of drivers and passengers, technical developments and social trends, all of which are complex considerations. Bertrandt supports its customers by providing ideas, solutions and implementation services covering all aspects of the process of developing the vehicle interiors of the future.

Safe, innovative and flexible

The combination of safety, sportiness and style puts the new Mercedes B-Class at the cutting edge of technology. Every detail of the new model is impressive: the highest safety standard ever in a compact car, outstanding ride comfort, low fuel consumption and a premium interior. The second generation of the B-Class heralds the start of a new era of compact cars in terms of both concepts and technology. The Bertrandt Technikum provided broad-based support for the development process.

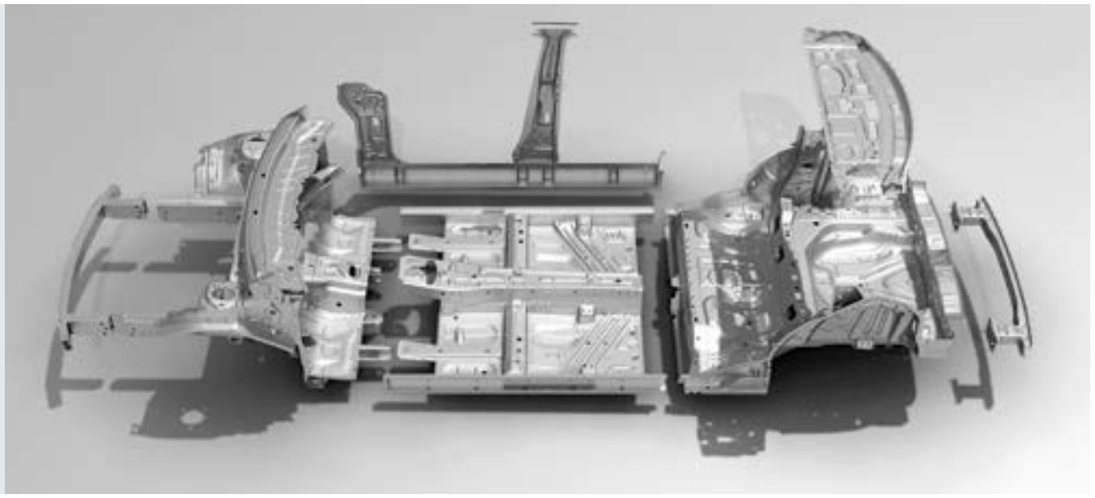
The Bertrandt Technikum provided development services for the compact sports tourer

Development partner with comprehensive expertise

The Bertrandt site in Ehningen took responsibility for complex components as part of the process of designing and developing the new B-Class, with the main focus being on the vehicle body development department. Bertrandt's projects involved services ranging from virtual CAD development of the body-in-white components, doors, closures and subframe through to tolerance management, conversions of pre-production vehicles, endurance testing and support for the prototype production plant. In addition, the Bertrandt engineers were responsible for producing visualisations for presentation documents and rendering the body-in-white components.

Innovative and flexible

One particular challenge relating to the body-in-white involved a new development method: Daimler's CAD template process. For the first time, the vehicle body was fully networked. This means, for example, that when the outer shell is redesigned, it is not only the side panels that change, but also the components behind them. This new high-tech procedure brings many advantages for the development process, including guaranteeing greater efficiency, improved quality and better knowledge management. The CAD template process, which includes fully networked and configured data for all the body-in-white components, allows for more efficient working methods and higher quality data. This integral approach and the heavily networked development process require a larger number of interfaces and more communication, but the increased amount of preparatory work reduces costs by around 30 % for the base model and 50 % for the derivatives. The innovative template process, which the Bertrandt engineers used for the first time, was also accompanied by a detailed tolerance management process which began at an early stage and which Bertrandt took partial responsibility for.



Complex 3D visualisations illustrated the features of the B-Class body-in-white for the EuroCarBody award.

Modular body-in-white concept

Bertrandt's involvement in the project started very early and covered all the design and development phases. Work on developing the different derivatives was staggered. The focal point of Bertrandt's services was the complete body-in-white. Its modular concept presented a particular challenge. The idea behind this was to design the B-Class from the beginning to accommodate an alternative drive system. Interfaces in the body allow the main floor panel to be modified for the versions with a different drive system. For example, various derivatives of the A-Class and B-Class have the same engine bulkhead, but different windscreen positions. The modular structure enables a variety of distinctive body variants to be produced which use a high proportion of the same components. The intelligent system makes a broad range of different body variations possible.

Prototypes and endurance testing

The tasks which Bertrandt was given responsibility for included project management and design engineering for special test vehicles. Components such as axles and powertrains are integrated into these vehicles and tested at an early stage. Bertrandt also provided support for the process of planning endurance tests for the B-Class transmissions. In addition, Bertrandt's endurance testing team contributed to the complete vehicle tests.

Support for production start-up

The Bertrandt team's services also covered the production processes and the start of manufacturing at the prototype production plant in Sindelfingen, with a focus on the technical validation of the structure of the prototype and validation vehicles. Virtual assembly tests, together with tests on the vehicles themselves, were carried out to evaluate possible solutions. Finally, Bertrandt provided support for the start of volume production at the plant in Rastatt and later in the new factory in Kecskemét in Hungary.

Winner of the EuroCarBody award

Bertrandt helped Daimler AG to produce a presentation for EuroCarBody, the global car body benchmarking conference in Bad Nauheim, where the B-Class was one of the winners of the world's most prestigious bodywork prize, the EuroCarBody award, in the body-in-white and production categories.
The very close coordination between the partners, which was based on mutual trust, resulted in excellent cooperation throughout all the phases of the development process. The short distance between the Bertrandt and Daimler sites allowed Bertrandt to meet its customer's requirements quickly and efficiently.

A new era in the compact class

Other characteristic features of the new B-Class, alongside the flexible design engineering methods, the new template process and the modular body-in-white, include excellent results in the NCAP crash test. The compact sports tourer comes as standard with a radar-based collision warning system with adaptive Brake Assist, which reduces the risk of a rear-end collision. The B-Class is the first compact car to be fitted with the PRE-SAFE® preventive occupant protection system. The new model also has impressive aerodynamics figures, including a drag coefficient of only cd = 0.26, which makes it the best in its market segment. Bertrandt took up the challenge as a partner of Daimler AG and provided end-to-end development expertise as its contribution to a new era in the compact class. ■

Ingo Schulz, Ehningen

In brief

Mercedes-Benz B-Class

Body-in-white development
- *Body components*
- *Doors and closures*
- *Subframe*

Tolerance management

Conversion of pre-production vehicles
- *Project management*
- *Component development*
- *Prototype bodies*

Endurance testing
- *Planning*
- *Reporting*
- *Implementation*

Prototype production plant

Graphics and visualisation
- *Presentation documents*
- *3D visualisation*

Opel Zafira Tourer

Top of the class in flexibility

Bertrandt supports the development of Opel's new FlexRail system

The first generation of the Opel Zafira, launched in 1999, was responsible for defining the seven-seater compact MPV segment. Now the third generation of the model is once again setting new standards. Alongside its dynamic, sculptural design, the focus is on providing the maximum flexibility and feel-good factor for all the vehicle occupants. The Zafira has plentiful storage space for everything you need on the road. The new FlexRail system, with modules that can slide back and forth between the front seats, and the fully-integrated bicycle carrier system at the rear of the car are particularly impressive features.

Comfort and well-being in every seat

The highlight of the new Zafira Tourer is the Lounge Seating system, which provides second-row passengers with the kind of seating space normally found in a large executive saloon car. Like the panoramic windscreen and FlexFix, the bicycle carrier system with space for four bicycles, the new seating system meets the highest standards of comfort. However, it is the many small innovations and developments which turn the Zafira Tourer into the first people carrier with Flex Appeal.

FlexRail, the innovative storage system in the centre console, is a good illustration of all these solutions. Bertrandt supported the interior specialists from Opel and Johnson Controls in developing the new system.

Centre console with maximum flexibility

The centre console, which is already familiar from the new Meriva, has been developed further. Two rails made from high-quality polished aluminium run between the front seats and the centre console modules slide back and forth on these rails. The armrest is mounted on the upper rail. Like all the other FlexRail modules, its position on the rails can be adjusted to provide the greatest level of comfort for the driver. In addition to these ergonomic benefits, the generous armrest has a folding lid with a large compartment underneath, together with a smaller compartment at the back with a roller cover, both of which offer extensive storage capacity. On the second level of the rails below the armrest is a removable FlexRail module with two cupholders. There is an additional storage compartment at the lowest level, which is lockable and can be used in combination with the other two modules. This storage area is concealed by the armrest and the cupholders and is not visible from outside the vehicle. Because of its proximity to the AUX and USB ports as well as the 12-volt socket, it is the perfect place to keep an MP3 player or a portable navigation device safely hidden from public view. Alternatively, the cupholders and the armrest can be moved backwards to create a large storage area with rails at the sides, which can be used for larger bags on holiday journeys, for example.

Easy to use with individual settings

The focus during the design of the individual components was on flexibility and, in particular, on ensuring that they were intuitive and safe to use. All the FlexRail modules can be moved backwards and forwards or removed separately. As a result, the modules can easily be positioned to suit the requirements of individual drivers or passengers. The FlexRail centre console also has ambient lighting, in order to make the system easy to use even at night. This combination of flexibility and a maximum feel-good factor is what takes the Opel Zafira to the top of the class.

Bertrandt in demand for development and design

During the prototype design and production development phases, the Bertrandt engineers and technical specialists spent two years providing support for all the variants of the Opel Zafira Tourer. In total, three centre consoles were designed and developed. In the case of the most complex version, the FlexRail console described here, Bertrandt was responsible for developing all the components of the console, including the rails and the necessary mounting points, and for integrating the ambient lighting. One particular challenge involved designing the sliding system for the modules to make it easy and intuitive for the vehicle occupants to use. In addition, the components had to meet high standards in terms of crash resistance and durability. The design process focused on ease of use in all operating and climate conditions. Once again, Bertrandt was able to demonstrate during this project its reliability as a development and design partner. ■

Michael Kaiser, Rüsselsheim

In brief

Opel Zafira Tourer

Interior

- *Cockpit/centre console*
- *Development and design of all the centre console variants*
- *Development of all the components of the complex FlexRail console, including the rails and the necessary mounting points*
- *Integrating the ambient lighting*

911 Classic, but innovative

It is unmistakably a 911, despite the striking changes under the bodywork which combine tradition with innovation. With its distinctive design, this classic car remains true to its roots, but at 48 years old it looks younger than ever.

Bertrandt supports the development of this classic sports car

Almost every component of the 911 is new or has undergone an innovative redesign process using the latest technology. The visible changes to this iconic sports car, such as the flat, stretched silhouette, give the new model range its unique image. The 911 is certainly impressive in terms of speed, power and low fuel consumption, but its most important features are the innovations that are concealed behind the elegant and sporty design. Bertrandt was involved throughout the development of the new model and provided its comprehensive expertise across almost its entire range of services. The Bertrandt engineers worked closely with Porsche and just one of many tasks that they were responsible for involved supporting the development of complex components.

Bertrandt was awarded these comprehensive projects on the basis of its long-term cooperation with Porsche and its successful support for the previous 911 model, which covered almost the entire product development process and enabled Bertrandt to provide Porsche with a broad portfolio of services. The Bertrandt team involved in the development and design of the new Porsche model range came from across all the company's departments, including electronics, vehicle body development, body-in-white, exterior, interior, modelling, powertrain, chassis, testing and engineering services. Bertrandt was able to meet the challenges it was presented with, which ranged from creating data control models and running crash simulations through to producing video and photo vehicles, and gave Porsche comprehensive development support for the latest version of its classic sports car. ■

Ingo Schulz, Ehningen

In brief

Porsche 911 Carrera

Body development Body-in-white
- *Wings*
- *Side panels*
- *Roof*
- *Rear end*
- *Soft-top compartment cover*
- *Front and rear closures*
- *Cross members*

Body components
- *Fuel system*
- *Data transfer, package investigations, technical and styling checks of the rear floor pan*

Body interior
- *Door panelling*
- *Tailgate panel and rear end of the car*

Chassis
- *Axles*
- *Brake ventilation system*
- *Engine mounts*
- *Hydraulic energy supply*
- *Suspension and damping development*
- *Active and passive roll stabilisation systems*

Simulation
- *Simulating all front and rear crash load cases for body development*

Electrics/Electronics
- *Validating control units and components on HiL test benches*
- *Infotainment*
- *Networked functions*
- *CAN mobile support*
- *Cabling, vehicle electrical system development*
- *Circuit diagram development*
- *Prototype management*
- *Developing a tyre pressure monitoring system*
- *Start-up diagnostics*
- *Diagnostics for the specification/qualification/flash qualification of control units*

Modelling
- *Data control models of the exterior/interior*
- *Video and photo vehicles*
- *Lights for data control models*
- *Prototype components (SLS parts/injection moulded parts)*

Testing
- *Climatic testing and photogrammetric measurements of rear spoiler modules*
- *Axles*
- *Brakes*
- *Steering system*
- *Coordination and technical support for endurance testing*
- *Test vehicle management, organising vehicle conversions, coordinating the workshop*

Engineering services
- *Complete vehicle package*
- *Prototype logistics*
- *Managing the use of prototypes and preparatory work*
- *Parts list and approval management*
- *Technical illustrations*
- *Colour documentation*
- *Project procurement*

A revolution in the compact car segment: the only Volkswagen in its class.

VW up! Complete component development plus exclamation mark!

The VW up! was launched at the Frankfurt Motor Show in mid September 2011 and is already showing the potential to become a cult car. This specialist city car is only 3.54 x 1.64 metres in size, but offers generous space and comprehensive functionality, together with above-average safety levels for the compact car segment. The team of engineers and technicians at Bertrandt Wolfsburg once again gave an impressive demonstration of their end-to-end expertise in engineering services.

A revolution in the compact car segment: the only Volkswagen in its class.

Highly efficient development services

The expertise and commitment of the employees from the vehicle body development, exterior, doors and closures, light and visibility as well as interior teams and from the electronics, testing and powertrain departments enabled them to achieve their objective: presenting Volkswagen with development services that left the customer highly satisfied. The ability of the Bertrandt teams to fulfil complex requirements while working in partnership with VW deserves a special mention and an exclamation mark!

Differing body structures

The vehicle body development team joined the VW up! project in August 2008 and began working on the underbody and the upper body. The Bertrandt employees continued to provide support for this area of the development project until the end of 2011, covering the planning approval and procurement approval phases through to the handover three months after the start of production. As the platform also had to be used for the Citigo (Skoda) and Mii (Seat) models, the assignment involved designing an identical underbody structure for all three vehicles. The differences between the three models lie in the side panels, tailgate, front end, rear end and lights. Throughout the entire development phase, weekly coordination meetings, attended by all the VW technical departments, were held by Bertrandt to track the product development process. The CAD data was handed over according to plan, which allowed production of the three-door model to begin on schedule.

Perfect doors and closures

The Bertrandt doors and closures team was responsible for the development of the five- and three-door versions and worked on identifying technically feasible designs during the styling phase. The focus was on designing suitable joint lines for the doors. In addition to developing the door shells, creating the kinematic designs, positioning the lock systems and designing the mirrors and seals, the main challenge involved producing different components for the three brands, VW, Seat and Skoda, while keeping development and manufacturing costs low. The all-glass tailgate of the VW up! is unique and combines modern design and traditional Volkswagen durability.

Light and visibility team in demand

The members of the light and visibility team worked on the headlights and rear lights from the concept phase through to procurement approval. They focused on providing design support during the validation of the installation space, the surfacing and the lighting technology using design models. Other tasks included testing the function of the rear lights, producing concepts for improved seals and fastenings and designing a lighting system which complied with the regulations for a test vehicle in the early stages of the project.

Interior components

The interior department was responsible for functional design, package creation, design engineering and producing drawings for the greenhouse as well as door and boot panelling for the VW up!, together with derivatives for the greenhouse of the Skoda Citigo and Seat Mii. ■

Thomas Klingner, Wolfsburg

In brief

VW up!

Body

- *Developing the VW up! platform and upper body up to three months after the start of production. Achieving the 5-star Euro NCAP safety rating, lighting tests, designing fastening and seal concepts, work on surfacing in the grey area.*

Doors and closures

- *Styling support, body-in-white development, kinematic design, developing seals and door mirrors.*

Light and visibility

- *Design support for headlights and for rear, brake and reversing lights and indicators, surfacing, lighting tests, improving seals and fastenings.*

Interior

- *Functional design, packages, designing door and boot panelling, greenhouse, bulkhead insulation.*

Engine/chassis

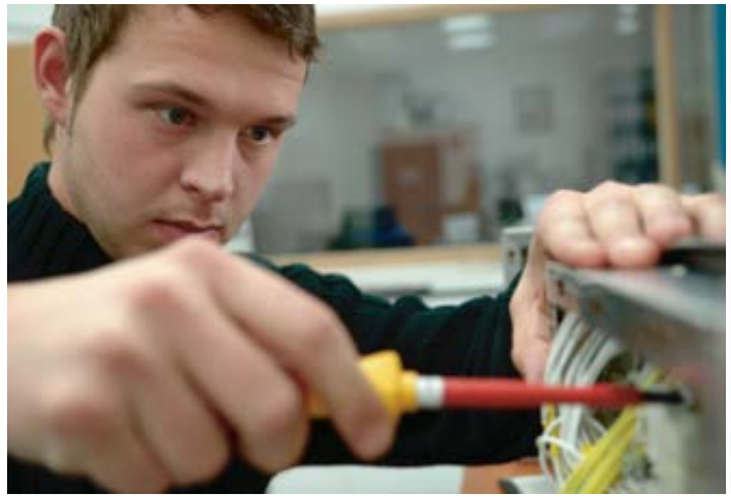
- *Designing holders for the fuel filter and underfloor fuel pipes, developing the sump, the rocker covers and the timing belt cover. Designing, improving and carrying out package tests for the brake servo system, developing connectors for the handbrake cable and lever, producing a package for alloy wheels and carrying out tyre clearance tests.*

Testing

- *Endurance testing and environmental simulation of the dashboard, centre console, door and side panelling and front and rear seat units.*

Broad range of aviation services

Airborne galleys from SELL in Herborn



Bertrandt provides services covering broad areas of aircraft development, which range from developing systems, components, structures and cabins through to interfaces between production and development (manufacturing engineering). The Bertrandt teams are constantly extending their expertise in these fields. The partnership between SELL GmbH from Herborn and the Bertrandt Hamburg site has contributed to the overall growth in Bertrandt's competence.

Where past and present meet

Bertrandt makes use of its comprehensive technical knowledge to enable both the aviation and the automotive industries to benefit from the synergies between them in areas such as lightweight design, electronics and seat development. In particular in the field of CFRP development and simulation, Bertrandt has a strong position on the international market, which has proved beneficial for SELL GmbH in Herborn.

The development engineers at Bertrandt are helping SELL to continue its long-term success story. As early as 1955 the first SELL aircraft galleys, named after the founder of the company, were installed in a Lufthansa Super Constellation. At the time, no one suspected that SELL would become world market leader in the production of modern aircraft galleys over the decades to come. The company is still thriving today. In 2012 large and small airlines from throughout the world are still fitting SELL galleys in all types of aircraft. For example, in 2010 almost half the long-haul aircraft produced by the world's two largest manufacturers, Airbus and Boeing, were equipped with premium galleys from SELL.

The Bertrandt engineers have played a part in this process. The successful partnership between the two companies began in 2008 when Bertrandt provided design and production services at SELL's two sites in Herborn and Homberg. In 2009 for the first time Bertrandt took complete responsibility for designing components for the Airbus A380 galley. This laid the basis for the provision of further design services for SELL.

Broad range of aviation services

Challenges in galley design

The constantly changing requirements for the galleys, which consist of several thousand individual parts, represent one of the main challenges faced by the Bertrandt engineers during the design process. The specific technical restrictions and cost constraints placed on new design projects result, for example, from the individual catering and comfort concepts of the airline in question. Depending on the routes that the aircraft will fly on (long-haul or short-haul), a different number of storage areas, ovens, coffee machines and trolleys is needed.

In addition, the requirements of the aircraft manufacturer influence the designs produced by the Bertrandt design engineers for the SELL galleys.

The main considerations in this area are space restrictions resulting from the aircraft structure, different interfaces between the galley and the aircraft and maximum weights for storage areas. In addition to the specifications of the different airlines and aircraft manufacturers, the special requirements that apply to products used in the aviation industry also have to be taken into account. Inflammable materials, structural specifications and preventing injury to galley users are just some of the factors that have to be considered. Human factors are playing an increasingly important role in Bertrandt aviation development projects and this helps to ensure that the resulting products are user-friendly, ergonomic and labour-saving.

During the process of designing the SELL galleys, the Bertrandt engineers develop the structural components and integrate all the necessary systems, including electrics, ventilation, cooling and water. When all the requirements are taken into consideration, it is clear that each of an airline's new aircraft requires a complex new galley, which is developed by SELL with the support of the Bertrandt engineers.

Moving forward together

The purchase of SELL in 2010 by the multinational ZODIAC Aerospace group laid the foundations for a long-term strategic partnership with Bertrandt.

Over the next few years, Bertrandt's aviation expertise across several disciplines will prove valuable in helping to accommodate the airlines' increasing focus on the passenger experience and on style. Complex free-form surfaces and innovative lighting concepts are just two examples of the growing trend for customisation, particularly in galleys and bars. SELL's leading market position enables it to meet these customer requirements. The Bertrandt engineers can provide expert services to help SELL to move towards a successful future. ■

Konrad Villmar, Hamburg

SELL GmbH Herborn

- Galley expertise since 1954, part of the ZODIAC Aerospace group since 2010
- Number of employees: around 1,400 at its Herborn and Burg sites, in SELL's design engineering office in Homberg (Ohm) and at its service sites in Hamburg, Toulouse and Seattle

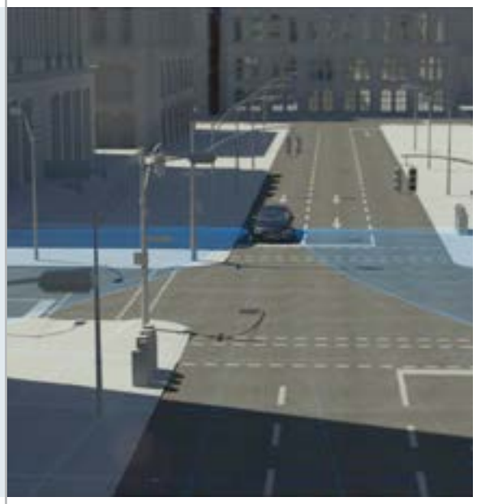
SELL GmbH's portfolio of services:

- Aircraft galleys
- Rest and sleep areas
- Stowages
- Partitions
- Video monitoring centres
- Bars
- VIP shower and wash rooms
- Stairs
- Inserts (ovens, coffee machines, beverage machines, water boilers, bread roll warmers)

Bertrandt Hamburg's portfolio of services:

- Structures
- Stress/simulation
- Cabins
- Systems
- Manufacturing engineering
- Electrics/electronics
- Testing

New safety system for urban transport



Solving the problems of complex individual urban transport presents a major challenge. Increasingly, the choice of new comfort and safety functions for vehicles is based on the needs of residents in mega-cities. Safety is always one of the most important considerations when developing new vehicle functionality.

In brief

Urban Assist

Interior
- *Concept development of seats and door panelling*
- *Integrating the HMI concept*

Complete vehicle
- *Constructing test vehicles*
- *Operation and maintenance*
- *Recording measurement data*
- *Integrating sensor concepts*

Testing
- *Road trials*
- *Test planning*
- *Test method development*
- *Test bench development and construction*
- *Functional testing*

Simulation
- *Evaluation of efficiency*
- *Benefit analyses*

Virtual reality
- *Visualising project results*

Urban Assist

Interdisciplinary project to develop complex vehicle functions

Joint project with Audi

During 2010 the Bertrandt Ingolstadt site worked together with Audi AG on an interesting and challenging project to meet the requirements of future urban transport. The goal of the Urban Assist project is to play a supporting role in cross-traffic by providing increased integrated side impact protection. A preliminary project in this area had been underway since 2008 based on the classic development process with different decentralised partners which provided services in the individual disciplines of design, simulation and testing. At the end of 2009, the team decided to make the project more creative and efficient by taking a different approach.

The idea was born: to network the line functions for this highly complex project and not just on paper, but in one room and on a daily basis.

Developing cross-disciplinary solutions

The result is that the most important links in the chain focus on this objective and cooperate on implementing the project: the customer's project management team and the specialists from the design, simulation, testing, electronics, sensor, vehicle communication and HMI (human-machine interface) groups, together with the organisation.

The team members work together in a specially set up project area covering around 200 m² with an adjacent workshop. There are modern workplaces for up to 25 people which provide the ideal conditions for creative activity and allow the team members to see the results of their efforts in the vehicle every day.

A tightly organised process with regular weekly status meetings allows Bertrandt to ensure that the project management team can follow every step of the development process in detail. This also guarantees easy communication via both internal and external interfaces.

The engineers and technical specialists worked on the basis of the concept of cross-disciplinary problem-solving which means, for example, that a design engineer should talk to a sensor developer, despite the fact that their work involves totally different content. This fundamental networking concept was one of the numerous factors which contributed to the success of the project.

Networking guarantees a high level of project maturity

During the course of the project, which ran for a specified period, the team constantly came up against cross-functional challenges, such as evaluating the quality of a function objectively and going far beyond the available vehicle safety test scenarios. The networked team made it possible to take issues like this and turn them directly into solutions, which resulted in the creation of innovative test facilities and dummies for testing active safety functions, among other things.

One example is a mobile test bench designed to carry out controlled and non-destructive tests which involve impacts between the test vehicle and obstacles such as vehicle silhouettes and pedestrian dummies. The test specimens are made from lightweight foam covered with a flexible carbon material to ensure that they retain a specific shape and remain highly durable. The test bench which impels the objects against the vehicle with a high degree of accuracy has proved its worth in hot and cold climate tests, but nevertheless is undergoing further fine-tuning.

In this context the question naturally arose as to how we could measure the benefit of a new vehicle function which provided additional comfort and could therefore be used to convince potential customers to buy the vehicle. In addition, we needed to consider how a complementary safety function which went beyond current requirements could be financed, because a significant proportion of the development costs would be spent on risk assessment.

Furthermore, the new project organisation also allowed different vehicle functions to coordinate with one another which, for instance, used the same sensors or were affected by additional components. Examples of these functions included the seat and the door.

More mature solutions

Looking back it became clear that the bold move of linking together individual disciplines in a project structure resulted in the development of a variety of solutions with a high level of maturity which can easily be transferred to production development.

The robust solutions that have been produced can now be passed on to the production development phase to provide safe and comfortable travel in the next generation of cars.

Cross-project evaluation methods have been put in place and new objective test methods for active safety are now in regular use.

The project has been a complete success both for Audi AG and for Bertrandt. The next stage will soon be starting, with the aim of creating a safer world. ■

Kai Golowko, Ingolstadt

The future of mobility:

Electronic control systems

Electronics plays a key role in allowing us to manage complex systems. Software and electrical and electronic components make up around 20 % of the average value of a car and the figure is constantly growing. The cars of the future will need more advanced technology and an increasing number of innovations and electrical and electronic systems, for networking, integrated medical functions and assistance systems which act as co-pilots.

Bertrandt is exploiting the available potential to the full and providing a wide variety of electronics services.

An overall integrating role within the group

The electronics development department at Bertrandt produces sophisticated tailor-made solutions for its customers which involve developing, integrating and validating components, modules, systems and complete vehicles, while providing a variety of related services. Bertrandt's many years of experience help to ensure that it has the necessary expertise for everything from creating individual solutions to running large-scale projects which include all the different development disciplines and roles and involve the company taking complete responsibility. The Bertrandt engineers and technical specialists in the electronics department aim to meet customers' complex requirements for electronics systems in the automotive and aviation development process. The department uses modular units and standardised interfaces, together with adaptable methods and processes, to enable complex systems to be managed. The resulting flexibility makes Bertrandt a valued development partner for the automotive and aviation industries. The department's portfolio of services is based on the classic V model and includes concept design, consulting, simulation, prototyping, implementation and verification, together with testing, integration, validation and electronics support.

Customers want comfort

Comfort is an important factor in ensuring that the car models of the future remain competitive. Sophisticated functions, such as automatic seat adjustment, sunroof control and parking assist systems, together with easy-to-use instrument clusters, have become a standard feature of modern cars. Programmable displays are likely to be the next major development in the near future. Bertrandt's body/comfort/displays team offers comprehensive development services for individual modules, from specifications and architecture through to implementation, testing and trials, systems integration and volume production support. The cross-disciplinary project management function is another service that forms part of the wide-ranging portfolio and can cover a variety of areas including body electronics, body controllers, displays, controls and instrument clusters.

Multimedia systems in cars

The majority of modern cars come with a full infotainment system. However, this presents the problem of coordinating the long development process for vehicles with the short product life cycles in the consumer electronics industry. As well as development activities, Bertrandt also takes responsibility for ongoing compatibility checks and volume production support in order to make it possible for manufacturers to continue offering drivers a wide range of communication options in future. The electronics department is a reliable partner for customers in the field of infotainment with services including connectivity and multimedia, interactive voice response systems, complete system development and integration, software and tools development and reliability testing for component and system approval.

Testing driver assistance systems

The increase in the number of electronics systems in vehicles will result in networked communications making an important contribution to accident-free driving in future. Driver assistance systems, such as adaptive cruise control, lane departure warning, parking assist, collision warning and road sign recognition, will make driving safer and easier. In its development processes, Bertrandt distinguishes between sensor-based and function-based driver assistance systems and provides its customers with services from the specification phase right through to volume production.

The portfolio of electronics services

Body/comfort/displays
- Body controllers/ body computers
- Displays/controls
- Instrument clusters
- Comfort control units
- Roof modules

Infotainment
- Telephony
- Connectivity (Bluetooth, WLAN, USB)
- Online services/ in-car internet
- Navigation
- Audio/video/head units
- Voice activation and control
- Software development (test automation, apps)
- HMI
- Instrument clusters/displays
- Production support

Driver assistance systems
- Radar:
  - Software development
  - Test environments
- Image processing:
  - Predevelopment of parking function
  - Test automation
- Transverse/longitudinal/ vertical control units:
  - Function development
  - Software development
- Measuring systems:
  - Development
  - Validation

Energy systems and powertrains
- Energy systems:
  - On-board charger unit
  - Power electronics
  - Lithium-ion batteries
  - Starter generators
  - Battery management
  - Energy management
- Powertrains:
  - Engine/ gearbox control units
  - Electric motors
  - Sensors/actuators

Chassis electronics
- Assistance functions
- Stabilisation
- Steering
- Brakes
- Vertical controllers
- Torque distribution
- Chassis control systems:
  - ABS and ESP
  - Adaptive cruise control

Networking and diagnostics
- Networking:
  - Systems architecture
  - Validating bus systems and protocols
- On-board diagnostics:
  - Specifications
  - Design/implementation
  - Flash data validation
  - Fault memory analyses
- Off-board diagnostics:
  - Development
  - After-sales/production

Vehicle electrical systems
- Electrical system development:
  - Network topology
  - Circuit diagram design
  - Prototypes
- Component development:
  - Mechatronics
  - Functional modules
  - Mechanical integration/ validation
  - Production support

Processes
- Requirements management
- Development processes
- Project management
- Supporting processes and methods
- Functional safety
- Levels of process maturity

Reducing resource consumption

One of the most important concepts in the development of the mobility systems of the future is a low environmental impact. New types of drive systems with electronic solutions bring a significant increase in efficiency. Bertrandt provides a comprehensive range of development services in the field of chassis electronics to support its customers in the automotive industry. Increasing the efficiency of combustion processes or improving gas exchange are areas which the Bertrandt electronics department is already working on. The focus is on refining existing combustion engines and developing electric drive systems. The electronics team helps customers to manufacture low consumption vehicles by providing services in areas such as requirements management, hardware and software development, systems application, testing and trials. In the field of engine electronics, Bertrandt specialises in networking, sensors/actuators, OBD development and electronic accelerator monitoring, together with power electronics, on-board charging systems, lithium-ion batteries, battery management systems, energy management software and developing concepts for electric cars.

Tracing errors with diagnostics functions

The complexity of current automotive software systems means that diagnostic functions are needed which allow the cause of faults to be easily identified, taking into consideration the relevant regulations and legislation. In the context of complete vehicles, both on-board and off-board diagnostics are included. Effective and systematic troubleshooting is only possible when both types of diagnostic system are available. The electronics specialists at Bertrandt are responsible for developing diagnostics tools, hardware and software. In addition, they evaluate and validate the results of diagnostics processes.

The chassis: modern electronic control systems

In today's automotive industry, the development of the chassis is increasingly moving away from its central, traditional focus on suspension and damping systems and towards an end-to-end functional approach to the chassis as an important factor which influences the overall dynamic behaviour of the vehicle. In addition to aerodynamic properties and the stiffness of the body, modern electronic control systems and regulated chassis components are important features which make a major contribution to increasing the comfort and safety of the vehicle. From specifications through to systems integration, Bertrandt is a reliable partner in the process of developing all types of vehicle components.

Increasing efficiency by reducing weight

Weight reduction and high-voltage networks play an important role in the development of vehicle electrical systems. Bertrandt specialises in areas such as reducing the size of cables, designing electrical architectures and using innovative materials. The mechanical integration of the electrical system and its electronic components is also a crucial factor. The focus here is on the creative use of modern design guidelines, lightweight components and integrating the electrical system into the existing vehicle structure. The electronics package that forms part of the development of vehicle electrical systems includes designing and positioning all the electronic components in the vehicle.

Requirement and process management

Outsourcing responsibility for development to external partners, increasingly stringent requirements from customers and the fast pace of changes in the economy are presenting the industry with specific challenges. The production of complex components, higher safety standards and new technologies are increasing the demands placed on vehicle manufacturers. They can only achieve a competitive advantage by manufacturing high-quality and, at the same time, cost-effective products. Constantly changing legislation and certification processes require companies to be extremely flexible in the development of new functions and products. Bertrandt has established a process management system in the electronics department which focuses on operational support and continuous improvement. ■

Electronics services in demand

An interview with Klaus Härtl, head of the electronics development department, about the role the department plays within the Bertrandt Group

Bertrandt*magazine:* Klaus Härtl, you manage the electronics development department, one of the largest in the Bertrandt Group. What goals have you set for yourself and your employees?

Härtl: Our priority will be to continue working in the areas where we have already been successful. This means ensuring that we become our customers' established partner. As a consequence, we must be fully up-to-date with the latest technological trends and innovations relating to all aspects of vehicles.

B*m:* What is your objective with regard to the growing complexity of cars?

Härtl: Our customers are increasingly moving towards outsourcing complete projects to us, as a result of the variety of platforms and derivatives that they are offering. We are not only providing individual development services. We also have the competence to manage the entire development process with confidence and to a high standard of quality as part of the projects or subprojects we are awarded by our customers.

B*m:* What about new technologies?

Härtl: This relates to the car manufacturers' specific domains. There is an increasing trend for installing more software in cars. In order to be able to handle complete projects, it will be more and more important for us to manage all the supporting processes, including project, process and quality management and quality assurance.

B*m:* The mechatronics systems house, which represents the structure of your department, distinguishes between individual services, competence clusters, service packages with project responsibility and development projects. Can you explain the concept behind the mechatronics system house?

Härtl: Until now, the majority of components has been mechanical. The process of electrification means that electrical variants of many of these components have to be created. Electronic systems without a mechanical function are currently becoming much more widespread. We see mechatronics as being the marriage between the mechanical features and the electrical functions. The mechatronics systems house exemplifies the fact that as a service provider we can bring together all the disciplines on the basis of our broad portfolio of services, covering the entire product development process. In other words, when we are designing a sensor, we not only determine its electrical function, the signal quality, but we also connect it to the vehicle body, which brings vibration-related and mechanical considerations into the equation.

B*m:* What benefits does this bring for Bertrandt's customers?

Härtl: Our customers can source everything they need from one provider. We are currently noticing a shift in the way our customers award projects. They have accepted us as a service provider and are confident that we can handle complete projects. Our teams are extremely efficient and offer high quality standards, which is a very attractive proposition for our customers.

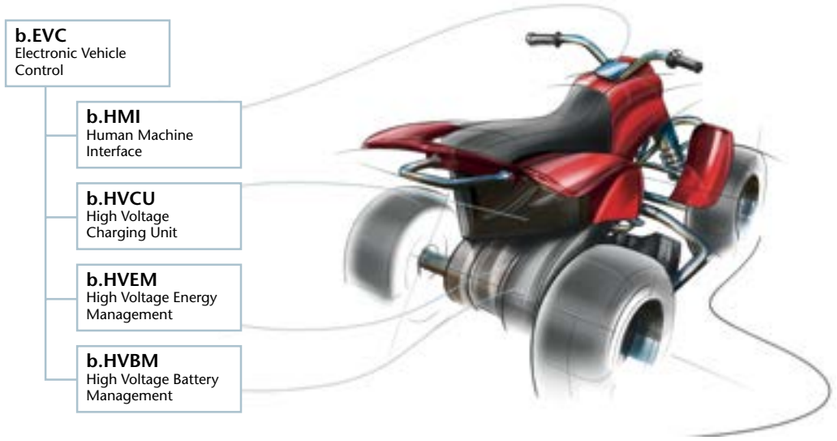
> "In order to be able to manage the complexity of these new concepts, it is essential to put standards in place."

B*m:* Electric vehicles, driver assistance systems and infotainment are some of the most important trends in electronics. How is Bertrandt positioning itself in these areas?

Härtl: In order to be able to manage the complexity of these new concepts, it is essential to put standards in place. Proprietary and OEM-specific solutions have a limited future. We need common standards in areas such as communication protocols, which are not differentiating features for our customers. Another example is a common standard for software development that will allow existing functions to be ported to different processor platforms. This will enable us to save time and reduce development costs on behalf of our customers. Standardisation is an important consideration for the future. We need portable solutions.

B*m:* You are increasingly providing customers with development services in the field of environmentally friendly transport and electric vehicles. The "b.BEV" (Bertrandt electric vehicle) is a demonstration of Bertrandt's expertise in this area. Can you tell us more about the "b.BEV"?

Härtl: We launched the "b.BEV" with the aim of increasing our expertise in this fundamental technology. In the second phase of the project, we are focusing on all of the components and developing our knowledge in the fields of design and functionality. We have also created subsystem functions, in



"b.BEV", the Bertrandt Electric Vehicle.

particular the energy subsystem, which interact with individual components. We have developed our own hardware and software modules for this purpose. Our vision is to incorporate this into a vehicle that can be driven.

B*m:* The industry media are focusing increasingly on networked communications and the growth in the number of electronics systems in vehicles. Infotainment and multimedia are becoming ever more important features for car passengers. How do you think entertainment electronics in cars will develop?

Härtl: Entertainment electronics is a clearly defined trend which we are already involved with and will soon be focusing on in detail. Within Bertrandt, we are calling this area "b.on". In our society, it is important for information to be available everywhere and at all times, for us to be able contact other people and to be accessible ourselves. Communication with and within cars is presenting us with new challenges. We are faced with tasks which go much further than "just" making a vehicle roadworthy. For example, the infrastructure has to function in a completely different way and new services, including provider services, must be made available. The OEMs are also faced with very specific demands. They are no longer simply selling vehicles. They also have to provide information services as part of this new infrastructure, with back-end servers and other functions. IT services, which OEMs have to supply and validate, are taking on an increasingly influential role. This is a very exciting area.

B*m:* What challenges does your department face in this area?

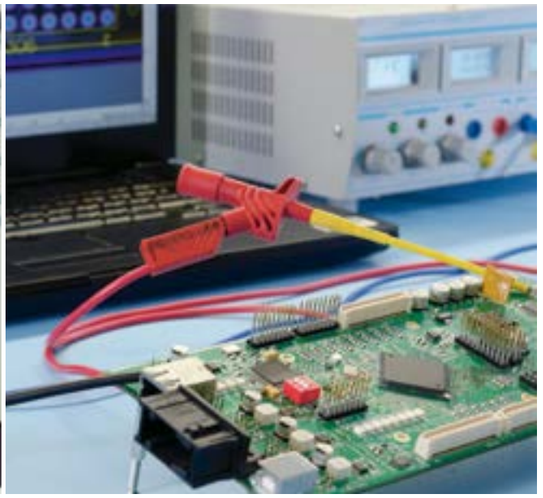
Härtl: In a similar way to the "b.BEV" project, we are developing scenarios and becoming familiar with this technology. For example, cloud computing will not only be a part of traditional IT systems, but will also take on a fundamental role in the provision of communication services in vehicles.

> "Communication with and within cars is presenting us with new challenges."

For the electronics development department, this primarily involves data communications, data streaming and infrastructure features which will allow vehicle information and functions to be presented via apps. In electric cars, for example, this will include displaying information about the charge level, the range and personal time management.

B*m:* What is Bertrandt's view of the route that the networked vehicle will take?

Härtl: We are currently facing the major challenge of bringing the different worlds together. The world of consumer electronics takes a short-term approach, both in terms of development and product cycles. New products come onto the market very quickly. At the moment, this is not entirely compatible with the development cycle for vehicles, which needs to become faster and more efficient. The other area involved is standards, which will also be responsible for ensuring that a wide range of consumer electronic devices can be incorporated into cars.
In combination with "b.on", we have already had some successes in this area. One example is the family app that we have developed. The latest trend is for developing apps. I would like to make it clear that the world of mobile phones is not a standardised one. A range of different operating systems is available for phones. It is important for us not to focus only on one area. We must specialise in at least



the three main operating systems. You will certainly already have heard of them: Android, Windows Mobile and Apple's iOS. We have identified areas where we can differentiate ourselves and where we need specific clusters. We have also specified which software domains we will want to use and to come to grips with. We will provide these services independently of mobile phone manufacturers.

B*m:* Your department is growing rapidly. How are you coping with the increase in the number of employees?

> "We have recently launched the EE Industries initiative to enable us to offer our services and specialist knowledge to other sectors."

Härtl: Things are going very well. This is a clear indication that electronic systems are becoming an increasingly important feature of cars and that the proportion of added value they offer is growing. I believe that this trend is underpinned by the strong growth and the demand for engineering services.

B*m:* How are you integrating the new employees into the department?

Härtl: We have a well-structured process for introducing new employees to the company and to the team. For example, we have departmental training courses covering tooling and various aspects of vehicle architecture which help new employees to integrate relatively quickly. We have a total of around 40 of these courses and this makes us unique among development service providers. Our most recent course trains employees in working with hybrid and electric cars. The high-voltage course prepares employees for training as an electrician.

B*m:* Would you like to take a look into the crystal ball? Where do you think the electronics development department will be in five years?

Härtl: The issues which are crucial now will be just as important in five years' time. We need to identify and come up to speed with new technologies. Then we must also be regarded by our customers as a competent, reliable and established partner in new areas of technology.
In answer to the question of where we are going, we have recently launched the EE Industries initiative to enable us to roll out the expert services and specialist knowledge that we have developed for the automotive industry and offer them to other sectors. There are many overlapping areas where we can see demand for our skills, for example in hardware and software. We have identified some specific starting points, but we are also in the process of finding the gaps in our knowledge and developing new expertise within the department. We think that this will represent a significant opportunity for the electronics development department in future.

B*m:* Klaus Härtl, thank you very much. ■

The Bertrandt Technikum develops an innovative electric scooter

LiBERT'e

Freedom on two wheels

Electric vehicles are right at the top of everyone's agenda. Development service providers like Bertrandt are increasingly focusing on the subject of electromobility. For this reason, engineers from the component development, electronics development, modelling and vehicle assembly departments, plus a group of trainee technical product designers, have come together in the Bertrandt Technikum to work on the LiBERT'e project with the aim of developing an electric scooter.

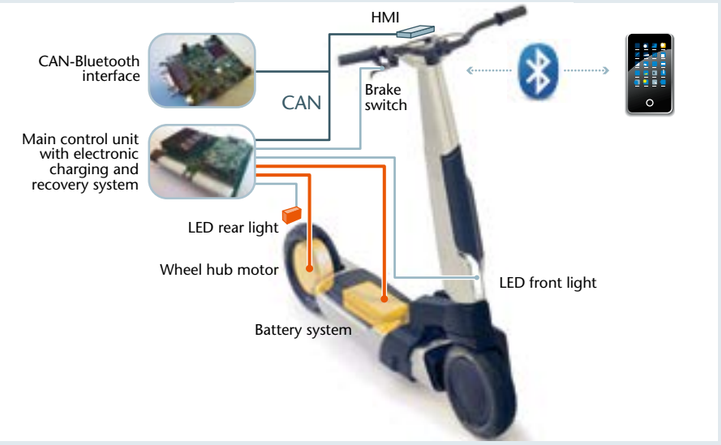
Project background and objectives

The two-stage LiBERT'e project concerns the cross-disciplinary development of an electric scooter. The goal is to produce a functioning demonstrator with an electronic system, a frame and an overall design that clearly distinguish it from the products already on the market. The purpose of the eye-catching electric vehicle is to attract the attention of customers, job applicants and employees at trade fairs and on company sites and to highlight Bertrandt's high-quality services and expertise. The project was run by the trainee technical product designers as part of their technical and practical assignments, in tandem with specialists from the various departments who met regularly to exchange information and ideas about electromobility.

Implementation

The first LiBERT'e generation consisted of a combination of bought-in components and parts that had been developed in-house. The focus of the development process was on design and on coordinating and integrating electronics components. A basic design concept was drawn up and a lightweight frame created which complied with the requirements specification. Appropriate mounting systems were developed and integrated for the frozen design. The highlights of the electric scooter include the waterproof, air-cooled housing for the lithium-ion battery, the LED front light, the Bertrandt logo on the side with LED illumination and the footboard made from honeycomb sandwich material, a lightweight design method often used in the aviation industry. The team members made use of their experiences from the first phase during the development of the second generation of the scooter, where the emphasis was on developing electronic components and the battery system.

Initial sketches for the LiBERT'e e-scooter project



Second generation of LiBERT'e: Structure of the electronic components

Design

The innovative electric scooter prototype demonstrates Bertrandt's skills in the field of electromobility. The inspirational design is the key factor which makes the scooter stand out from the crowd. The central feature of the design is the scooter's asymmetrical shape, which characterises its overall appearance.

Electronics

The scooter has a 390 W hub motor that directly powers the rear wheel. A 48 V lithium-manganese battery provides the energy supply for the motor. In the first LiBERT'e generation, a third-party control unit was responsible for motor management. The power output is controlled by a twist-grip throttle and the scooter can reach speeds of up to 20 km/h.

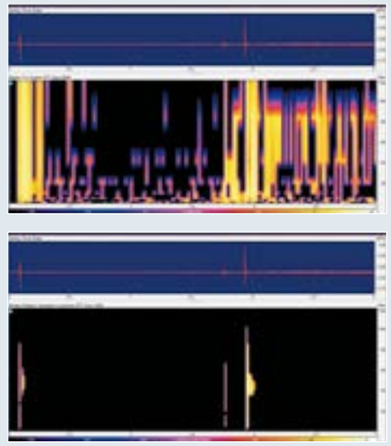
The second LiBERT'e generation

The electronic components of the second LiBERT'e generation are currently being developed in the electronics department of the Bertrandt Technikum on the basis of a modular development platform. The system consists of a central control unit with a powerful 32-bit ARM7 microcontroller, power electronics to drive the brushless DC motor and an electronic system to recover braking energy. To extend the scooter's range, which is currently 23 km, a battery system is being developed that can be integrated with the electronic components. An interactive touch screen display enables the driver to activate a number of functions, such as displaying operating data, which includes the speed, battery charge level, range and motor temperature, and additional functions, for example, switching the energy recovery system and the immobiliser on and off. An integrated Bluetooth module provides an interface which allows the scooter to be controlled using a smartphone and a suitable app and enables complete journey profiles with detailed operating data to be recorded. ■

Philipp Seitz, Dr. Hicham Dakir, Christian Kollmeier, Daniel Bennett, Moritz Kenner, Ehningen

Electronic validation of sound designs at Bertrandt Ingolstadt

Acoustic perception makes a major contribution to the impression that potential purchasers gain of a vehicle's quality. Not only the rich, full sound of the engine but also the noises which we only notice subconsciously come together to create a coherent acoustic environment. The sound of small electric motors, such as the seat adjustment or windscreen wiper motors, the noise of a button being pressed, audible warning signals and speech output and voice control systems, which are becoming increasingly important, play an integral role in terms of sound quality in the overall comfort of the car. For this reason, a systematic approach is needed to developing and improving these sounds.



Representation of an FFT analysis (top) and a relative approach analysis (bottom).

Quality as a subjective perceptual property in vehicle acoustics

Broad spectrum of sound engineering services

We offer our customers a wide range of development support services in the field of psychoacoustics, empirical data collection and sound engineering for automotive applications. Our specialists have in-depth expertise in this area based on their extensive experience of development processes. As a result, they can give products an acoustic signature which corresponds with the customer's brand image and requirements specification.

Modern pyschoacoustic measurement methods

The focus in sound development is on linking objective physical properties with the subjective sensory characteristics that they generate. In addition to technical measurement methods which incorporate the psychoacoustic properties of human hearing, empirical data collection is an essential feature. Using social scientific paradigms and hearing tests, it is possible to identify individual hearing habits, preferences and expectations. This allows an overall sound impression to be developed which is characteristic of the product.

Cognitive signal processing in human hearing is highly complex. The subjective perception generated by acoustic stimuli is situative. It depends on the person's socialisation and also on the environment in which the soundscape is heard. In order to take all the different dimensions into consideration, it is essential to do much more than simply measure physical values, such as sound levels and directions of sound incidence. Instead the focus must be on establishing a relationship between these values and the sensory characteristics that they trigger. Psychoacoustic parameters such as roughness, sharpness, loudness or fluctuation levels are used for this purpose.

Special measurement systems are needed to record these acoustic stimuli in a way which is modelled on the human ear. One decisive factor is human physiology. Spatial hearing ability is, of course, dependent on processing signals with both ears. However, sound refraction and the frequency-dependent damping of the sound in the head, shoulders, torso and outer ear also have an influence on directional hearing. This is where the so-called artificial head plays an important role. It enables the sound filtering and transmission properties of the human anatomy to be recorded and reproduced.

This means that the artificial head system needs to meet specific requirements. Its directional characteristics and dynamic range must correspond with those of human beings. The inherent noise of the microphone should not be audible. In addition, it must be possible to calibrate the system, which has to be compatible with conventional sound recordings. Another critical factor is the subsequent signal processing. The human ear functions adaptively, which means that it reacts primarily to spectral and temporal changes in the sound signal and evaluates the patterns of the sound. Conventional analysis methods are only of limited use in this respect. However, relative approach analysis is a valuable tool. It attempts to produce an estimate of the current signal value. The difference between the actual value and the estimated value is a measure of the variation in the signal. This is a relative rather than an absolute value and it corresponds with the way in which human hearing works. The temporal and spectral patterns in the signal, which are crucial to the way in which it is perceived, can then be identified and represented in visual form.

Recording sound impressions using empirical data and hearing tests

The behaviour of purchasers is largely determined by subjective impressions, which must be consistent with the product that is being evaluated. In order to develop an appropriate sound, it is important to actively involve potential customers in the sound design process. Hearing tests are a reliable method of classifying and evaluating sound impressions and answering the question of what is an appropriate sound to the satisfaction of customers. By selecting suitable test subjects, establishing clear requirements and asking the right questions, it is possible to develop targeted hearing tests using a variety of methods.

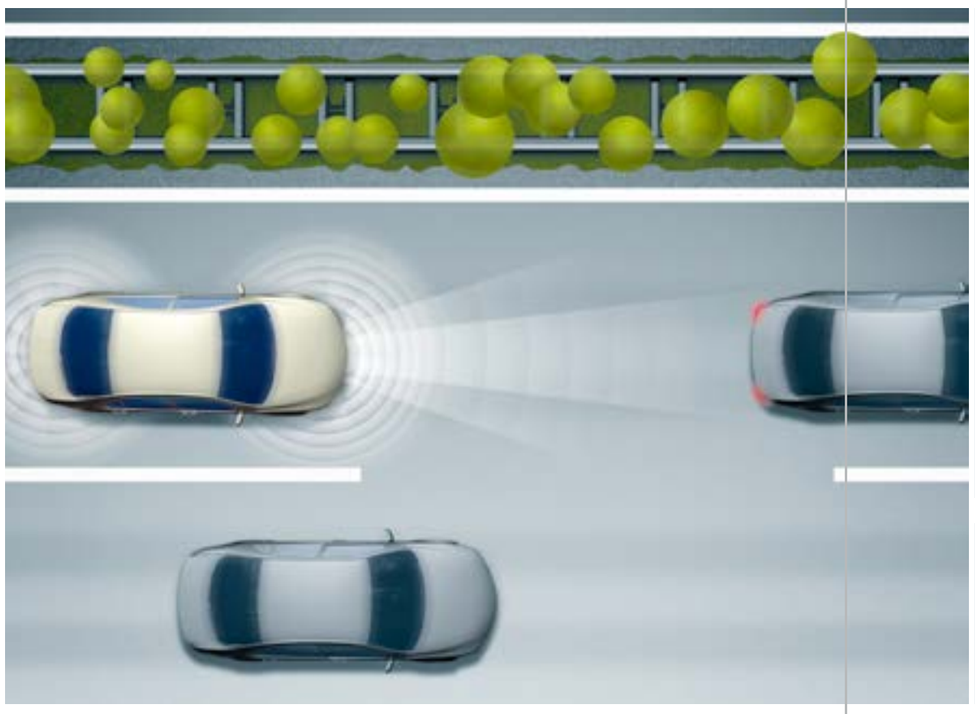
Acoustics engineers have numerous different processes at their disposal. For example, pair comparisons can be used to compare two similar sounds on the basis of a specific criterion. In the ranking process, the test subject has to sort several different sounds into a certain order. These methods allow the customers' initial preferences to be identified quickly. The semantic differential method is used to obtain more differentiated and detailed evaluations of the sounds. It allows for a multi-dimensional evaluation of noise using split scales. The test subject has to rank the sound on a graduated scale based on adjectives and their antonyms (words with the opposite meaning), such as cheap/expensive or pleasant/unpleasant.

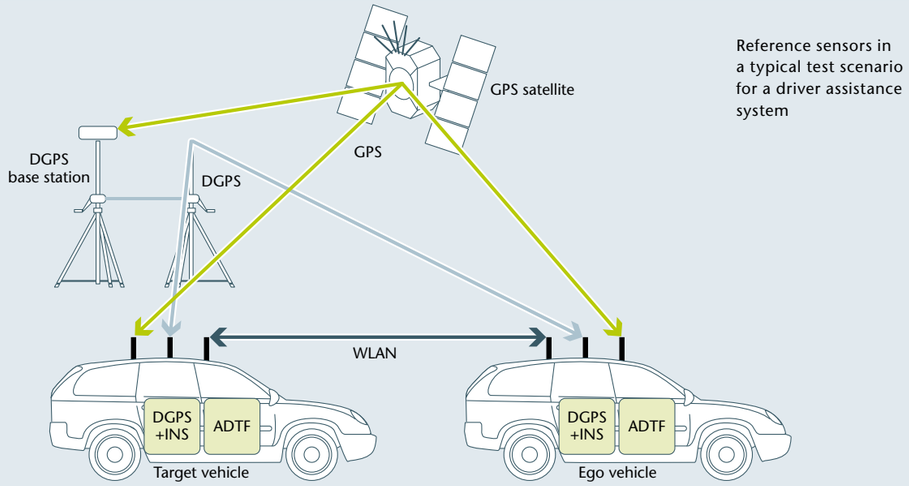
Purchasers increasingly require higher and higher quality products and their understanding of quality is closely linked to their acoustic perception. Bertrandt Ingolstadt can provide customers with the sound design expertise they need to meet these requirements. We offer our customers a reliable and competent service in areas ranging from tuning speech and music reproduction systems to improving the sound of individual components, controls, phone hands-free systems and engines. ■

Karl Roman, Stephan Mauer Ingolstadt

Testing driver assistance systems at Bertrandt

Using reference sensors





Reference sensors in a typical test scenario for a driver assistance system

Process for testing driver assistance systems

"Ghost taxis without drivers", "Robot cars on the roads of Lower Saxony and California": headlines similar to these have appeared in a number of articles recently on the subject of autonomous driving. Car manufacturers are already fully committed to the concept and development work on turning the vision into reality has been underway for some time. Autonomous driver assistance systems can only be made available for public use if the individual functions can be shown to be completely reliable and absolutely safe. In addition to ensuring that the development processes meet the highest quality standards, it is also essential to carry out traceable and reproducible tests that can be fully evaluated.

Professional testing plays a key role

By fitting cars with a variety of different sensors, including cameras and ultrasound and radar sensors, it is already possible to provide a wide range of new functions which increase comfort and safety in the car. Some examples are parking, lane change and braking assistants, together with night vision systems. Over the next few years, the number and quality of the sensors will continue to rise. By combining the data provided by the different sensors, it will be possible to develop increasingly comprehensive assistance functions. As the road infrastructure is improved and appropriate online services are made available, merging these functions will enable the vision of autonomous driving to become a reality.

A decisive factor in the development and approval of today's driver assistance systems is the ability to evaluate the function and its limits to a high level of precision. Tests must be traceable and reproducible and it must also be possible to evaluate them fully. For this purpose, reference sensors such as DGPS (differential global positioning systems), inertial navigation systems (INS) and laser scanners are being used during the testing process to provide suitable comparative data for the car sensors. Bertrandt offers the entire test process as a complete service.

Test planning

The key task of the test planning phase is to draw up clear and traceable test scenarios. These are based directly on the functional requirements and are incorporated into a scenario catalogue which can be reused for other test processes. Examples of test scenarios include:

- Comparative analyses of different implementations of a function
- Function applications
- Approval runs
- Analysing customer complaints and identifying measures to rectify faults

The next step is to organise the test vehicles, which must be fitted with the systems that are being tested and the relevant versions of the software. For example, when a lane change assistant is undergoing testing, two cars are generally needed: the "ego vehicle" fitted with the lane change system and the "target vehicle" which will perform manoeuvres relative to the ego vehicle (such as moving towards the B pillar at a predefined relative speed).

Reference sensors are being used more and more often in tests of this kind. These include DGPS systems which, combined with a DGPS base station, can provide absolute positioning information to an accuracy of less than one centimetre. Together with an inertial navigation system (INS), this enables the trajectories of the test vehicles to be measured very precisely even at high speeds and during brief interruptions to the GPS signal.

A development tool for driver assistance systems, ADTF (Automotive Data and Time triggered Framework) from Elektrobit, ensures that the data streams are recorded synchronously during the test. Filters are put in place as part of the preparation for the test which convert the data streams from the different sensors and also from CAN, FlexRay, Ethernet or WLAN sources into an ADTF-readable format.

In the next stage of development, the test vehicles can also be equipped with laser scanners which provide three-dimensional data about the vehicles' surroundings in the form of point clouds with a high level of point density. This enables the data from an object recognition system installed in the vehicle to be analysed, for example.

Test implementation

Activities during the test implementation phase:

- Implementing the planned test scenarios with the ego and target vehicles
- Static sensor measurements, in other words, measurements from sensors when the vehicle is stationary using suitable reference objects
- Dynamic sensor measurements from moving vehicles
- Measuring (relative) vehicle positions, speeds and acceleration
- Recording data in ADTF (sensor/video data, CAN, FlexRay, Ethernet, WLAN etc.)
- Logging metadata (hardware/software versions, environmental and road conditions etc.)

In future it will be possible to transfer the data during the test implementation to a so-called "mission control", where it will be analysed directly in order to evaluate how successful the tests have been. The aim is to identify possible problems during the test itself and, if necessary, to resolve them there and then.

Evaluation

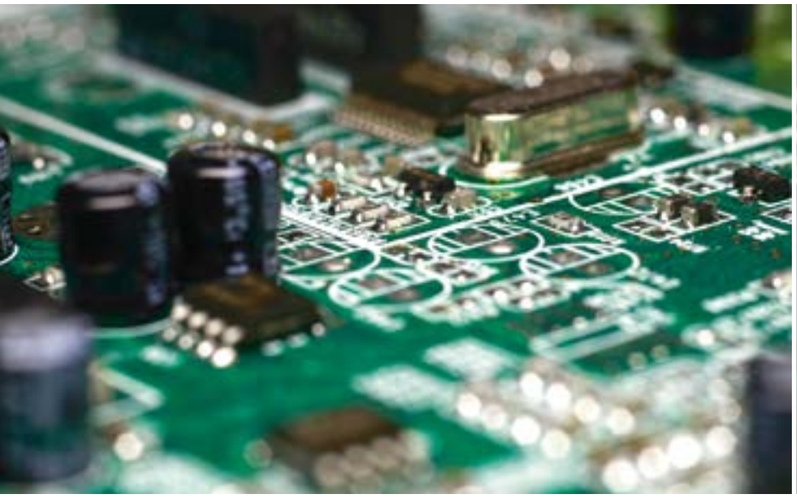
Evaluating the measurements is the last and most crucial step in the process of testing the systems. Tools such as Matlab are used to filter and visualise the data.

Summary

The use of reference sensors represents a major step forward both in implementing tests that can be traced and analysed and in the application of driver assistance systems. In addition, the latest virtual test methods are helping to reduce the costs of testing. ■

Dr. Dietmar Szolnoki, Ingolstadt

Tailor-made software solutions –
made by Bertrandt



„b.automized“

Hardware

Commercial measuring systems
(e.g. IMC Spartan)

Sensors | Actuators

Operating environment

Configuring real and virtual channels | Configuring watchdog, error criteria, timing …

Visualisation and analysis

Automatic test runs and reports | Visualising real and virtual channels

Innovative program for automating

system test benches

As the technology used in vehicles becomes increasingly complex, so too do the component and system test rigs needed to test them. In order to be able to produce effective results, the test benches need electronic, automated measuring systems. However, the solutions commonly available are generally restricted to evaluating a subset of the sensors and actuators. These systems are usually not particularly useful, as the existing software is often inadequate and the problem can only be resolved by working together with the software manufacturer and/or buying additional expensive licences, all of which involves investing both time and money. Bertrandt's technical departments have been looking for a comprehensive, efficient and rapid solution.

To meet this requirement, the software development team at Bertrandt's Rüsselsheim site has produced "b.automized", a tool which brings together a wide range of different testing equipment in one program, triggers all the common types of sensors and actuators and also evaluates the data and creates visualisations.

Three tasks in one step

"b.automized" is currently being used on a customer project in the powertrain department. A typical measurement process starts with the integration of the sensors and actuators. With around 90 different sensors and 10 actuators, a flow and temperature test rig for hybrid powertrains provides a good basis for the use of b.automized, in particular when it comes to triggering the actuators with digital, analogue and pulse width modulated outputs. A graphical user interface guides the user through the process of configuring all the measurement channels, where both sampling rates and real and virtual channels can be set up. In addition, an automated test plan can be configured, which enables events and measurements to be controlled. The data is stored on the basis of both times and average values. In the last stage of the process the software produces a visualisation of the results and offers a range of frequently used report templates for common test drives. The program also has an automatic report creation function.

Easy and flexible to use

After a test has been set up by the experts, a user without special training can start up and monitor complete measurement sequences at the press of a button. At the end of the measurement process, a test report or a graphical evaluation is produced automatically. The software development team can customise the program to meet almost all customer requirements.

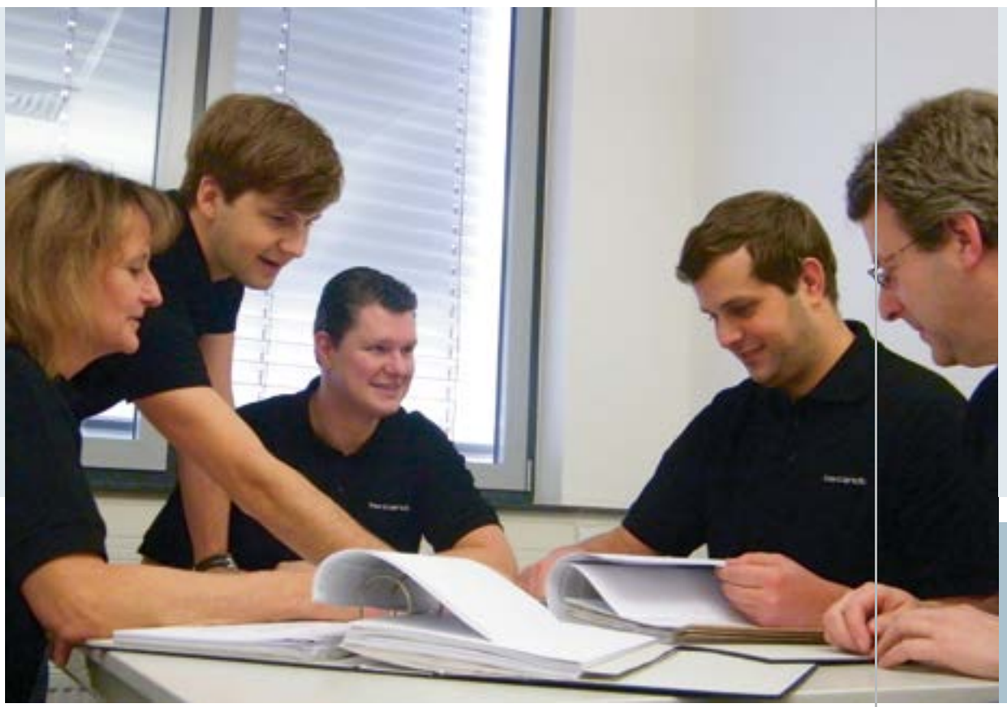
Five disciplines – one team

The software development team is made up of specialists in the fields of mechanical and electrical engineering, IT, maths and physics. Cross-disciplinary communication enables the team members to combine their technical skills and go beyond the boundaries of their individual specialism. The group is working both on long-term projects and on providing rapid, short-term support for the various departments. Because of the Bertrandt Group's broad base, the team has already been able to complete international projects for customers in the field of scientific evaluation and to run innovative HMI projects for well-known car manufacturers.

Like all the other departments at Bertrandt, the software team in Rüsselsheim works closely together with other technical departments within the organisation to provide customers with a highly comprehensive and wide-ranging portfolio of services. ■

Magnus Euler, Timo Burggraf, Rüsselsheim

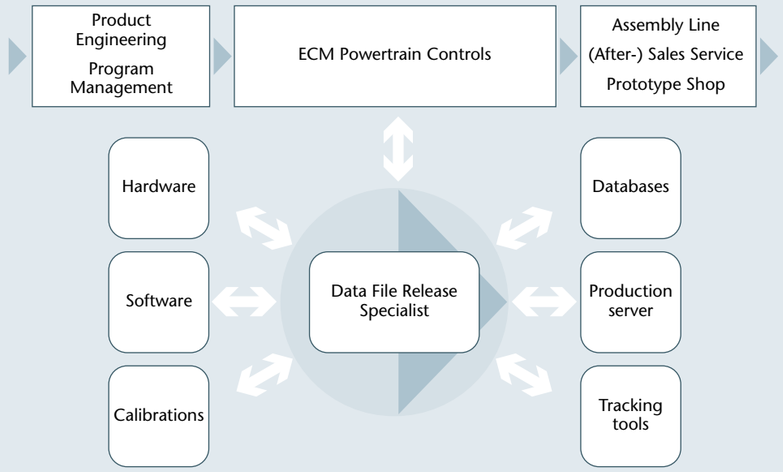
Operational support for releases



Bertrandt Rüsselsheim adds operational support for releases to its range of electronics development services

„Data File Release Specialists“

OEMs in the automotive industry are increasingly outsourcing self-contained projects and components of the development process to external partners. Bertrandt is often required to provide operational support packages which involve both an overall evaluation of customers' processes and the provision of support. One very good example is a package for hardware and software releases that has been in operation at General Motors (GM) Europe since early 2011.



The relationships and tasks of the operational support package for releases, including the interface to the global development process

Background

As a result of the growing number of models and variants and the global spread of the development process within the GM Group's organisation, the different stages of the process and its content have to be broken down. The engineers working on ECU controllers within GM need to be able to concentrate on the actual development of the hardware and software.
Downstream phases of the process, which involve combining the hardware, software and engine map data, can be outsourced to an external partner as self-contained process modules. The external company then takes on responsibility for the verification and release of the product program. The process owner implements the releases and manages the part numbers, as well as controlling the transfer of data to the EoL server in the production plants and the service and workshop areas.

Data file release specialist (DFRS) operational support package

Since the start of 2011 the DFRS team in Rüsselsheim has been responsible for hardware and software releases on behalf of GM as part of a global release process. This involves supporting the operational change management process for hardware and software releases for ECUs throughout the world.

Win-win situation

On the basis of our model, we develop an overall concept and provide a team to speed up the development process perceptibly and reliably. In addition, the use of a global process ensures that tasks and interfaces are clearly defined.
By taking on full responsibility for essential modules in the process, Bertrandt can establish itself both now and in the future as an important strategic partner of the OEM. ■

Robert Beisner, Rüsselsheim

In operation 365 days a year

Testing vehicles to the limit

In Namibia and Dubai or during cold climate testing in Scandinavia, the members of the endurance testing team test vehicles to the limit, with the aim of providing end customers with a high-quality product. Despite the fact that nowadays almost all a vehicle's functions can be simulated, it is still important to test the vehicles in real-life situations and to drive them on the road. The subjective evaluation of vehicles on the basis of the driver's gut feel cannot be replaced by a simulation program.

Endurance testing in three-shift operation

The Bertrandt test drivers test the cars 24 hours a day on all seven days of the week in three shifts. The vehicles only come to a standstill on a few public holidays throughout the year. During the shift changeover, the test drivers hand over the cars, carry out checks and document the functionality and any abnormalities in the test report. After this, a read-out is produced from the software tools and the measurement systems via the W-LAN, with the data being sent directly to the customer. The transfer of the vehicles to the drivers on the late shift begins with an initial check and then the tyre tread depth, coolant, oil and fluid levels are measured. After this the car goes back out onto the circuit. When the cars are tested on public roads, the drivers comply with road traffic regulations. These vary depending on whether the road in question is a motorway, an urban street or a cross-country route. However, driving on the test track also forms part of an endurance test. The aim is to drive the vehicles in a way which is reproducible. The period on the test track in particular allows the test drivers to evaluate the maximum speed and perform special manoeuvres which would not be permitted on public roads.

All the vehicle's functions are tested to the limit during the course of an endurance test.

Hot and cold climate testing

While the cars in Germany are generally tested at a location near to the customer's site, worldwide endurance tests are used to evaluate the vehicles' functionality under extreme climatic and topographical conditions. Some endurance tests take place on Alpine passes and can last for anything between a few weeks and a year, depending on the testing programme. The decisive factor is the stability of the vehicle, which will vary depending on the stage of development.

Dummies as passengers

The test drivers are accompanied by dummies during the testing process. They represent the passengers in the car, add to the load carried by the vehicle and reduce the number of staff needed. Sacks of sand or towed loads with a predefined weight are used to test stresses on the vehicle in mountainous areas. The test drivers must adopt a safe, passive driving style. It is also essential that they undergo training on subjects such as road safety and first aid, so that they are equipped to cope with emergencies. In addition, they must have the right driving licences, be prepared to work on a three-shift system and have completed a vocational training course in the automotive industry. The job of Bertrandt's test drivers is to enable customers to make flexible use of their own resources.

The Bertrandt Service Centre

Bertrandt is not only responsible for driving the test vehicles, but also for maintaining and repairing them in its own workshop, where there are specially trained mechanics for different makes of vehicle who can ensure that the endurance tests do not come to an unexpected stop. ■

Markus Nadler, Ehningen

In operation 365 days a year

Monitoring trends and planning for the future

During the interview Markus Nadler describes the objectives and the process of endurance testing.

The repair workshop at the Bertrandt Service Centre in Nufringen guarantees that endurance tests do not come to a stop.

Markus Nadler on the assignments, challenges and day-to-day work involved in endurance testing

Bertrandt*magazine:* Markus Nadler, what is the objective of endurance testing?

Nadler: Our main aims are to test product quality, costs, compliance with legislation and technical innovations. In collaboration with our customers and taking into consideration their objectives, we provide support for the testing process. The aim of testing is approval, in other words, confirmation of the product's long-term functionality and durability.

B*m:* How does the endurance testing process work?

Nadler: There are different types of test programs and test routes. They are chosen on the basis of climatic, geographic and functional considerations. The test programs can be broken down into complete vehicle tests, powertrain, engine and component tests. The distance covered varies between 3,000 and 160,000 kilometres.

B*m:* What challenges does testing involve?

Nadler: The initial challenge is to schedule the necessary capacity to meet the requirements. This can be very time-consuming and being able to plan ahead in this context requires a great deal of experience. Another challenge is the fact that we want to move forward together with our customers. This involves primarily new technologies, new legislative requirements and also electromobility, in other words, electric cars and hybrid vehicles. These areas are important to us. We are following developments and providing our team members with special training on these types of vehicles.

B*m:* How is your department structured?

Nadler: Alongside the workshop and the test drivers, we also have a test planning and driving operations team. We are responsible not only for driving, but also for planning, which includes allocating the routes, the drivers and the shift schedules. We also manage the entire organisation, collecting and delivering the vehicles and documenting the results from the engineering team. The Bertrandt engineers plan and schedule exhaust gas testing and workshop visits for the vehicles, evaluate the driving reports to ensure that they are plausible, follow up faults and document this process in our tools. Ultimately we aim to offer our customers an all-inclusive package.

> "We want to move forward together with our customers. This involves primarily new technologies, new legislative requirements and also electromobility, in other words, electric cars and hybrid vehicles."

B*m:* What other areas form part of your department?

Nadler: It also includes vehicle construction, in other words vehicle body building and conversion. Over the years we have begun specialising in prototype construction and disassembly, which involves expertise in bodywork. We build show cars and special vehicles for customer events. For example, we have constructed a vehicle for the sheikh of Dubai and the special Porsche Cayenne Transsiberia rally model. Another area that we cover is integrating the battery into the car. We develop the battery housing and mount it in the car body.
In order to evaluate its strength and durability, we take the entire body apart after the end of the endurance test, measure the loosening and tightening torque, for example, and send any welds that have broken for material analysis. As part of the benchmarking process, we also convert vehicles for wind tunnel testing, comparative tests and concept studies.

B*m:* When you look ahead, how do you think your department will develop? What tasks will you be responsible for in future?

Nadler: Complete vehicle testing and prototype construction will continue to be important aspects of vehicle development in the future. A whole variety of new technologies and developments will emerge. In the fields of hybrid vehicles, reducing emissions and pure electric drives, we already provide an expert service for our customers. We will be monitoring trends, making the necessary adjustments and plans and looking to the future. ■

Light and visibility

The growing importance of lighting systems

Light
Visibility
Safety

More than 80 % of the information received by our brains reaches us via our eyes. This is why indicators and headlights are the vehicle components which provide us with the most important information on the roads. However, vehicle lighting systems are not only vital safety items, but also essential styling features. The external lights play a major role in defining the appearance of the car and give it an unmistakable image both during the daytime and at night. Bertrandt's light and visibility teams have been developing headlamps, rear lights and internal lighting systems on behalf of customers for more than 10 years.

From the initial concept through to the fully functioning prototype

The process of developing lighting components is subject to a variety of constraints. The lights must meet the comprehensive requirements of the automotive industry and, in addition, the ambitious plans of the styling team have to be brought into line with the legislation on mountings and lighting systems. With this in mind, optical systems and lighting sources are tested and their size determined during the concept phase. After the functional lighting elements have been integrated, the entire system is designed. Prototypes are then created to enable all the functions and specifications of the lights to be validated.

Hardware and software for innovative lighting systems

Two different areas of technology have revolutionised the development process and its results over the last few years: comprehensive and accurate simulation software packages allow complex optical systems to be developed and accurate predictions to be produced of the light they emit. Bertrandt has been successfully using software of this kind for several years on customer projects. In addition, new LED technology enables lighting systems with low power requirements to be produced with shapes and structures that were not previously possible.

Development services for lighting and visibility systems

The extent to which the Bertrandt light and visibility teams are involved in the development process described above depends on the customer's requirements. At all the Bertrandt sites both inside and outside Germany our experienced staff can provide light and visibility development services for headlamps, rear lights and interior lights, for example, either on customers' premises or in the form of independent projects.

Cooperation and training to increase capacity and skills

Bertrandt is constantly expanding its light development expertise. The company's contacts with the Karlsruhe Institute of Technology (KIT) at the Technical University of Karlsruhe are also valuable in this respect. The objectives include technical support, joint dissertations and study trips. The central modelling department in the Technikum plays a major role in developing the company's expertise in lighting systems. This is because, in the case of lighting prototypes, the geometry and surface of the lenses have to be produced to a high level of precision, in addition to taking the materials and the shape into consideration. Initial projects involving the entire process from the concept through to the fully functioning lighting system which have been successfully completed have demonstrated that theory and practice can be combined without problems. ■

Detlef Decker, Ehningen

Inspirational and innovative lighting concepts

Fibre-optic systems

The eye-catching design of the LED rear light of the Audi Q7 formed the inspiration for the use of fibre-optic technology.

Eye-catching, modern lighting systems which create an emotional atmosphere are very much in demand. Fibre-optic technology is increasingly finding its way into vehicles. By combining existing systems with new ideas, it is possible to produce lighting concepts, both internal and external, which are innovative, trend-setting and inspirational.

Modern lighting systems

Bringing a more modern touch to lighting results in more personalised cars, with new technologies constantly being introduced. However, the space available for installing lighting units in vehicles has remained the same or even been reduced, largely as a result of the more challenging design-related and technical requirements. One solution to this problem is fibre-optic systems. They can create thin strips of light or illuminate large areas, such as the upholstery on a door panel. Simulation is used to help design the fibre-optic systems during the development process and to enhance their quality. The objectives behind the design of the systems are to optimise the components that transmit the light, improve the passage of light through the optical fibres, reduce output coupling losses and produce a uniform spread of light.

From the light source to the output coupling

Despite the fact that fibre-optic technology has been in use for several years, it still has a great deal of potential to offer when combined with increases in lighting performance. The key benefits of this technology include the option of installing LED fibre-optic systems in highly restricted spaces, an increase in design freedom and the flexible positioning of LEDs. In a fibre-optic system the light is generated in the light source, which normally consists of one or more LEDs (referred to as LED arrays). The criteria used to select appropriate LEDs are colour, lighting current, light intensity, beam angle and operating temperature. Once the light has been produced by the LED, it has to penetrate into the optical fibres. The so-called input coupling is responsible for guiding the light into the fibres. It makes use of the physical effect of beams of light refracting when they meet the interface between two different materials. The shape chosen for this input coupling determines the efficiency with which the light is transmitted by the optical fibres. For example, a convex curve focuses the light, while a concave curve diffuses it. This enables the light to be directed. Optical fibres with a suitably shaped cross-section, together with prisms, can help to transmit the light. A further criterion which influences the efficiency of the fibre-optic system and which is selected on the basis of the parameters of the lighting function is the choice of a suitable material for the optical fibres. The next step involves defining the light which will emerge from the optical fibres before it reaches its destination. The so-called output coupling on the optical fibres is chosen to suit the relevant conditions. Prisms or eroded areas are commonly used, but printed or coated structures are also possible.

Ideal for volume production

Many of the properties of fibre-optic systems that have already been mentioned make them ideal for use in volume production. Every application is different, in part because of the installation space available and in part because of the design requirements. This makes the development process extremely complex, because the fibre-optic system has to be designed accordingly.

The type and shape of the beam of light required determine the underlying technology, including the transmission of the light and the light output and input couplings. A basic distinction made is between direct and indirect lighting. If the optical fibres have to be visible, the covering in front of or behind them is given a frosted finish, depending on the design and the look-and-feel required. Extensive experience of this type of system is crucial for the purposes of volume production. If the parameters imposed during the development process, such as a small installation space or an irregular mounting, do not allow the necessary shape of beam and type of light to be produced, the lighting concept or the parameters must be redefined.

This demonstrates that the wide variety of parameters which influence the development of fibre-optic systems (installation space, surrounding components, technologies, design requirements and function) will result in applications that differ from one vehicle to another. Experience of previous developments may play a role in a modified form, but each new lighting concept is fundamentally different from its predecessors.

Lighting competence across the Bertrandt Group

Bertrandt has extensive experience of providing services in this area, including system layout and design for suppliers, together with component support and development for OEMs.

Summary

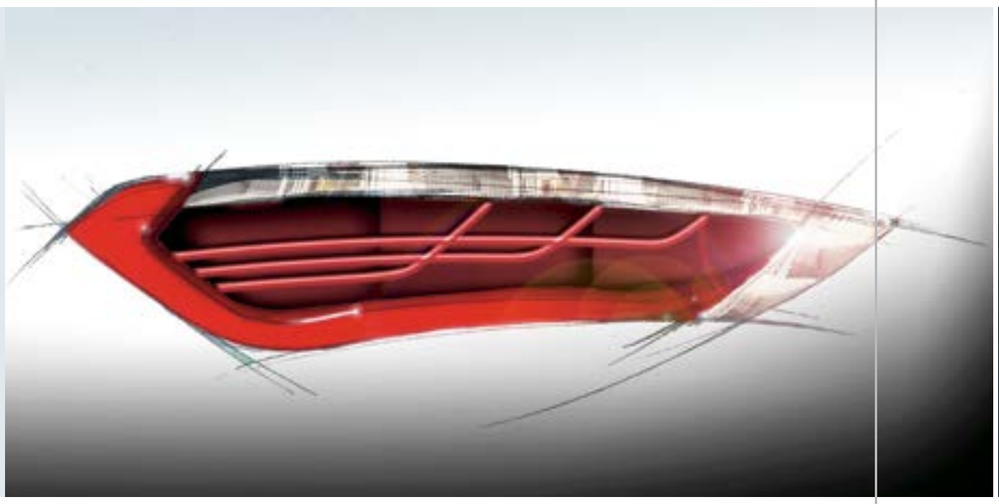
Light has a strong influence on people's emotions. It is responsible for creating a feel-good factor and can ultimately determine customers' purchasing decisions. In the field of interior and ambient lighting in particular, the focus is on fibre optics. The combination of LEDs and fibre-optic systems opens up a whole range of new possibilities for manufacturers. Fibre-optic technology is also increasingly being used in exterior lights, including rear lights and, more recently, headlights. One example is the headlights of the Audi A1, which incorporate daytime running lights and sidelights that use fibre-optic systems. Because LEDs did not produce sufficient light to meet legislative requirements, this has not been technically possible in the past. Only the recent development of high-performance LEDs has enabled fibre-optics to be used in this type of application. ■

Daniel Sturm, Ingolstadt

Light and visibility

State-of-the-art vehicle lights from design to the finished product

Prototype lights



The role of rear lights in current vehicle styling now goes far beyond simply meeting legal lighting requirements. Lights must be an identifying feature of the vehicle, have different daytime and night-time designs and give the exterior of the vehicle a unique appearance. As part of the light development process, a prototype light is an important tool which helps designers to reach decisions during the early phases of the project.

Reflectors from the prototype light after vacuum plating.

The first variant of the fibre-optic module.

From sketches to fully functioning models

When new lights are developed, the competition is on to find the most eye-catching solutions. Some OEMs have been quick to create lights that are distinctly different from the designs of five years ago.

Bertrandt provides support for its customers throughout the entire light development process, which can be broken down into the following phases:

- Sketching designs
- Modelling the class A surfaces
- Designing the light functions
- Simulation to ensure that legal requirements are met
- Visualisation of the daytime and night-time appearance
- CAD modelling of the light
- Manufacturing the light, including lighting functions, using rapid tooling

The individual phases do not necessarily follow one another sequentially. Some will influence each other during the course of the project. While visualisation can provide a first impression of the light early in the project, a prototype light is also indispensable. Firstly, some physical visualisations are difficult to model in mathematical terms, including the special effects of matt lenses. Secondly, lights cannot be represented realistically for technical reasons. On the one hand, the visualisation is two-dimensional. On the other hand, the dynamic range, which is the interval between the darkest and lightest brightness settings of all currently available monitors, is much more limited than that of a real light.

Rear light on display

For its stand at the Frankfurt Motor Show, Bertrandt wanted to demonstrate its ability to provide all the necessary light development services. A new design was created for a sports car, which means that the light is slim and wide. Because LEDs are definitely the light source of the future, the engineers chose to produce a full-LED light. This offers a range of options for controlling the lighting functions. In order to highlight the possibilities available, the various functions are based on different principles. The indicators and brake lights have different types of blade reflectors and the fog light is fitted with direct LEDs in reflectors. The rear light consists of two functions: a row of LEDs behind a matt lens form the basic light, while a sparkling fibre-optic module made from transparent acrylic glass acts as an eye-catching feature.

After a number of variants had been produced, the process of modelling the class A surfaces began. These are the surfaces which will be directly visible and, therefore, they need to be designed with very special care. Subsequently, the position of the LEDs and the levels of the boards were decided on. This was a challenging task because there are no flat surfaces in the design. Boards made from several parts represented the best solution for creating curved surfaces. The colour and output of the LED was chosen to suit the function of each part of the light and suitable reflectors were designed.

The next stage involved modelling the shape of the fibre-optic module. Because of the complex milling work involved, the decision was made to cut the fibre-optic component out of a semi-finished piece of acrylic glass using a laser, for the purposes of the trade fair exhibit. The fibre-optic module is held in place by a grid of chromed strips. Using this module, Bertrandt was able to demonstrate one of the standard features of its prototype lights. In order to give the designer greater freedom, Bertrandt develops its prototype lights in such a way that different variants of components can easily be exchanged. As a result, the different effects can be compared. In the case of the rear light for the motor show, three variants of the fibre-optic module were created with different removable lenses and matt or high-gloss finishes.

After the complete light had been modelled, the process of simulating the legally required light output began. The scattering angles had already been taken into consideration when the reflectors were designed. The next development phase involved duplicating these individual reflectors and positioning them within the light. As a result, very little adaptation was needed to ensure that they fitted with the remaining components.

After this the CAD work continued in order to ensure that the light could be produced as a prototype. This was a time-consuming but important process which involved, for example, positioning the screws and bolts.

Next the data was transferred to the rapid tooling team in Ehningen, where the parts were produced using different methods, depending on the requirements in each case.

Following the final assembly process and before the light was exhibited at the motor show, it was measured and evaluated by the Light Technology Institute in Karlsruhe. This process showed that the simulation and the actual measurements corresponded very closely.

The light was subsequently presented at the Frankfurt Motor Show as an example of Bertrandt's expertise in complete light development. The main benefit for customers is that they can obtain information about different design variants at an early stage of the project, which results in a much shorter development cycle. ■

Patrick Wegener, Wolfsburg

Light and visibility

Lighting expertise

The development process

An important design feature of many new vehicles is their front and rear lights, which have lighting effects and surface finishes that differ strikingly from one model to another. The modelling department in the Bertrandt Technikum has begun working closely with the light and visibility teams across all the company's sites not only to design functioning lights for customers, but also to manufacture high-quality prototypes in Ehningen.

The light presented at the Frankfurt Motor Show in 2011, for example, consists of 27 individual components, such as lenses, reflectors, circuit boards and sand-blasted, vacuum-plated external parts with textured coatings.

The starting point: Top-quality, non-functioning light modules for data control models

The process of developing lights begins with the manufacture of non-functioning lighting units which have the same appearance as the future production components. These are frequently needed by the design modelling department for data control models, but in the past the actual production of the light modules was outsourced. However, the rapid prototyping method provides all the necessary manufacturing processes, such as printing, laser sintering, stereolithography, five-axis milling and vacuum plating. These technologies can be used to produce a large number of individual components from a variety of materials with different surface finishes. These are then assembled to create a high-end light fitting.

Manufacturing using rapid prototyping

The first stages in the process of producing the hardware involve the preparation of the surface and volume data for the lighting system, which is needed for production using rapid prototyping. This data is sufficiently detailed and specific to the light in question that it can be used to develop rapid prototyping components. After a design engineer has spent a week compiling the data, the SLS machines can start work and the construction process begins. Components which are subject to higher stresses are manufactured using laser sintering. Print technology is ideal for other parts that will subsequently be vacuum chrome plated. The products are created directly from computer data using rapid prototyping machines, which saves both time and money. During the next phase, all the glass covers and lenses are manufactured on a five-axis milling machine. The advantage of this is that no visibility problems or distortions are created on the surface. The high quality of the finish is validated by the Light Technology Institute in Karlsruhe.

A comprehensive range of services is available in the field of lighting to produce lights for cars and other applications and for exterior and interior use, reflectors, fibre-optic systems and LEDs. Lights of almost any size can be assembled. The hardware team can provide all the necessary services from under one roof, including designing and manufacturing functioning prototypes and pre-production versions. The tool making department, which has extensive expertise in producing die-casting tools, can even offer small pre-production runs of the relevant components. The advantages offered by the Bertrandt light and visibility network lie primarily in the end-to-end process which includes the technical verification of the lights.

New challenges: functioning lighting systems

In the past, halogen bulbs were the standard solution for vehicle lights, but now OEMs are moving to LEDs and fibre-optic systems, depending on the market segment of the vehicle. Other new technologies are in the pipeline. There is an increasing trend for developing functioning light modules which can provide useful information about the quality of the future production versions. The use of fibre-optic technology is likely to become more widespread in the interior of cars, including indirect spotlights, illuminated trim strips, interior lights and luggage compartment lighting. Designers are pleased to able to exploit the opportunities offered by this new technology.

Growing complexity

The challenge lies in managing the increasing diversity of the products. The light presented at the Frankfurt Motor Show in 2011, for example, consists of 27 individual components, such as lenses, reflectors, circuit boards and sand-blasted, vacuum-plated external parts with textured coatings. The complexity of light fittings is growing, which presents challenges for the creation of fibre-optic systems with new shapes and designs. In addition, customers require not only the production of reflectors using rapid prototyping materials, but also complex milling of aluminium blanks that meet the lighting requirements more effectively. In addition, these optical modules require a variety of electrical and electronic components.

Confidentiality guaranteed in the lighting studio

The central point of contact for all light-related issues is the new lighting studio in the Technikum in Ehningen. A higher level of confidentiality is now required for lighting than has been the case in the past. The enclosed room, which looks unimpressive at first sight and has a separate access system, was set up at the request of a customer. This is where the high-quality end product is produced from a large number of components and subsequently undergoes functional testing, including the electrical and electronic parts. The decisive benefits for customers are the precautions taken to ensure confidentiality, together with the high quality of the results.

Bringing together expertise

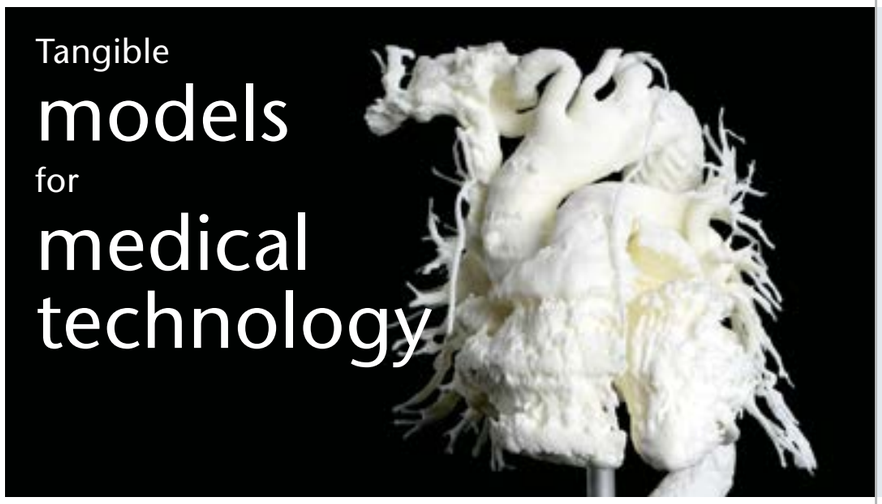
Resolving the issues of how close the prototype is to reality and how informative the lights are in relation to the simulation of the geometric data is another task involved in the process. This is where Bertrandt's close contact with the Light Technology Institute in Karlsruhe is particularly valuable. The institute's facilities and expertise are available as part of a service for measuring components, such as reflectors, lenses and fibre-optic systems. Changes and corrections can be made to the hardware very quickly on the basis of the measurements taken at the institute. This closed process allows Bertrandt to achieve the desired results for its customers. In the fast-growing field of lighting technology, Bertrandt has the necessary expertise in lighting and visibility. ■

Michael Wetzstein, Franz Jerg, Bertrandt Technikum

Rapid Prototyping

Processing high-resolution radiological image data, for example from computer axial tomography or magnetic resonance imaging scans, using 3D design engineering methods is increasingly enabling rapid prototyping processes to be used in the medical technology industry. Bertrandt Technikum GmbH and the University of Heidelberg have been collaborating in this area since 2005.

Tangible models for medical technology



Model of an aorta used for illustrative purposes and to evaluate the accuracy of the measurement data. The model created by means of rapid prototyping with a laser sintering machine has a wide variety of medical applications and is likely to be used more widely in future both in patient care and research.

Laser sintering allows complex models and delicate blood vessels to be reproduced realistically.

Picture source:
Dr. Hendrik von Tengg-Kobligk/
Dr. Frederik Giesel, Vital Recon GmbH in cooperation with the University of Heidelberg and the German Cancer Research Centre in Heidelberg.

Three-dimensional representation for data evaluation

Spatial visualisation on the screen is an everyday process, but producing construction data from models and manufacturing the models using laser sintering is by no means as common. Generating models to allow computer data to be evaluated in spatial terms forms the foundation for the developments that have been made so far. At the start of the collaboration, the tasks involved representing hearts, ventricles and brain fluids. Subsequently it became possible to show vertebrae and to create spatial visualisations of areas of the body's surface. In cooperation with the radiological department headed by Dr. Frederik L. Giesel, the design modelling and rapid technologies department under team leader Michael Wetzstein (at the Bertrandt Technikum in Ehningen) has produced three-dimensional representations using rapid prototyping processes, in order to enable the accuracy of the measurement data to be evaluated.

A wide variety of uses in medical technology

Visualising two- or three-dimensional data on a screen is often not sufficient to gain a comprehensive understanding of the complex anatomical details. This is where rapid prototyping comes in. It is a tool which can be used to understand and create spatial visualisations of fundamental irregularities. Rapid prototyping also offers the potential for creating custom-made prostheses and implants. In addition, it opens up new opportunities for scientific research. Examining models created by means of rapid prototyping can help to explain physiological processes which have not yet been fully understood.

Aorta model for illustrative purposes

The process can best be described using the example of a model of an aorta created by the Bertrandt Technikum. A patient with a connective tissue disease suffered a tear in the inner wall of the blood vessel after the birth of her child. This allowed the blood to penetrate and separate the layers of the aorta wall. Following a bypass operation, four stents were implanted in the patient. The aorta model was created in the form of a three-dimensional design and the image data was converted into machine-readable format. A suitable software tool was used to produce a model which the Bertrandt modelling department built within a few days and returned to Heidelberg. The main benefit of rapid prototyping is the speed of the processes which enable real models to be created from data. This advantage is not yet being widely exploited in the field of medical technology.

Producing models using laser sintering

As a result of Bertrandt's expertise in the day-to-day use of laser sinter machines, it can produce individual parts in small volumes. However, the components currently being manufactured for the medical technology industry are only for visualisation purposes. The challenge faced by Bertrandt's engineers in the case of the aorta model involved setting the machine up in such a way that the model, which was made from polyamide powder using the laser sintering process, could represent realistically both the tiniest and most delicate blood vessels and also the large aorta. The three-dimensional representation of the stents allowed the doctors in Heidelberg to see what the stretched blood vessels and, therefore, the visible outer surface looked like in reality. The same process was used to create a counterpart model which enabled the flow of blood through the major arteries to be tested. The example of the ventricle model demonstrates that models of cavities filled with fluid can also be created for the purposes of investigation.

Laser sintering layering process

The principle of rapid prototyping is based on the use of three-dimensional computer models to allow a physical three-dimensional model to be created using layers of material. During the process of producing the object, the laser sintering machine reads the data from a CAD drawing and creates the model using successive layers of polyamide powder in a series of cross-sections. This layering process involves the laser melting the powder and gradually building up the model. These layers correspond with the virtual cross-sections of the CAD model that have been merged with one another to produce the final shape. The main advantage of laser sintering is its ability to create almost any complex geometrical form.

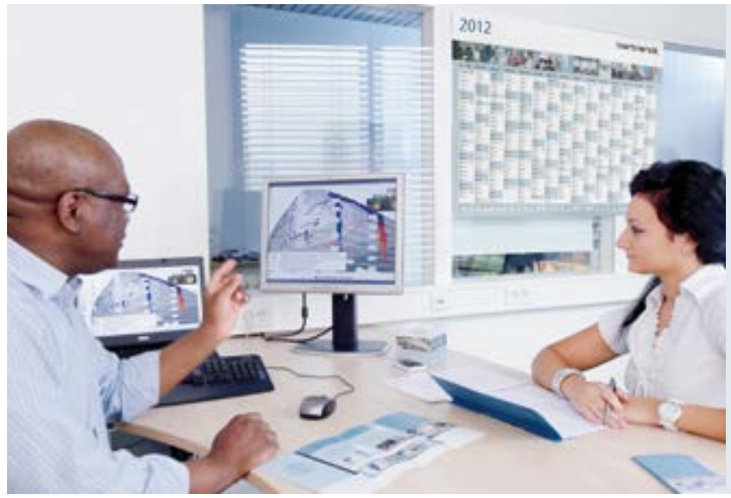
Potential for the future

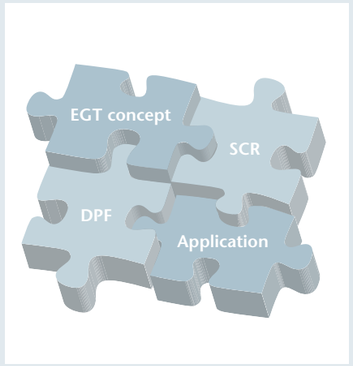
The use of rapid prototyping in the field of surgery is particularly valuable for diagnosis, treatment planning and interoperative surgical navigation, especially in cases where two- or three-dimensional visualisation is not able to give a complete picture of the pathology. This promising technology has a variety of medical applications, including surgical planning, implant design, biomedical research and medical training. The process has significant potential and is likely to be used more widely in the near future both in individual patient care and in scientific research. ■

Dr. Frederik Giesel, University of Heidelberg;
Michael Wetzstein, Ehningen

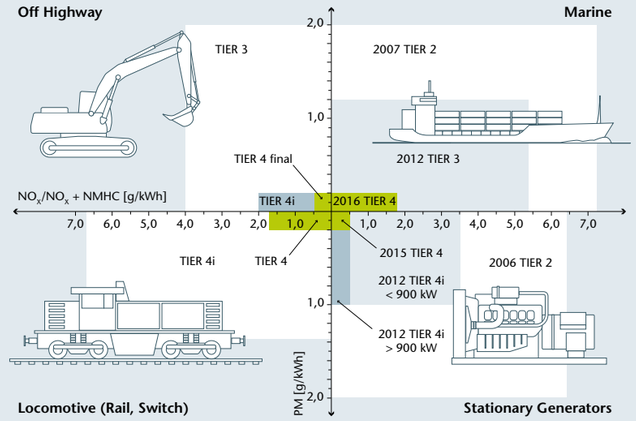
Efficient development and analysis of powertrain configurations

The development process in the automotive industry is becoming ever more dynamic and complex as a result of increasingly strict legislation and a growing awareness of environmental issues. At the heart of the changes is the powertrain, which has to comply with requirements in areas such as fuel consumption, exhaust emissions and the driving experience or performance of the vehicle, while at the same time remaining cost-effective and meeting customer expectations. This is where Bertrandt comes in. A newly developed simulation environment makes it possible to analyse powertrain configurations in heavy machinery.





Contents of b.clean: enhancing the understanding of the technology used in exhaust gas treatment systems.



Emission limits for industrial applications.

Simulation-based powertrain development for off-highway applications

A combination of efficient development tools and technical expertise

Development activities are increasingly focusing on new concepts, such as electric powertrains with a wide range of different designs. These allow for a greater degree of freedom, but also require more analysis. In order to be able to analyse different powertrain configurations at an early stage of the development process, Bertrandt has developed a new simulation environment. The challenging goal of reducing emissions and fuel consumption, while maintaining engine power and performance, can only be met by a combination of efficient development tools and technical expertise. The objective of the simulation environment developed against this complex background is to carry out a quantitative and qualitative evaluation of different measures. On the basis of fuel consumption and of CO_2 and pollutant emissions, the new environment provides support for concept and volume production development processes by allowing for in-depth analyses of different powertrain configurations.

Identifying future trends using a virtual powertrain

The virtual powertrain simulation environment, which is based on MATLAB/Simulink, has a modular structure and, depending on each individual situation, allows for discrete-time simulations in a forward or backward direction. The benefit of the modular format of the complete model is that partial models can be modified to suit the needs of each application without influencing other models. Clearly defined and structured interfaces form the basis for this process. The powertrain model is currently made up of the following submodels: driving cycle/load spectrum, driver, differential and transmission models, torque converter, combustion engine model, evaluation and visualisation, exhaust system and electric powertrain.

The modular structure also makes it simple to represent and quantify a variety of different powertrain combinations. In addition, by modifying the model variables it is possible to create trend forecasts and sensitivity analyses. There is also the option of simulating electric powertrains and hybrid variants.

Diagram showing the potential drop in consumption resulting from optimising the powertrains of large machines.

- Conventional powertrain configuration
- Economy mode powertrain configuration
- Specific NOx
- Exhaust gas temperature isoline
- Engine power output isoline

Other important modules include the exhaust and thermal management systems. Industrial trucks and construction machinery with electric or hydraulic drives can also be simulated.

Powertrain analysis of a tractor and a hydraulic excavator

Two examples from the field of heavy machinery illustrate the potential for analysing and improving existing powertrains. The individual powertrain components are linked together in the traditional way for each application and are subjected to a genuine spectrum of loads.

In addition, the potential for improvement is represented in the form of an economy mode. The result of modifying the powertrain is a shift in the operating range and a reduction in fuel consumption, while the existing exhaust gas temperature and emission levels are maintained. Without any foreseeable negative effects on the exhaust gas treatment system, a reduction in fuel consumption of up to 16 % for the hydraulic excavator and up to 6 % for the tractor is possible.

Diesel-hydraulic and diesel-electric powertrains

In order to be able to assess the loads on the combustion engine and exhaust gas treatment system more accurately, a diesel-hydraulic and a diesel-electric powertrain have been added to the simulation. The diesel-hydraulic drive is a hydrostatic system with a hydraulic pump connected directly to the combustion engine, valves, a hydraulic motor and cylinders. In contrast to the hydrostatic version, the energy from the diesel-electric powertrain is supplied by a three-phase generator and motor with power electronics. Both powertrains have significant potential in the light of forthcoming strict legislation on exhaust emissions for off-highway applications.

Validation using real vehicle data

Bertrandt's modular, flexible software environment for virtual powertrains provides analysis and design functions for powertrain development. Validation using comparative data from real vehicles confirms the qualitative and quantitative value of the process, providing that sufficient computing power is available.

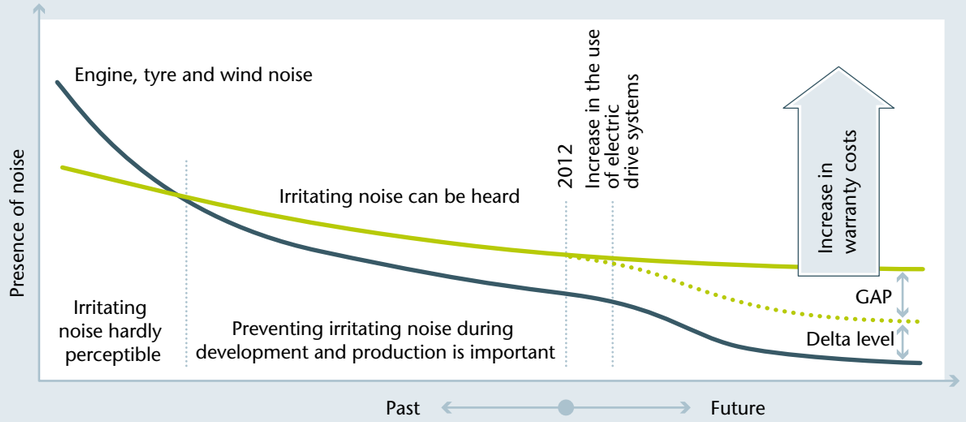
Future prospects

Off-highway applications involve a variety of highly specific developments and represent a challenging environment, in particular given the legislative requirements for more efficient powertrains with lower emissions. Established technologies from on-road applications with complex powertrain control systems and efficient exhaust gas treatment systems will have to be transferred to the heavy machinery sector, but a detailed understanding of the market requirements is needed. Bertrandt has extensive experience of integrating and developing these state-of-the-art technologies. With its own initiatives, such as b.clean, which aims to enhance the understanding of the technology involved in exhaust gas treatment systems for off-highway applications, it is setting new standards and establishing itself as the developer of the mobility solutions of tomorrow. ■

Dr. Oliver Maiwald, Neckarsulm

Designing cars that make no irritating noises

Experts from the worlds of politics, research and business all agree that the lights have turned green for electric cars. However, the technology is not yet sufficiently mature in all areas for volume production to start. Alongside the much-discussed problem of the range, there are also other issues which need to be resolved, such as irritating noise. It is not clear how important this factor is to customers, because not enough research has yet been done into the sounds produced by electric vehicles in the absence of traditional engine noise. At Bertrandt we are combining virtual simulations and physical testing methods to identify and eliminate irritating noises at an early stage.



Comparison between engine, tyre and wind noise (blue curve) and irritating noise (green curve) over a period of three decades.

From tyre, engine and wind noise to the individual perception of sounds inside the car

Consumers require products to be of high quality. However, this allows plenty of scope for discretion, because "high" is a very subjective concept. Sounds generate emotions and car buyers are constantly balancing reality with past experiences. Only when the two sets of perceptions differ from one another the person making the judgements becomes aware of the situation. Whether it is a compact car or a luxury saloon, customers make the decision to buy on the basis of their concept of comfort and quality.

The noises made by a car in motion must be appropriate to the car in question. We distinguish between three types of noise: tyre, engine and wind noise. These are desirable noises because they give the driver feedback about the condition of the car. The ticking of an indicator, often referred to as a functional noise, is also expected by the driver. However, if surprising or unfamiliar noises are heard, this is often unpleasant or irritating for the occupants and gives the impression of a poor quality vehicle.

A challenge for electric cars: their impact on noise emissions

In the early days of motorised transport, irritating noises were blocked out by the noise of the engine, tyres and wind. As cars became more sophisticated and refined, the focus on rattling and creaking noises in the interior grew. Nowadays, the emphasis is on developing cars which produce no irritating noises at all. However, the latest developments are not simply aimed at reducing noise. They are also intended to keep the resulting warranty costs to a minimum.

Irritating noises in the interior of the vehicle become more concentrated and more noticeable when there is no engine noise, because electric motors do not produce the same sounds as combustion engines. Another consideration is the speed of the motor, which is much lower than that of a combustion engine. Therefore, the motor creates far fewer mechanical noises and this has a direct impact on the noise level inside the vehicle. As a result of these changes, development engineers are faced with the growing challenge of combating increases in warranty costs caused by a greater awareness of noise among customers.

An investigation of the overall noise and individual noises in the vehicle interior shows that engine noise is the dominant sound across broad frequency ranges. At speeds above 50 km/h, tyre and wind noise transform the noise of the engine into a rushing sound. Cars often travel at speeds under 50 km/h on poor road surfaces in towns and these speeds therefore represent an important design criterion with regard to irritating noises. Many OEMs are investing more time and money in preventing rattling and creaking noises.

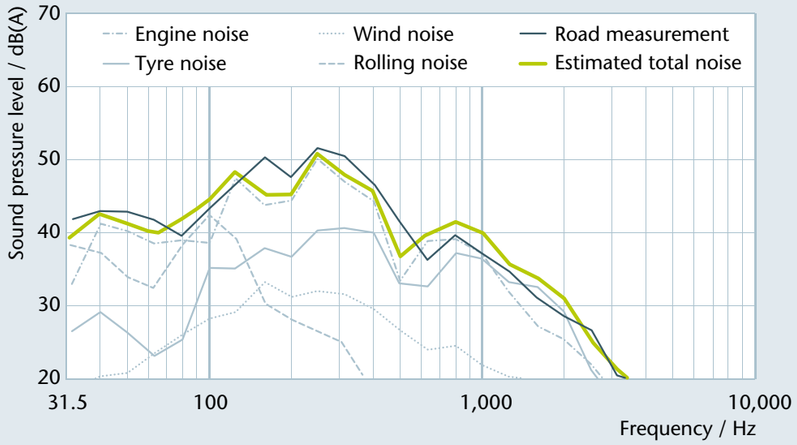


Diagram of the total noise and individual noises inside a medium-sized car at 50 km/h.

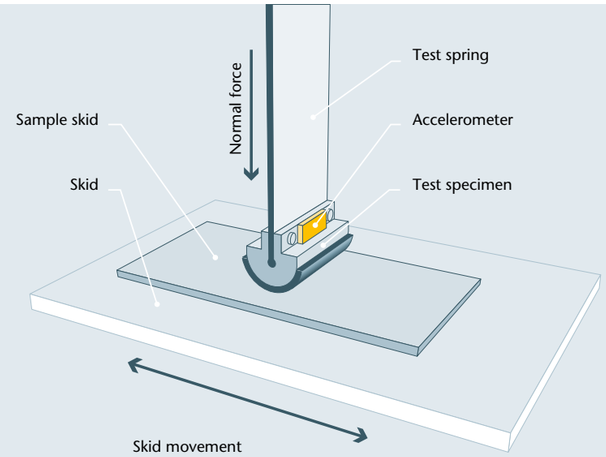


Diagram of a test bench for reproducible testing of materials and combinations of materials.

Preventing irritating noises during the development phase

The innovations introduced in electric cars include new combinations of materials, futuristic designs and a range of new concepts. Another important factor in electric cars is the minimalist interior which, on the one hand, corresponds with the distinctive, innovative and dynamic design of the exterior and, on the other, helps to keep weight to a minimum. Tried-and-tested virtual development methods become more important than ever against the background of new joining concepts and interfaces, together with combinations of the latest materials.

Preventing irritating noise is already a well-established part of the vehicle development process. During the early phases of development, specialists detect and evaluate possible causes of irritating noise and take the necessary measures. As part of this process, it is essential to highlight possible risks and identify solutions to the problems during the creation of the concepts. As development cycles become ever shorter and the pressure to keep costs to a minimum increases, virtual evaluations of irritating noises are often ignored. Expert knowledge, experience and assertiveness are needed, because up to this point there have been no objective assessments of the vehicle interior. It is the job of the experts to differentiate between the different rattling and creaking noises and to identify the components that cause them.

Virtual development phase

Virtual analysis methods are currently the most effective means of identifying irritating noises at an early stage. CAD software such as CATIA is used to highlight the contact points within a component (for example, the mounts for a dashboard) and the interfaces with neighbouring components (for example between the dashboard and the A-pillar trim or the centre console). The components must remain a minimum distance away from one another. This distance is determined on the basis of a number of individual parameters such as the joining method, the material, the stiffness of the component and the expected tolerances. If the distance between components falls below this specified value, there is the potential for irritating noises to be generated as a result of interference, contact or a pinch point between the components.

Hardware noise analysis

Once the virtual test phase has come to an end and the initial components, such as the doors, instrument panel and centre console, have been built, the experts move on to the analysis of subsystems. In order to obtain information about the risk of irritating noises as early as possible, interior components are tested independently of the vehicle using a shaker. The most common form of test bench for simulating the effect of the vibration from the road surface on a complete vehicle under laboratory conditions is the four-post servo-hydraulic testing system. The force is exerted by four hydraulic cylinders under the tyres of the car. Using a climate chamber and a sunlight simulation system it is possible to simulate irritating noises which only occur at certain temperatures or after the vehicle has reached a certain age. This ensures that individual noises can be reproduced at any time, making the analysis of the noises easier.

Another important process is the mobile analysis of the complete vehicle which, when compared with tests carried out on a test bench, has the advantage of allowing stimuli and influences resulting from the engine, the exhaust system and the air conditioning to be tested. However, incorrect environmental conditions and engine, tyre and wind noise which block out the irritating noises often make it necessary to carry out tests on a test bench in the lab under reproducible conditions.

Summary and future prospects

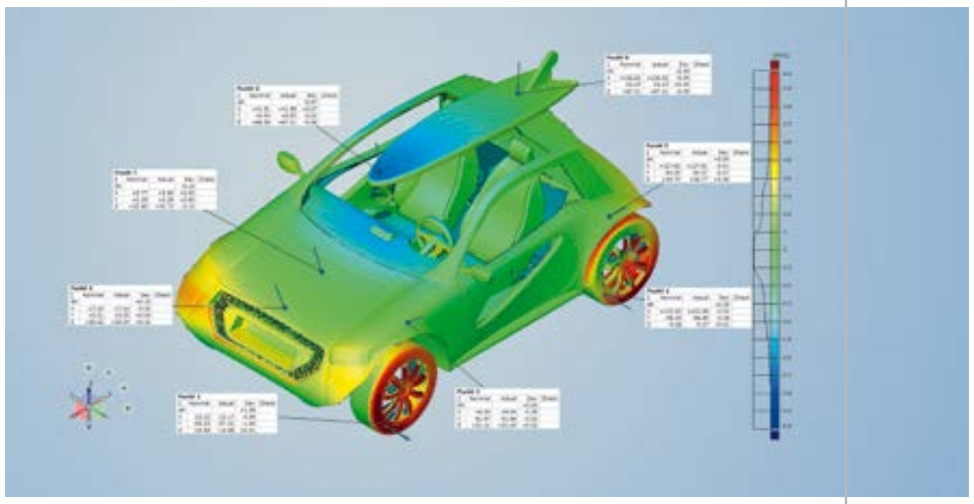
A vehicle consisting of a thousand components is tested on the basis of a wide range of different constraints. The design, installation space, assembly process, producibility, costs and many other factors often vary, which constantly presents developers with new challenges. Because of these differences, similar components used across a variety of models need different measures. The best solutions are identified in collaboration with the experts and the component developers and evaluated using short- and long-term tests. In the case of pure electric vehicles, the situation is even more complex. Alongside the conventional methods of testing hardware, virtual validation methods to help prevent irritating noise will start to play an increasingly important role.

An aspect which is often neglected during the development process, such as two components knocking together, can give rise to significant warranty costs. This makes it all the more important to evaluate designs early on in the product development process and to work together with component developers to produce virtual solutions which generally have little impact on costs. Shorter development times and falling production costs will make this an essential task during the development of pure electric vehicles. ■

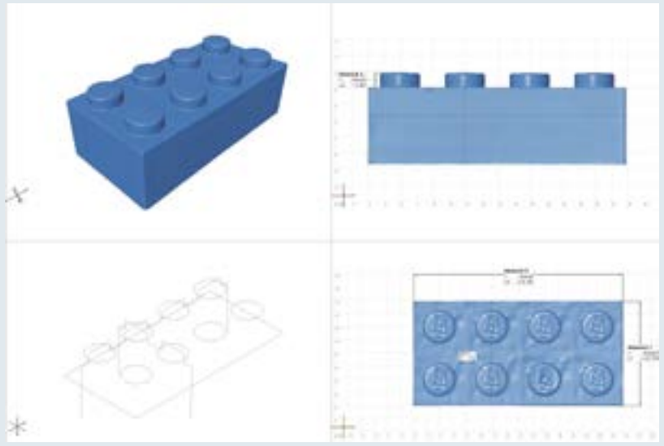
Mario Cannata, Holger Jahrow

Portfolio of state-of-the-art optical and tactile measurement services

Measurement technology is playing an increasingly important role in the product development process, because products have to be developed systematically over as short a period as possible. The aim is to identify problems quickly and with a high level of accuracy in order to take preventive measures at an early stage. Using optical and tactile measurement processes, the team at Bertrandt's site in Tappenbeck can produce high-precision measurements of components, assemblies, vehicles, tools and production plants in a very short time. A wide range of the latest measurement and analysis systems is available at our measurement centre for use during the development of products and production facilities and during the quality assurance process.



False-colour image of a model car used to compare scan data with CAD data. The image shows the deviations in the measurements.



Example of two- and three-dimensional evaluation and measurement using scan data for a Lego® brick.

Efficient measurement and analysis

Three-dimensional scan provides comprehensive results

Bertrandt Wolfsburg has extensive experience of three-dimensional scanning. The ATOS II Triple Scan from GOM, one of the most powerful measurement systems on the market, provides state-of-the-art measuring functions. Components undergo a non-contact scan during the digital measurement process. The results, in the form of false-colour images, can be compared directly with the CAD data and deviations can easily be seen by the user.

Scan data produced before and after a component test can also be compared. This provides detailed information about the deformation or distortion of the part, which is generally caused by simulated environmental stresses. In addition, the department's specialists can evaluate measurements such as the diameter of components or the gaps between them in two or three dimensions. Other cross-sections can be created in any direction for the purposes of inspection and can be used, for example, to identify the wall thickness of any part of the component by means of non-destructive methods. The measuring system also offers the option of scanning separately the individual components that make up an assembly and then subsequently merging the data. This enables gaps and functional measurements inside the assembly which are not visible externally to be identified. This analysis method is used for complex measurements inside vehicle front-ends or engine compartments and during the process of fastening a variety of components using clips. A three-dimensional scan of the component surface can be created and analysed in a very short time and the process is therefore more efficient than manual measurements. As a result of the high density of the measurement points, the full surface scan produces much higher quality results than other measurement methods. In addition, there are no limits on the size of the component. Whether you want to measure a small complex connector housing or a complete aircraft fuselage, the measurement system is mobile and can be used in any conditions.

Returning data to the CAD system from the 3D scan (reverse engineering)

If foam seat cushions are modified manually during the concept development process or clay models are created by hand, for example, the surfaces can be measured using the three-dimensional scanning process and the resulting data can be processed in all current CAD systems.

Laser tracker – precise measurements over long distances

It is extremely difficult to measure very large components or complete production lines using conventional measurement methods. The results are not sufficiently accurate and the process is not cost-effective. For cases of this kind, the Bertrandt measurement centre at Tappenbeck uses the Faro Laser Tracker ION.

The measuring area of the system has a diameter of 110 m. This enables even aircraft and ship components, large tools and production facilities to be measured with high levels of accuracy in a very short time, as the system rarely needs to be repositioned. The equipment can be used at customer sites anywhere in the world.

The measurement system uses a high-precision laser to measure the distance to a small reflector. In addition, the laser head can be rotated in two directions and the corresponding angle of rotation is accurately recorded by the system. This enables the position of the reflector in the room and in relation to the component to be determined with a high level of precision.

Photogrammetry – accurate analysis of deformations

Vehicle components are subjected to complex testing during development and as part of production monitoring. The parts are exposed to extreme temperatures or artificial sunlight in order to simulate their behaviour over the life cycle of the vehicle. In these tests it is important not only to quantify the deformation and movement of the components, but also to assess the quality.

Bertrandt uses photogrammetry to obtain measurements of this kind. The TRITOP measurement system from GOM forms the basis for this process. Small position markers are attached to the component and it is photographed using a special high-resolution camera. Subsequently, the system calculates the coordinates of the markers in relation to calibrated gauges.

The measurement can be repeated after the test or in some cases during the test if the temperature is appropriate. This allows the movement of each marker in any direction to be recorded and, as a result, any deformations can be visualised.

Measuring arm for mobile measurements

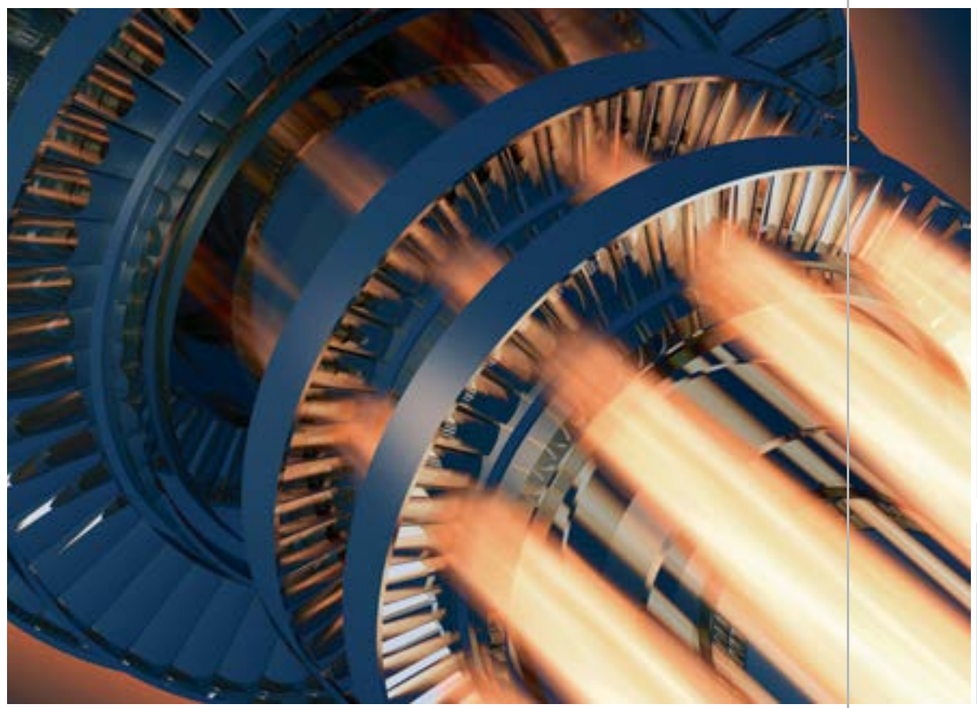
The FARO Fusion portable measurement arm enables Bertrandt to measure vehicle components, tools and equipment on any customer site and to make any necessary modifications. This reduces costs and transport time for customers.

The Bertrandt Wolfsburg measurement centre uses a wide variety of modern measuring methods. The centre's employees, who carry out even non-standard measurements efficiently and systematically, have many years of experience in this field and this is a crucial factor in the centre's success. As a result, problems during assembly or functional testing, for example, can be analysed and eliminated, and this plays an important role in increasing the efficiency of the development process. ■

Christian Rode, Wolfsburg

Development services in the field of renewable energy

Moving to more environmentally friendly energy sources



An end-to-end approach to complex development processes: Bertrandt Services identifies potential for improvement in terms of quality, the environment and cost.

The intention of the EU directive on the promotion of the use of energy from renewable sources is to reduce emissions of greenhouse gases which cause climate change. In order to overcome this challenge and accommodate the accompanying increase in the amount of development activities, external partners such as Bertrandt are providing the energy industry with end-to-end services covering the entire product development process.

The first moves have been made

The EU climate and energy packet triggered changes in the use of energy. By 2020, a significant proportion of the electricity used in the EU must be produced from renewable sources. In 2011, 19.9 % of the electricity generated in Germany came from hydropower and wind energy (of which wind energy made up 7.6 %). In order to achieve the objectives by 2020, a sound mix of conventional and renewable energy sources is needed. The energy industry must continue to develop renewable energies in order to achieve this mix. This is where external development service providers can support energy companies with their in-depth knowledge of all types of development processes and their effectively networked expertise. This allows them to offer the entire spectrum of services needed for the construction of energy generation facilities. Engineering service providers such as Bertrandt Services also take an integral approach to the construction of power plants by developing cross-disciplinary and cross-site solutions for customers from the energy industry, ranging from basic mechanical and electrical engineering and detail engineering through to physical component testing.

Gas turbines in the age of electricity

Bertrandt Services GmbH has extensive expertise in the field of industrial plant construction. The company's engineers and technical specialists provide support for customers during the development of gas turbines which are used to resolve the difficulties of planning energy supplies based on sun and wind. Gas turbines as power plants or in combination with a steam turbine form the ideal link between conventional and renewable energy generation. They act as a back-up to cover peak loads and to regulate the base load. The advantage of gas turbines is that they can be connected to the electricity grid very quickly. More than 600 gas turbine power stations are currently in operation throughout the world. All the projects and activities which occur during the lifetime of a gas turbine, from regular maintenance and inspections through to repairs and upgrades, can be managed by the Bertrandt Services team, together with technical improvements.

Project management as a supporting function

The engineers and technical specialists from Bertrandt Services provide project management services and support for solutions across a wide range of departments. In one area the focus is on the commercial evaluation of projects and in others on resolving technical issues and detailed action planning or managing worldwide logistics systems for new and used turbines and for spare parts transfers. One example of this is the development of a new logistics approach. Until now the components requiring maintenance were removed from the turbine during the inspection, reconditioned and reinstalled. Now they can be replaced with existing components from the same type of turbine. This significantly reduces the downtime of the turbines and can bring savings of millions of euros.

Quality documentation

Other services include providing comprehensive quality documentation and managing documentation on ongoing projects. One example of this involves recording and evaluating operating data from turbines already installed in the field. The findings from this process play an important role in the ongoing development of gas turbines.

Other areas for improvement

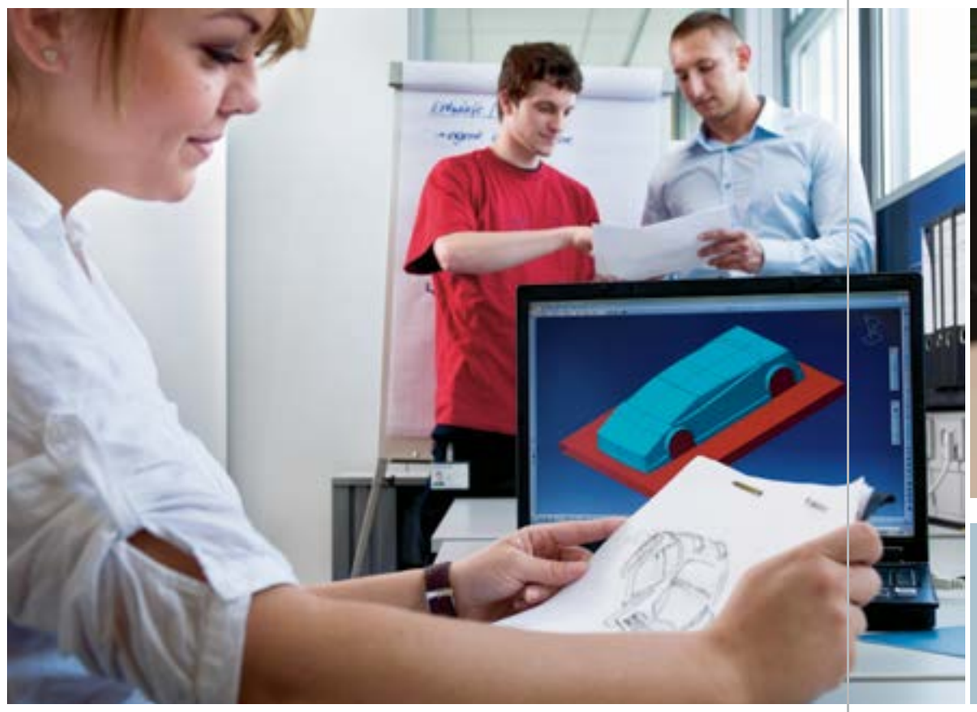
On the production side, Bertrandt Services is also involved in development and improvement activities. Examples include supplying prototype parts for production, tests in the test centre and on turbines in the field and separate component tests. The extreme operating conditions of gas turbines place significant demands on the measurement systems (in areas such as high temperature, optical and flow measurement and telemetry). Universities and external service providers are also involved in the development process.

Renewable energy from photovoltaics

Bertrandt Services provides support for solar energy companies as part of the development of turnkey production lines, individual machines and process control equipment for manufacturing solar cells. The variety of projects covering the complete value-added chain has enabled the Bertrandt Services team to develop wide-ranging expertise in the photovoltaics field. Solar energy is increasingly being generated on roofs and used as an energy source for parking meters, electric cars and calculators. Customers of Bertrandt Services in the solar industry benefit from a wide range of services based on a modular system which covers the entire product portfolio.

Its modular engineering solutions, proximity to its customers, with 19 sites throughout Germany, and 35 years of development experience guarantee that Bertrandt Services can provide reliable support in every project phase. The benefits for customers are obvious: Bertrandt Services can highlight potential for improvement and cut costs throughout the course of the project. ■

Giuseppe Manolio, Bertrandt Services

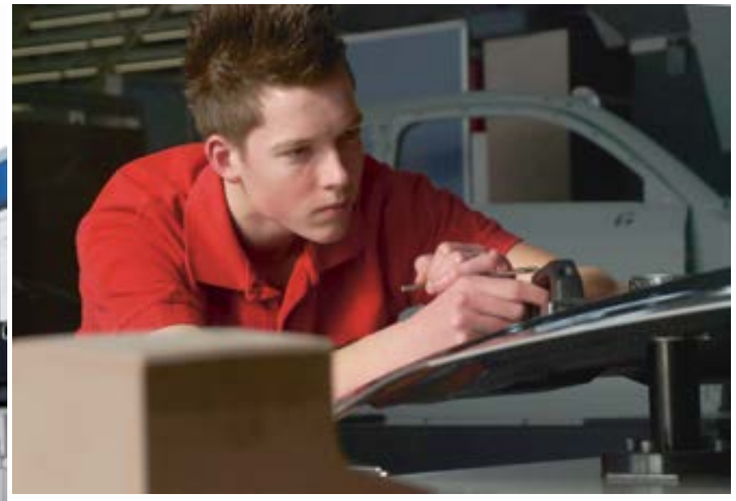


No future without the next generation

School is over, but what comes next? Most young people choose an apprenticeship or a university course which helps to determine their future career path. This represents an important step in every young person's life. Education is also a crucial factor in ensuring Bertrandt's future success. This is demonstrated not only by the special programmes, activities and training courses designed for the students and apprentices, but also by the figures. In this financial year, 87 young people began apprenticeships within the Bertrandt Group. Across the entire group and all four years of training, the company has a total of 174 trainees, making this a record year for apprenticeships at Bertrandt.
Both the university sandwich-course students and the commercial and technical apprentices receive an excellent theoretical education and, at the same time, learn about all the areas of the company that are relevant to them. The importance placed on education becomes clear on the very first day. During their induction week, trainees and students are given a comprehensive overview of the structure of the company and its portfolio of services. The support that the new joiners receive in the initial week makes the first steps easier for them, because it is not only the company that is new to them, but also the world of work itself, and they have learn to find their own way around.

Network of apprentices

The trainees also form part of the Bertrandt network and activities such as visits to the Autostadt in Wolfsburg and the Smart factory or even an evening barbecue help to increase their sense of belonging. A trainee day involving the entire group ensures that the network remains active and up-to-date. A wide range of training courses is also available for the trainees. Technical seminars and workshops are on offer, together with methodology training sessions, all with content specifically designed to meet the needs of the young apprentices and students.
The focus on education and all the related activities makes one thing clear: the goal is to improve knowledge and skills for the benefit of the company. The contract which every trainee and student signs specifically states that there will be a job for them with the company in future. Appointing its own trainees brings only benefits for Bertrandt. Whether they have taken a degree course or undergone vocational training, they are well-informed about the activities and structure of a wide range of different departments and fully familiar with the corporate philosophy.



The start of a promising career

Bertrandt offers a total of 14 apprenticeships and 8 different university sandwich courses.

Lifelong learning at Bertrandt

Acquiring and developing technical knowledge and skills is not something that only happens during the time spent in education. Employees who are part way through their working lives should also be able to take lifelong learning for granted. Knowledge is particularly important for a development service provider, because it is one of the company's main competitive advantages. For this reason, Bertrandt encourages and supports the development of every employee. Almost 300 internal training seminars are listed systematically on the Bertrandt knowledge portal, in such a way that employees can find the courses that they need straight away. "All our employees can now work together with their managers to plan a series of training measures that are appropriate for their level of knowledge," says Sandra Hoffmann, head of employer branding and staff development. "Given the wide range of internal training available, everyone is sure to find the right course for their needs. We will be happy to provide individual support on the phone for anyone who can't decide." ■

Sandra Fischer, Ehningen

Apprenticeships

Technical
- Electrician for devices and systems
- Bodywork and vehicle construction mechanic
- Vehicle mechatronics engineer
- Mechatronics engineer
- Upholsterer
- Technical model maker
- Technical product designer
- Machining engineer
- IT specialist
- Vehicle painter

Commercial
- Office administrator
- Industrial administrator
- Specialist in office communications
- Recruitment specialist

Sandwich courses

- Business studies, industrial and service management
- Vehicle system engineering
- IT
- Business studies, accounting and financial controlling
- Mechatronics/electromobility
- Human resources management/recruitment
- Cooperative degree courses
  - Cooperative degree in automotive engineering
  - Cooperative degree in systems engineering

Training

- The Bertrandt knowledge portal with around 300 internal training seminars

Model health and safety processes in Ehningen

VBG awards its AMS certificate to Bertrandt Technikum GmbH

The statutory accident insurance organisation VBG awarded the Bertrandt Technikum its "AMS-Arbeitsschutz mit System" (health and safety management) certificate. The company's health and safety management system was assessed on the basis of national and international standards and met all of VBG's twelve health and safety criteria.

Creating a safe and healthy workplace

VBG awards its certificate to companies which can show that they have a systematic health and safety system that is integrated into their operational processes. Effective health and safety measures ensure that accidents at work can be prevented. This is not the only advantage of the management system. The systematic promotion of health in the workplace and a widespread awareness of health and safety throughout the company will improve the quality of employees' work and increase their productivity, efficiency and motivation. ■

A constant presence for customers

The Bertrandt Neckarsulm site opens new premises in Mannheim

At Bertrandt, providing customers with the best possible service includes ensuring that it has premises that are close to customers' sites, developing innovative solutions and always being available to meet customers' needs. The portfolio of services provided by the Neckarsulm site is in great demand in the Rhine-Neckar region, so expansion into new offices in Mannheim represents a natural progression.

Ideal location close to customers in the Rhine-Neckar region

Bertrandt has been working for clients in the Mannheim area for more than two years. Gradually, Bertrandt took responsibility for larger development projects, which involved setting up a special project office. Growing demand and the need to be closer to customers, together with an increasing number of projects, prompted the opening of new premises in Mannheim.

The new site offers design engineering, virtual reality, electronic system development and supporting services for the automotive industry. The site's geographical proximity to its customers allows the Mannheim team to offer them the best possible support. The aim is to provide customers with high-quality services that meet their requirements. ■

In a strong position

Expanding the testing department at Bertrandt Wolfsburg

In the new test building in Tappenbeck, Bertrandt can offer its customers the very latest testing services:

Vehicle safety

In the vehicle safety department, the concept of independent project rooms will make it possible to meet the prototype protection requirements of highly sensitive derivatives. Installing air conditioning guarantees compliance with the constant temperature and humidity requirements specified in the test regulations. In future, head impact tests, out of position tests and airbag tests will be carried out in this accredited testing area.

Acoustics

The new class 1 semi-free-field room gives the acoustics engineers the facilities they need to test individual components or even complete vehicles. They can carry out detailed tests and produce definitive results in accordance with ISO 3745, together with benchmarking processes and A/B comparisons for internal packages from other departments. The quality of the pyschoacoustic tests and applied modal analyses will be significantly improved by the removal of environmental influences.

Chassis development

The new test centre, which covers an area of 600 m², opens up a wide range of new opportunities. The additional space available will allow the potential of the department responsible for developing chassis, engines and add-on parts to be exploited to the full and will enhance its dynamic approach. One of the many new features that highlight the technical focus of the powertrain and chassis development team is the possibility of multi-axial vibration testing of chassis components. The measurement assessment systems in use here close the loop between engineering design, simulation and testing.

Electromobility/electrical and electronic testing

Electromobility/electrical and electronic testing is a very important area. This relatively new field of vehicle development has grown in significance following considerable investment. This includes the purchase of a dynamic, high-speed test bench for electric motors which meets the latest international standards. A specially equipped safety area has been set up in the high-voltage department for commissioning and integrating batteries. The department has several other electronic test labs with a comprehensive range of equipment, where tests are carried out on HiL test benches or sample vehicle bodies. These tests form an important part of the overall vehicle integration testing process. For all the electrical and electronic testing areas described here, the focus is on acquiring further internal test references for modifying applications, endurance tests and accompanying function tests. ■

The latest news from the Bertrandt world

- Aerospace services are now coordinated centrally by Bertrandt Hamburg, with sites in Bremen, Augsburg, Donauwörth and Toulouse.
- Bertrandt now has an office in Shanghai.
- In May 2012, Bertrandt Services opened an office in Dresden.
- The Bertrandt Services team from Göppingen moved to Esslingen in June 2012.
- The Bertrandt Technikum has opened two new sites in Ludwigsburg and Leipzig.

Highly productive and

Multi-talented

Expansion of the design modelling, powertrain development and testing departments

- The new annex in Ehningen offers plenty of space for the latest technology.
- Measurement rooms.
- Focusing on child safety: seat certification in accordance with FMVSS 208.

A new area has been created for individual engineering services. The annex has almost doubled the floor space available in Ehningen to 24,000 m², allowing the site to offer an even more wide-ranging portfolio of innovative technologies. It includes a new development workshop where engines can be tested and the results of the tests analysed, together with a modern battery test centre which extends Bertrandt's expertise in the field of electric vehicles and enables electric motors to be tested as part of the complete vehicle validation process. In the battery centre it is also possible to identify potential areas for improvement in energy management systems which control the supply of energy to the individual units in the vehicle. During the process of planning the annex, the focus was on providing an even broader spectrum of services and carefully structuring the individual steps in the processes. By offering a high level of flexibility, Bertrandt can reduce development times for its customers even further.

New powertrain development workshop

Car manufacturers are heavily involved in finding new solutions to make vehicles more environmentally friendly and in continuing to develop conventional internal combustion engines and gearboxes, together with individual components and complete hybrid or electric powertrains. In the new development workshop, which will be completed by the end of 2012, prototype motors, engines and gearboxes can be measured, tested and put into operation. The objective is to test all the functions under representative conditions, to produce useful measurements for validating simulations and to identify faults at an early stage. The test results will be analysed in detail and evaluated in collaboration with the simulation department. The development workshop also has a separate room for components, a component crack testing system, a parts cleaning machine and numerous workplaces for manual tasks.

Another new area of development relates to thermal systems. The concept of thermal management involves the effective control of cooling and heat flows in order to reduce consumption in vehicles powered by hybrid or fully electric drives or by fuel cells and to use the energy that has been saved to extend the vehicle's range. For this purpose, Bertrandt's specialists will in future be constructing complete vehicle cooling circuits to allow functions such as the rapid heating of the motor or the car interior to be investigated and to identify suitable operating strategies. The cooling system can be tested in advance without the need for costly prototype vehicles and time-consuming conversion work. This brings significant benefits for customers, including a reduction in the development time and in the amount of resources used.

Plenty of space in the design modelling department

As a result of the growing variety of vehicle models being developed, Bertrandt decided to provide new studios for the modelling department. The extra studios with their multi-functional equipment cover the complete range of design development services and enable the design of additional derivatives and models to be evaluated.

A high-quality system of line lights (3,000 lux) allows designers to assess highlights and the flexible room layout provides enough space for presentations to be given. Next to the studios is a new QA centre with state-of-the-art CNC measuring systems.

Another area in the modelling department has been specifically equipped for manufacturing fibre composite parts (GFRP/CFRP). Using the vacuum infusion process, high-gloss surfaces can be produced on the visible areas of components. This carbon fibre technology is also used in the cubing process, which allows the shape of components, modules or complete vehicles to be evaluated by means of functional models. The manufacturing system covers a distance of 4 metres and this enables the complete side of a vehicle body to be produced using the cubing process (in aluminium). The measurement room and the paint shop make it possible to create realistic, high-quality models. The modern spray booth and the large finishing area, which has lighting with an output of 1,500 lux, both make a significant contribution to the creation of high-end surfaces. In addition, the new annex has a logistics area, offering secure loading and unloading facilities within the building.

Testing to produce high-quality components and complete vehicles

Certifying seats in accordance with FMVSS 208

One of the areas of vehicle safety which the Bertrandt Technikum specialises in is child safety. As part of the seat certification process for FMVSS 208, the functionality of the occupancy mat in the passenger seat is tested for the US market. The mat identifies whether the seat contains a belted child seat or a fifth percentile female (height 139.7 to 150 cm/weight 46.7 to 51.2 kg) and informs the airbag control system. Depending on the force applied to the mat and the distribution of the force, the airbag can be activated or deactivated.

Airbag laboratory

Improving the active and passive safety of vehicle occupants and pedestrians is one of the most important development objectives in the automotive industry. The new airbag lab will help to protect the lives of road users after the so-called point of no return, in other words, the point at which an accident can no longer be avoided. The aim is to keep the consequences of the accident to a minimum by using passive safety measures. For this reason, Bertrandt has invested in an additional climate chamber for complete vehicles, equipped with side windows, at the Ehningen site. Three new high-speed cameras, which can take a maximum of 5,000 colour images per second, have been added to the existing range of equipment.

Bertrandt Technikum: Highly productive and multi-talented

- New studios for the design modelling department: cubing room.
- Laminating with CFRP.
- Measuring with the laser tracker.

- Sunlight simulation system.
- Infrastructure for the integrated systems testing area.
- Climate chamber in the battery test centre.

Sunlight simulation system for complete vehicles

In combination with the 72 m³ climate chamber, the new system makes it possible to simulate the use of individual components or complete vehicles in hot, dry or hot, moist climates.

The sunlight simulation system allows components to be tested for damage caused by deformation, fractures or cracks, rattling or squeaking noises (NVH), creating rubs on adjacent components as a result of the expansion properties of the material and changes such as the loosening of clip, adhesive or welded joints. Other tests include delamination, UV light resistance and changes in the dimensions of joints. As part of the process of meeting the constantly rising quality standards for vehicles while keeping development cycles as short as possible, planning and running targeted and efficient tests gives a decisive competitive advantage.

The sunlight simulation system for complete vehicles complements the existing test facilities and adds another important module to the broad range of component and vehicle testing services.

Technical details of the system	
Temperature range:	-40 °C to 140 °C
Climate range:	10 °C to 90 °C at 10 % to 95 % relative humidity
Internal dimensions:	6 m x 4 m x 3.5 m
Radiation area:	5 m x 2.2 m
Radiation intensity:	up to a maximum of 1,300 W/m²

"b-energized" – in the new battery test centre

With predictions of one million electric vehicles on the roads by 2020, Germany is one of the leading markets for the development of electromobility solutions, which is one of the reasons why Bertrandt has established a new battery test centre in the Technikum. The new centre offers testing services for the latest high-voltage energy storage systems that power electric vehicles and helps to resolve customers' capacity bottlenecks. It provides a test environment for batteries for hybrid electric vehicles and battery electric vehicles.

The new test centre also includes a series of modular test systems in which all the channels can be configured separately. This allows individual conditions for measuring and aborting each stage of the test to be defined. All the measurements from each test are presented in real time and the configuration can even be modified during the course of the test itself.

The battery test centre is divided into three testing areas. One or two batteries can be evaluated in each area. The test systems can also act as battery emulators for testing power electronics systems and DC-to-DC converters, for example.

The batteries and individual components of the systems, such as the power electronics, can be tested in the test centre's climate chambers (8 m³ to 10 m³) and temperature control cabinets (800 l). An additional temperature control unit is available for this purpose.

Testing area for components in integrated systems

This testing area enables the integration of entire systems to be evaluated. It forms a link between component and complete vehicle testing. It replicates the vehicle environment in order to allow components such as electric motors, power electronics and integral battery chargers to be tested as part of integrated systems. Both digital and analogue measurements can be recorded and documented. In addition, information about temperatures and other variables in the existing system can also be recorded synchronously for each customer.

Technical details of the battery test centre	
The maximum output figures of the single-channel system are	
Output power:	+/- 180 kW
Output voltage:	0 V to 850 V
Output current:	+/- 600 A
The maximum output figures of the two-channel system are	
Output power:	+/- 300 kW (parallel operation)
Output voltage:	0 V to 600 V
Output current:	+/- 1 200 A (parallel operation)

The battery test centre extends Bertrandt's expertise in the field of electromobility. The company's long-term goal is to be able to test all types of new developments relating to electric powertrains. ■

Corporate Calendar | Bertrandt Sites

13.-15.09.2012	Job Compass, Braunschweig
20.09.2012	VDI day, Ulm, Maritim Hotel
08.-10.10.2012	21st Aachen Colloquium Automobile and Engine Technology
10.10.2012	VDI day, Karlsruhe, Congress Centre
10-11.10.2012	VDI Focus on Vehicle Electronics 2012, Baden Baden
10.-12.10.2012	IZB (International Suppliers Fair) 2012, Wolfsburg, Hall 5, Stand 302
23.10.2012	VDI day, Hamburg, Chamber of Commerce
24.10.2012	Company contact fair, Magdeburg
08.11.2012	ZWIK, Zwickau
09.11.2012	VDI day, Ludwigsburg, Forum am Schlosspark
14.11.2012	Company contact fair, Köthen, Anhalt University of Applied Sciences
15.11.2012	VDI day, Munich, M,O,C
20.-21.11.2012	Career days, Weingarten, Ravensburg University of Applied Sciences
06.12.2012	Annual report press conference, Stuttgart
06.12.2012	Analysts press conference, Frankfurt
20.02.2013	Bertrandt Annual General Meeting, Sindelfingen

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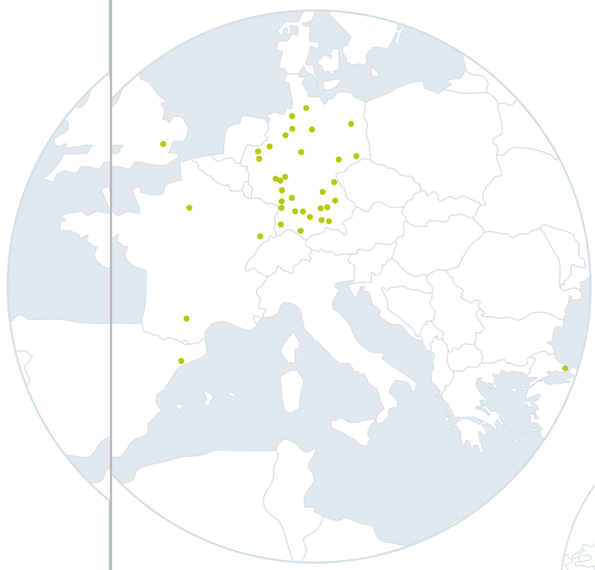

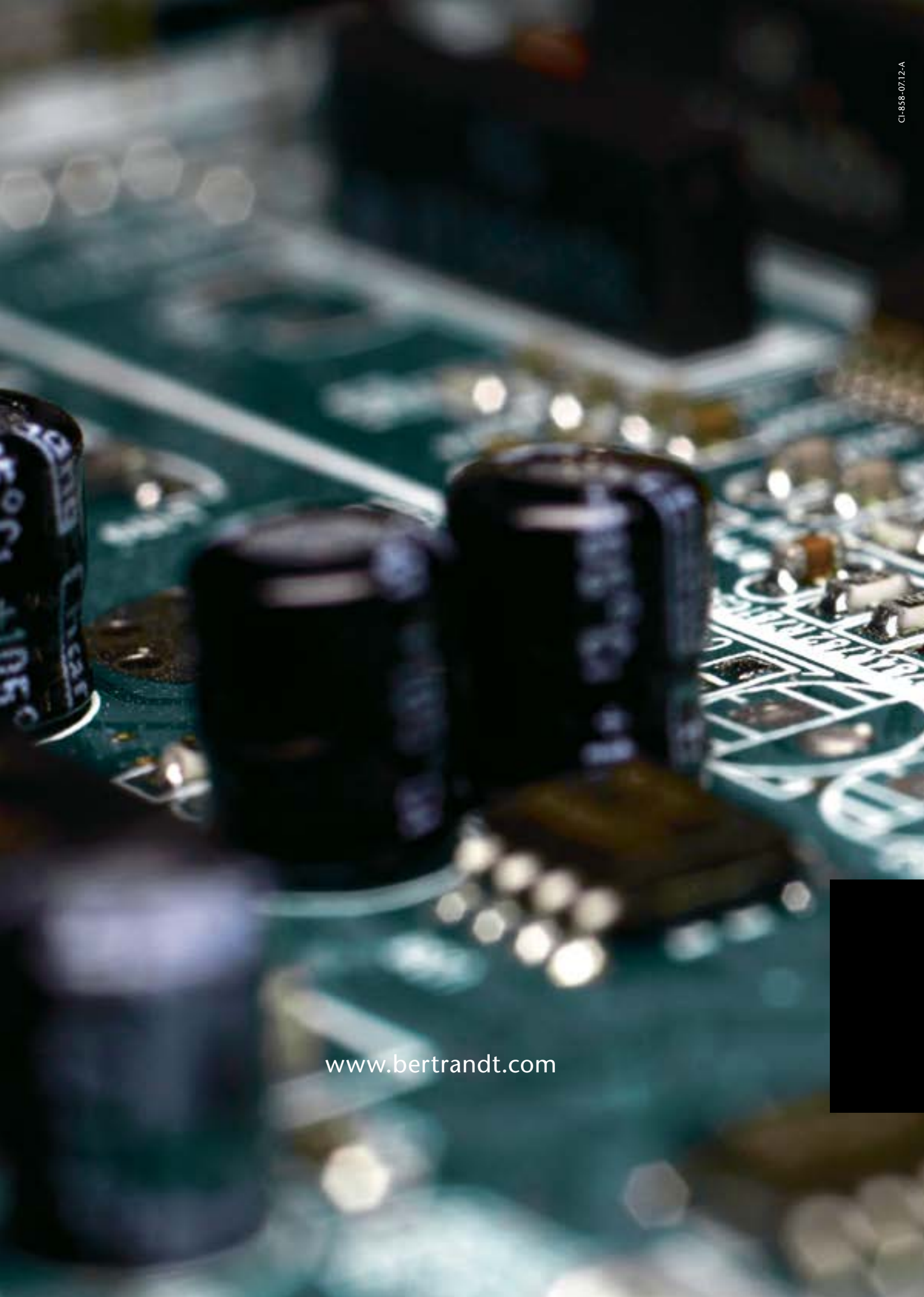

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