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Mercedes-Benz CL-Coupé: Body-in-White development

Audi A5: Cockpit and Centre Console

Combino: Bertrandt supports Siemens Transportation Systems

Valeo Comfort Demo Car: Ideas visualised with Bertrandt

Bertrandt Engineering Network: Electrics/Electronics

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Editorial

Our future mobility will be determined by a large number of technological influences. For example, trends towards more safety, networked communication or efficient drive concepts will play a significant role in the development of the vehicles and aircrafts of tomorrow. Modern technologies will influence development work and confront people in engineering departments with new challenges.

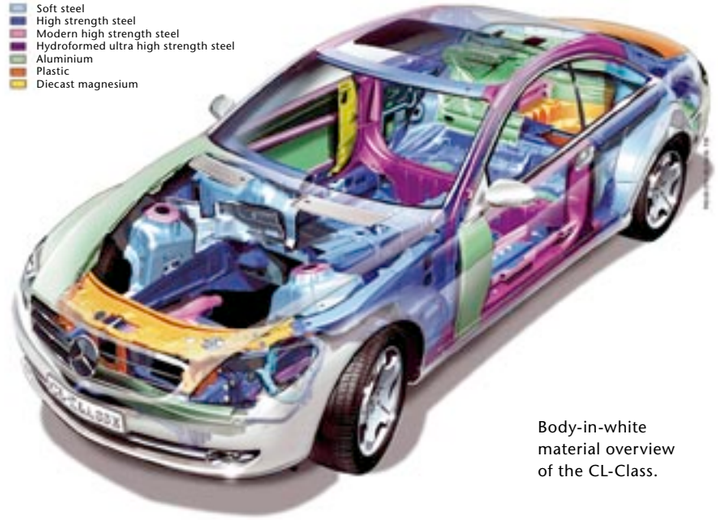
This is clearly shown by electronics as one of the key driving forces in innovation. The increasing proportion of electronics in vehicles and the higher complexity of systems are leading to changes in the requirements that development partners in the automotive industry have to meet. The broad range of electronics applications offers market players many options to position themselves as partners in electronics development, either as a niche supplier or as a provider of complete packages. Bertrandt offers both of these. With our Electronics Competence Centre, we are not only a qualified partner for special requirements but at the same time can also apply specialist knowledge of complete vehicle development to complex projects. Our engineers and technicians have the right approach – and an individual solution for every requirement.
Our main report in the centre of this magazine focuses on electronics development at Bertrandt, and we hope to provide some truly “electrifying” information. For example, our report on the Valeo Comfort Demo Car shows the practical implementation of a number of innovative electronics applications.

Of course, the latest edition of our magazine also makes interesting reading for those not specialised in electronics. From the Body-in-White development of the Mercedes-Benz CL-Coupé to the interior design of the Audi A5 and Audi TT, we will take you on a journey through the world of complete vehicle testing. Take a seat in the LuxuryCell interior model and see how our diploma students see the concept of eco-friendly driving. Experience comfortable mobility by rail on a trip with the Combino local transport system from Siemens.
Climb on board and experience the mobility sector in all its facets from the Bertrandt perspective.

Dietmar Bichler

Mercedes-Benz CL-Coupé

The new CL-Class, introduced in the autumn of 2006, is the pinnacle of the 50-year-old coupé tradition at Mercedes-Benz. For decades, the big Mercedes Coupés have been the embodiment of elegance and exclusivity in the automotive world. They set standards in design and equipment and combine an excellent safety record with high levels of comfort and a premium driving experience. A sophisticated car requires a sophisticated development process. Years of cooperation with Mercedes-Benz made Bertrandt the ideal candidate to take responsibility for the entire Body-in-White (BIW) development process.



Body-in-white material overview of the CL-Class.

Prestige model brings success throughout the range

Extensive competence

The CL-Coupé project was unique for Bertrandt in terms of both its scope and its challenges. Throughout Germany, engineers were working on the new top-of-the-range model from Mercedes-Benz. In cooperation with DaimlerChrysler, Bertrandt took on responsibility for the development of the entire BIW and the accompanying validation process. The scope of the undertaking included project management, supplier management, documentation and simulation.
Two areas of the car in particular, the pillars and the rear end, demonstrate Bertrandt's innovative abilities.

Crucial crash testing

The challenge for any design team is the crash tests, as they determine the success or failure of the entire development process. In order to meet the high standards of the US market in particular, the new CL-Coupé had to undergo a tough testing process.
The five crash tests listed in the box represented the acid test for the CL-Coupé. The team used all its expertise to overcome obstacles such as the roof impact and side impact tests and to produce the best possible results. For example, the entire assembly sequence for the side wall had to be modified. In addition, the rear end and the pillars were completely redesigned.

The rear end

As there are a large number of electronic components in the boot lid that require electromagnetic compatibility, using plastic for the Body-in-White in this area seemed the ideal solution. As a result, the engineers chose pressed, glass-fibre reinforced plastic instead of the more common aluminium. The use of plastic also brought considerable weight advantages. The lightweight SMC (Sheet Moulding Compound) plastic chosen has a significantly lower density than normal SMC plastic. The planned carbon strips were not needed in the boot lid, as the rear impact crash showed.

The pillars

The pillar design, which tapers slightly at the bottom, is a typical feature of the large Mercedes Coupés, which have their origins in the 1950s. The design specification involved rejuvenating the overall appearance of the new model. The curve of the roof was widened and flattened to emphasise the elegance of the Coupé. However, the resulting need to move the C-pillars back by 200 mm caused a minor revolution. It was necessary to find new ways to ensure the required levels of stability.
As a result of the more complex requirements for stability in a side impact crash, the B-pillars also had to be modified. The planned lock-in pillars were positioned on the main chassis beam.
The A-pillars also underwent a major change. At the start of the development process, the plan was to use USIBOR deep drawn components. This is a type of steel that is formed at around 800 °C and has a tensile strength of up to 1,300 megapascals. However, the first crash tests with the prototype vehicle identi-

Offset crash/frontal crash
The vehicle crashes into an offset deformable barrier (ODB) at a speed of 64 km/h.

US rear impact crash
The rear end of the car is subjected to an impact at 80 km/h.

Side impact
A movable barrier crashes into the side of the car at 50 km/h.

Driver crash
The vehicle crashes head on into a wall at 56 km/h. The focus is on the acceleration of the occupants.

Roof impact test
A test specific to DaimlerChrysler in which the vehicle is dropped upside down from a height of 0.5 m onto the A-pillar joints. This test was one of the most demanding for Bertrandt's vehicle developers because of the long curving member joining the A and C-pillars of the CL-Coupé.

fied areas for improvement, in particular in the roof impact test, as USIBOR is not sufficiently ductile. An ultra-high-strength tube design was developed for the side wall and the materials used for the A-pillars and side roof rail were changed. The final result was a three-shell structure. The external and internal A-pillars combined with the reinforcement tubes produced the required ductility and stability.

Simulating safety

In addition to the integration of the crash test results into the Body-in-White development process, other important simulation and testing areas included the validation of the interior and head impact simulation. Bertrandt was also responsible for the in-house simulation and testing of pedestrian protection. In order to feed back all the data and results into the project without delay, Bertrandt employees became members of the DaimlerChrysler simulation team and the complete vehicle integration team.

The route to 0-Series

Bypassing the prototyping phase represented a major increase in efficiency. The project moved directly from the structural vehicle to the validation car or pre-production model. This was made possible by the high level of digital validation quality and the specifications of the structural vehicle.
The result was a significant reduction in the development time. The project started in May 2003 and by as early as October 2004 Bertrandt was able to announce that the vehicle was ready for production release, having obtained all the necessary releases for tools and milling. At Easter 2005 pre-production began.

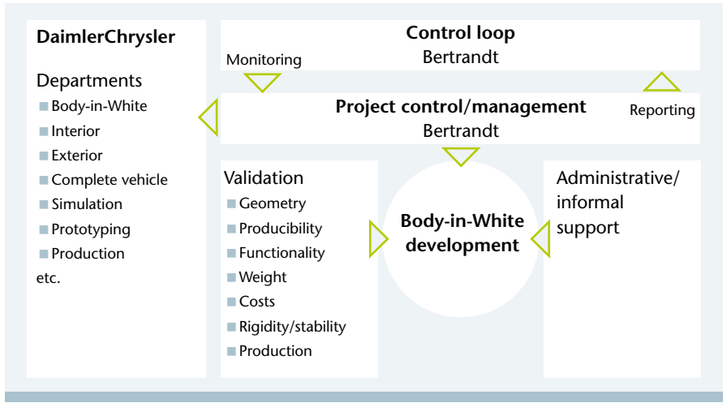
A question of synchronisation

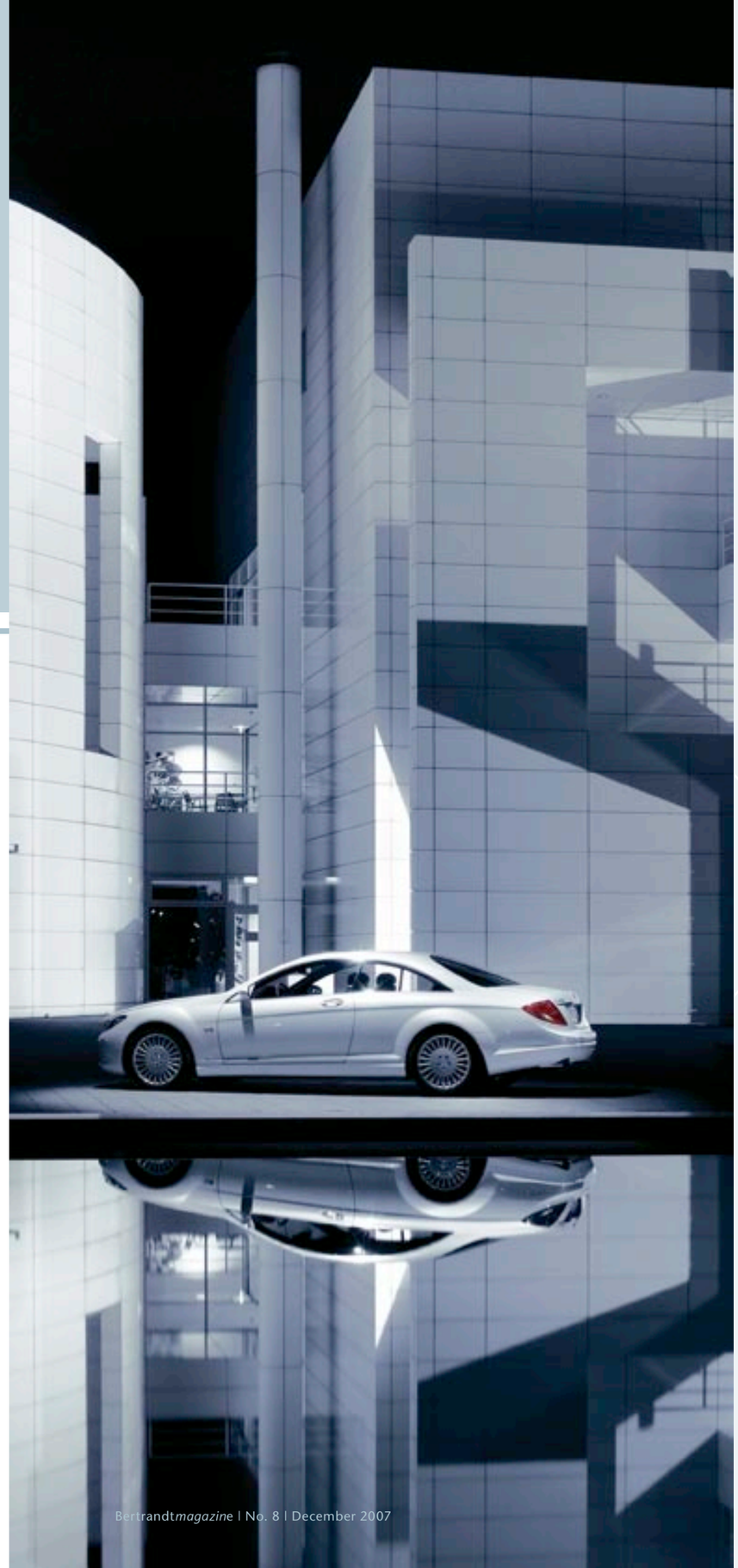
The Bertrandt project management team was responsible for the overall coordination of the huge project. Only the perfect interaction of the complex project structures and internal processes of DaimlerChrysler and Bertrandt would ensure the high quality and efficiency of the resulting vehicle. The scope of the CL-Coupé project is shown here in order to illustrate these interfaces and the overall effort involved.

Summary

Around 80 specialists involved in development, data management, quality management as well as release and change management were able to complete the project within three years. This represented a milestone for Bertrandt, which further increased the competence of its engineers and opened the door to other complex collaboration projects. We are proud to have made a contribution to the most popular luxury Coupé in the world. ■

Lysann Kurpiela, Ehningen





Scope of the Mercedes-Benz CL-Coupé *project in brief*

Body-in-White
- *Complete Body-in-White/bodywork: Development of all components, assemblies and assembly stages*
- *Acoustic insulation*
- *Archiving in SMARAGD*

Doors/lids
- *Boot lid*
- *Bonnet with insulation*

Exterior
- *Exterior trim*

Project management
- *Overall project management of the Body-in-White development in collaboration with DaimlerChrysler*
- *Development management*

Quality management
- *Product release recommendation*
- *Project quality management*

Digital car
- *DMU for the Body-in-White*

Supplier management
- *Change management*
- *Supplier support for the boot lid and Body-in-White insulation and in part for the Body-in-White components*

Documentation
- *Data testing and release recommendation to DaimlerChrysler*
- *Technical documentation*

Model construction
- *Test and functional cubing*

Simulation
- *Occupant protection*
- *Networking and CAx model construction at DaimlerChrysler*

Safety
- *All the vehicle crash tests at DaimlerChrysler*

Rapid technologies
- *Rapid tooling*

Toolmaking/Prototype construction
- *Production of prototype parts and side wall components*

Component testing
- *Pedestrian safety tests*
- *Interior validation*

Sportiness and Elegance Combined

Bertrandt developed the cockpit for the new Audi A5 Coupé

"A New Form of Driving!" is how Audi is advertising its new masterpiece, the Audi A5. Based on proven Audi technology, the extraordinary Coupé conveys to the driver the highest degree of driving pleasure and comfort. Furthermore, it features an interior that is both innovative and attractive as well as having an ergonomically optimised design. This is precisely where Bertrandt came into play. The engineering service provider was a selected Audi partner in the function development of the cockpit.

The order: Complete function development

Audi AG is currently creating a sensation with its new Coupé, and is once again reinforcing its position as a trendsetter in the disciplines of design and quality. These objectives were supported by Bertrandt, as the premium car maker commissioned the engineering service provider to develop concepts and prototypes for the cockpit assembly, including the instrument panel, storage compartments and centre console, as well as the door and side panelling. This module development on the basis of the product design process defined by Audi comprised not only the pure design but also simulation and testing. For the first time, the order also included the integration of the electronic components in the cockpit and the door panelling, which meant that it became a complete function development for Bertrandt Ingolstadt.

The "project house": Interdisciplinary cooperation

Controlled communication

In order to sustainably secure the success of the project, resource management and the related synchronisation of the processes were an important and central task. This is where Bertrandt's concept of the "project house" came into play, which has been characterising the interdisciplinary execution of projects for several years now.
The focus is on achieving a close proximity between all those involved in order to obtain efficient project work as well as shorter and systematically controlled communication channels. These link both the local cooperation between Bertrandt employees among themselves and the Audi teams and their business partners. For example, in the Audi A5 cockpit project, the person responsible for the module crossbeam was located directly adjacent to the developer of the glove compartment and the engineer for electrical integration.

SE terminals

A further feature of the project house concept is the establishment of separate meeting rooms, so-called SE terminals (Simultaneous Engineering), which are equipped with state-of-the-art CAx and visualisation technology. The terminals allow a wider circle of partners to discuss and coordinate technical issues without impairing the actual development process. In addition, a customer office for the Audi employees from the competence centres involved was set up nearby.

Benchmark area

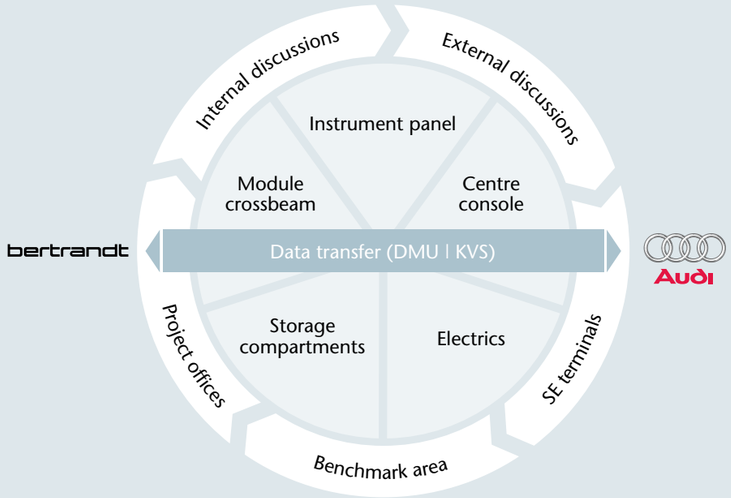
A special feature of the cockpit project is the benchmark area in the project building. There, all Audi cockpits and the most important cockpits from the current market are assembled and serve as illustration objects for the designers and developers. The aim was to find inspiration for engineering solutions and to promote their development as evolution in the sense of a continuous process of improvement.

"Best of" Team

Due to the many years of cooperation between those responsible at the various competence centres at Audi and the experienced project team at Bertrandt, a "best of" team was put together for the customer in the project house. In the course of the project, the team also succeeded, with the assistance of Audi AG, to engage a number of system suppliers as additional partners. Employees from these companies were integrated into the system house before the system supplier contracts were awarded. In close cooperation with Audi, the partners made valuable contributions to the development with regard to feasibility and manufacturing. The early dialogue with the production ensured that the development targets were met within what was a very tight schedule.

Project management

The integrated project management was put to a very special test due to the large number of interfaces in a cockpit. In addition to five project leaders and an overall project leader for the cockpit, two further project leaders were responsible for the door panels. During the main development periods, more than 45 engineers and technicians were working on the project in parallel.



Cockpit design in the "project house" – efficient development through interdisciplinary communication.

The project: Integrated development Cockpit

The main priority was Audi's further development of a single-piece instrument panel in two colours with a high-quality slush surface finish.
With regard to vehicle safety, the integration of the passenger airbag played an important role in the development. In earlier model series, the airbag was fixed to the cockpit by means of a guidance unit and various brackets made of metal. In the new A5 series, the engineers integrated the airbag guidance unit into a complete solution made of plastic in the instrument panel. In addition to the design configuration, this was simulated by calculation as part of the function development process and was verified by testing in a separate detail prototype. Apart from the classical coordination processes as part of the simultaneous engineering process, an implant structure was produced that allowed the main geometries to be obtained in an existing environment using series parts. The resulting connection geometries were put into an existing environment and tested using various airbag activation tests. The carrier material used is polypropylene long glass fibre (PP-LGF). This allows considerable cost and weight benefits to be achieved.

Centre console

The scope of the development for the centre console for the first time included an armrest with lengthways adjustment.
As one of the most important interfaces to the centre console, the floor covering in the A5 model series has a closed design. Although this changes the centre console package, it considerably improves assembly and sound insulation.

Glove compartment

In the development of several glove compartment versions, particular attention was paid to the production costs. In a further evolution sage, numerous synergies were found and exploited in the coordination process between tooling concepts and joining techniques on the one hand and the glove compartment versions chosen by Audi on the other. This made it possible, for example, to considerably reduce tooling investment.

The interior of the Audi A5 Coupé combines comfortable sportiness with a high level of innovation.

The isometric representation of the CAD model of the cockpit with the centre console.

Door/side panels

The door and side panels were designed and developed by Bertrandt both as concepts and for the individual prototypes. A supplier optimised the series development of the panels. Bertrandt continued to be involved in integration and interface management in the development phase up to serial production.

Electrical integration

The project was rounded off by the electrical integration of the Electric Control Units (ECUs), operating elements and infotainment into the cockpit, centre console, storage compartments and the door and side panels. The aim was to integrate the different electrical components from various suppliers into the interior, taking into account such aspects as installation space and ergonomics. The SE work performed by employees of Audi AG as well as by the system suppliers and Bertrandt played a significant role in this process and enabled the partners to achieve their objectives.

Summary

At the end of any project, the result is what counts. The quality and the exciting premium product that customers can now witness at their Audi dealers answers all questions. The new A5 Coupé makes hearts beat faster. What is more, it was possible to optimise and above all shorten the entire development process at the same time. A new standard of coordination between function and design has been set. Function development and vehicle safety issues have been implemented in an even more targeted manner by the controlled cooperation of all those involved. A good inter-company and interdisciplinary team has come into being as a result of this successful development. ■

Erhard L. Dörr, Andree Hündling, Ingolstadt

Scope of the Audi A5 Cockpit and Centre Console *project in brief*

Interior
- *Development Cockpit/Centre Console*
- *Development Door/Side Panels*

Calculation
- *Knee Impact*
- *Head Impact*
- *Vibration Calculations*
- *Passenger protection front*
- *Rigidity calculation of the door panels, centre console and centre arm rest*

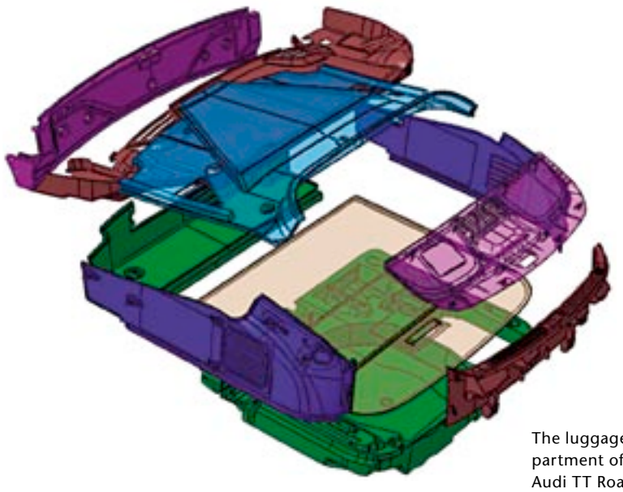
Testing
- *Environmental Simulation Tests*
- *Endurance Tests*

Electrics/Electronics
- *Electrical and Infotainment Integration*

Project Management

The New Audi TT

The first generation of the Audi TT as a roadster and coupé already captured the hearts of car enthusiasts and quickly became a design icon with a cult status. Now, the second generation matches this reputation in every respect. For example, readers of several car magazines have already voted it "the most beautiful car in the world" or "Germany's favourite car". So what were the special challenges in designing the new generation? The TT successor had to be instantly recognisable as a TT. At the same time, the car was to appear more modern and more "grown-up". The motto was evolution rather than revolution. Bertrandt Neckarsulm supported various Body-in-White and interior development projects from the design phase right through to the market launch.



The luggage compartment of the Audi TT Roadster, with surface design carried out in-house by Bertrandt Neckarsulm.

From design to series production

Whether it was for the closures, the exterior or the interior – Bertrandt Neckarsulm was called upon to demonstrate a high level of interface competence across many different development periods in the TT project. Their assignment was to develop the hood, wings and boots for the Coupé and Roadster as well as the panelling in the interior – from the design phase right up to SOP. In addition, Bertrandt supported the concept phase of the bumper development process. A particularly challenging task for the designers was the surfacing for the luggage compartment of the Audi TT Roadster, which was developed as an in-house project and coordinated with Audi's interior design team.

A further challenge lay in designing the parts in accordance with production requirements, as a very wide variety of components were involved. Whether it is injection moulding with gas internal pressure, laminated fibre composites or lightweight materials, sheet metal forming and joining processes, every manufacturing process requires the most varied parameters. Together with the special departments at Audi and the system suppliers, all tasks were performed using state-of-the-art processes.

The service package was completed by design FMEA, which Bertrandt Neckarsulm supported in cooperation the nominated system suppliers. The Neckarsulm team produced various prototypes and played a key role in the start of series production in Györ via the Supporting Services department.

Scope of the Audi TT Coupé/ Roadster *project in brief*

Body-in-White
- *Wings*

Doors/Closures
- *Bonnet inclusive acoustic insulation and unlocking*
- *Unlocking – tank lid (concept phase)*
- *Rear hatch (concept phase)*

Exterior
- *Front/rear bumpers (concept phase)*

Interior
- *Panelling for luggage compartment Coupé/Roadster*
- *Panelling for rear end Coupé (Roadster concept phase)*
- *Panelling for rear hatch Coupé (Roadster concept phase)*
- *Panelling for sills Coupé/Roadster*
- *Panelling for lower A-pillar Coupé/Roadster*
- *Panelling for rear wall upper/lower Roadster*
- *Panelling for soft-top compartment Roadster*
- *Cover for luggage compartment floor Coupé/Roadster*
- *Toolbox Coupé/Roadster*

Supporting Services
- *Process support and technical support for the market launch of the Coupé and Roadster*
- *Repair and maintenance work*

Scope of interior development for the Audi TT Coupé luggage compartment.

Carry-Over Parts Challenge

The Volkswagen Group's carry-over parts (COP) concept was implemented throughout the entire project. Since the two vehicles are only partially identical, special attention was paid to the examination and consistent implementation of the carry-over parts concept. The focus was on generating solutions to minimise component differences as far as possible or to absorb them by controlled manufacturing processes. The aim was to achieve an optimum cost situation and parts logistics. Bertrandt implemented this in the interior in the development of the luggage compartments, the tool box and the lower pillar and sill covers for both the Coupé and the Roadster. Furthermore, the engineers and technicians took account of the different Body-in-White versions as well as the different soft-top versions for the Roadster. Country-specific requirements also had to be considered – such as a special tool box version for the USA that allowed the installation of the legally required active carbon filter, or space for fitting a smoke candle in the lower pillar cover for the Japanese market, where this is used instead of a warning triangle.

Well thought-out project structure

Due to the wide variety of tasks involved, up to four project teams worked in various phases of development during the development period. Optimum and smooth communication in the project was ensured at all times by regular coordination meetings between the individual teams, special departments and system suppliers. In addition to communication with the customer and among the Bertrandt project teams themselves, special emphasis was placed on ensuring uniform documentation throughout the entire development period. This allowed the progress of the project to be consistently represented at every phase. The Bertrandt teams also worked together across the boundaries of the various Bertrandt sites, especially in the area of front closure development, which had to consider pedestrian protection requirements.

Due to the flexibility and expertise of all those involved in the project, Bertrandt Neckarsulm was able to respond to the individual requests of AUDI AG at any time. The impressive result is the Audi TT – a car that justifiably demonstrates both driving pleasure and delight in the exceptional. ■

Oliver Keicher, Neckarsulm

Development of the Instrument Panel and Centre Console for the "Big Models" from Mercedes-Benz

DELPHI and Bertrandt – a strong development partnership for DaimlerChrysler

Comfort, luxury, space, an attractive design and lots of fun – this is the combination that characterises the M-, R- and GL-Class, the "big models" from Mercedes-Benz. And it is this combination that is also reflected in their interior design. DaimlerChrysler chose the automotive supplier Delphi as a competent partner for the development of selected interior components. Delphi turned to engineering service provider Bertrandt for support.

Delphi wins concept competition

While supplier Delphi USA was still in the middle of the production phase for the first generation of the M-Class, DaimlerChrysler was already thinking about its successor and started a concept competition for the instrument panel and centre console of the M-Class.
After a successful concept phase, Delphi was asked by the manufacturer to work on three attractive models. Delphi was awarded the contract to develop the instrument panels and the centre consoles for the Mercedes-Benz M- and R-Class as well as the instrument panel for the GL-Class. Shortly afterwards, Bertrandt Cologne was commissioned by Delphi to provide support in the field of product engineering. This allowed Delphi to benefit from a greater degree of flexibility in the value chain. Bertrandt was the ideal choice as it was able to provide support in almost all functions along the development process chain within the framework of this project.

Development combines aesthetics, quality and recyclability

In the prototype phase, there was an increased demand for qualified engineers and technicians in the field of product engineering and CAD. At this point, it became clear just how high the quality demands were that DaimlerChrysler was placing on its supplier Delphi. In turn, these also applied to Bertrandt, of course.
With the aid of calculation and simulation, statements on such properties as safety, stiffness and vibration could already be made at this early stage in the development. Subsequently, prototype tools were commissioned, even though the actual series production design had not yet been finally decided.
The distinctiveness was that DaimlerChrysler did not want to rely exclusively on simulation. Therefore, the partners examined the series production material in advance to ensure that it met the high quality requirements regarding crash behaviour, haptics, appearance, ergonomics, head impact and climatic influences. The findings gained from simulation and direct component testing were able to significantly improve the quality in the subsequent design and development phases.
For example, compared to the predecessor version, the new instrument panel for the M-Class was to be equipped with an invisible airbag door. The aim was to develop an instrument panel that has a harmonious appearance with no interruptions. The developers therefore decided at an early stage in favour of an instrument panel without a visible tear line in the area of the airbag doors.
This aesthetic requirement increased the demands on the design of the instrument panel carrier, which consists of a single-piece, injection-moulded retainer unit (PP-GF30) combined with a backfoamed PU sprayed skin. The airbag deployment channel is fixed to the underside of the retainer unit. The invisible airbag door is produced with an invisible laser seam on the instrument panel.

A further specification was to meet all of the requirements regarding head and knee impact in the interior in accordance with American guidelines and European legislation.
In addition to the requirements concerning safety, engineering and comfort, the focus during the development of the concept was not only on technical details and innovative designs but also on the best possible recycling according to the concept of "Design for Recycling", a key aspect of environmental protection.

Qualified series development

After the series design for the M- and R-Class had been frozen by Mercedes-Benz, Bertrandt supported Delphi on site in the fields of product engineering, CAD and release processes. Engineers and designers from Bertrandt worked with the Delphi team on their own responsibility and were commissioned with developing assemblies and components, component releases and comprehensive product documentation, among other things. All of these processes benefited from the many years of experience and the ongoing training of the employees in CAD and in project and quality management. Furthermore, the Bertrandt engineers were asked to help in reducing capacity bottlenecks.

Testing, optimised prototypes and series production tools

Following the wide-ranging development work, intensive preparation began on all the necessary testing, such as air conditioning tests, airbag tests and crash tests with dummies, as well as on homologation tests at an early stage.
The subcontractors were supported by the engineers responsible. This support included monitoring the tool making, determining the components required, coordinating the assembly of entire component assemblies and monitoring the production of small series.
In addition, even before the series tools had been completed, Bertrandt was able to include changes to the series design by means of rapid tooling. These close-to-production components could then be installed in prototypes or press vehicles before production of the series tools began.

First tests under series production conditions

As the pre-series production and support took place in Alabama, USA, the production tools were transferred directly to the production sites. This enabled the first components to be produced under series production conditions. The design concept and the high demands regarding minimum gaps required an extremely high fitting accuracy of the individual components, which in turn called for precision, lack of distortion and low longitudinal thermal expansion.
These components could be tested for the first time under series-production conditions. Special emphasis was placed on testing the deployment times and unfolding of the airbag, in particular using the very latest high-speed video technology.
Bertrandt employees supported the global Delphi team with such services as

- appraisal of parts from series production tools
- determination of containment actions
- evaluation of test records with resulting recommendations
- reworking
- supplier support
- release of tools
- launch support

An important aspect was the optimisation potentials gained in the series production processes, which were fed back into the development by targeted defect feedback and which were adopted in full by Delphi after the start of series production. At the same time, Delphi employees were trained in the use of CATIA V4 and CATIA V5 by the Cologne site.

Interior has won several awards

The M- and R-Class went into series production in 2006. In the meantime, the cars have won several awards from various institutions and the automotive press. For example, the Mercedes GL- and R-Class were named as "Best Interior Of The Year" in the USA. Delphi and Bertrandt would like to congratulate DaimlerChrysler on this technological success. ■

Oliver Karges, Cologne

Scope of the instrument panel project for the Mercedes-Benz M-Class, GL-Class and R-Class *in brief*

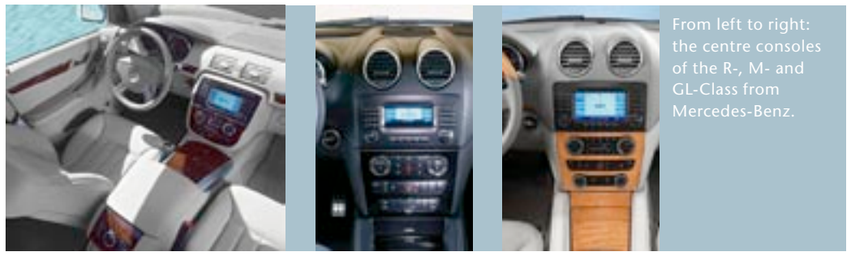
Interior
- *Development support: instrument panel and centre console for the M- and R-Class*
- *Development support: instrument panel for the GL-Class*
- *Computer-aided design of components*
- *Support for Delphi quality management*
- *Product engineering for components and assemblies*
- *Management of individual subcontractors*

Calculation & Simulation
- *Tolerance simulation*

Rapid Technologies:
- *Rapid prototyping – foam parts for knee impact energy absorption*

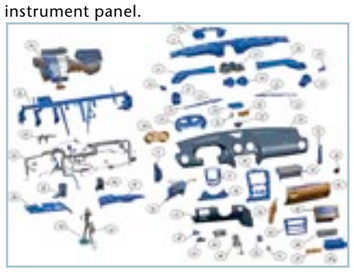
Launch Management
- *Launch support at the plant in the USA*
- *Production support at the plant in the USA*

Training
- *CATIA V4 and V5*



From left to right: the centre consoles of the R-, M- and GL-Class from Mercedes-Benz.

Component overview of the M-Class instrument panel.



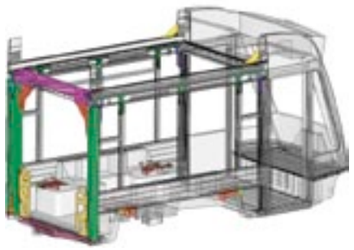
Attractive mobility solutions

The tram from Siemens Transportation Systems

Bertrandt supports the optimisation of the “Combino” local transport system

Previous history

The “Combino”, launched by Siemens Transportation Systems in 1998, was the first modular tram with an end-to-end low floor design. The Combino was designed according to the industry standard VDV 152 and on the basis of the underlying design load. However, when the trams came into operation, it became clear that the forces transferred from the track into the vehicle were considerably greater than had been assumed and the consequence was that the vehicles were subjected to very high levels of stress. During the initial investigations in the autumn of 2003, the experts from Siemens realised that only a combination of load reduction (modification phase 1) and the strengthening of the car bodies (modification phase 2) would result in a long-term decrease in the stresses involved.



The new solution involved using sheet-metal parts, extruded parts, cast parts and forged parts to reinforce the structure.

Modification phase 1: Load reduction measures

Modification phase 1 involved taking short-term measures in order to slow down the damage mechanism significantly and therefore to ensure the operational safety of the vehicles in use. The first step was to incorporate roll-swivel bearings and pivot-roll bearings between the car bodies. These bearings effectively reduced the torsion of the bodies.

Scope of the* Combino *project in brief

Simulation

- *Fatigue strength simulations*
- *Rigidity simulations*

Modification phase 2: Strengthening the car bodies

Concept and simulation

An important measure taken during modification phase 2 in order to reduce the load on the body shell structure considerably was to dampen the rotational movement of the bogie. This caused the sudden impact energy to be absorbed, thus effectively reducing the bearing link forces. As a result, there was a 50 percent cut in the force peaks in the car bodies. At the heart of modification phase 2 was the replacement of the overloaded screw-type brackets that connected the extruded components. The design of the strengthening measures required a high level of development work. Therefore, the Bertrandt simulation team at the company’s Cologne site was brought in to provide support.

As the timeframe for the development work was tight, the Bertrandt engineers worked in the Siemens development centre. This allowed the Siemens design department to put the concepts for reducing the component load into practice quickly in close cooperation with Bertrandt. The simulations produced by Bertrandt played a central role in advancing the development process. One important factor in the design of the strengthening measures was to retain the existing weight, design and functionality of the vehicle. In addition, the torsional rigidity of the car bodies was not to be significantly increased as this would directly increase the torsional forces.

End portal reinforcement results in additional weight savings

The new solution consisted of sheet-metal parts, extruded parts, cast parts and forged parts, all of which were bolted or welded to the existing structure. The welded end-portal reinforcement was used on the middle modules, the bogie modules and the front modules. It not only represented an elegant solution for one of the most highly stressed areas of the vehicle, but also weighed less than the original solution. In addition, the upper corner of the portal was bridged with a welded structure.

Double angle connectors prevent material fatigue

At the connecting points between the door/window posts and the cantrail, the task was to replace the heavily overloaded screw-type brackets with a more appropriately designed component. The advanced state of material fatigue in the cantrail also came under consideration. The fundamental solution (double angle connectors) therefore consisted of an extension of each post to allow them to be connected to a higher, undamaged part of the cantrail, without the angle brackets of the doors or hinged windows being affected. The reinforcement is a forged aluminium component that is bolted to the cantrail and welded to the door and window posts.

Testing the long-term viability

In order to verify the long-term viability of the modification, the mathematical and experimental analyses of the fatigue strength and the service strength were combined.

Summary

Creating simulations for the tram construction process is a new area of activity for Bertrandt. After two years of successful collaboration between the company and Siemens Transportation Systems, the first fully modified vehicles were taken back into service in summer 2005. ■

Falk Zimmermann, Cologne

The Valeo Comfort Demo Car

Valeo visualises ideas with Bertrandt

Graphical user interface for audio and air conditioning in the Valeo Demo Car.

Configuration and monitoring of the systems, installed in the centre console.

Energy management system in the spare wheel well of the Valeo Comfort Demo Car.

Integration, application and validation of the systems in the vehicle.

The Plan

The system supplier Valeo planned a Comfort Demo Car to present the capabilities and innovations in its range of services in the field of comfort. The company wanted to allow its expertise to be experienced in a concrete manner in a vehicle and to demonstrate innovative ideas that had not yet been implemented in products. Ten innovations were selected to be integrated into a Mercedes M-Class and then put on show.

Kick-off Session

In its capacity as a highly competent partner in the field of electrics and electronics, Valeo invited Bertrandt to France and presented its concept for the Demo Car project. First of all, Bertrandt was commissioned to carry out a feasibility study. The kick-off session was held in Paris in March 2006. The feasibility study was presented and the project was initiated in all of the areas involved. Bertrandt was assigned with three extensive and demanding projects from this idea pool – Pre-Ventilation, Access System, E-Media – for which the development service provider assumed full responsibility for the electronic integration into the vehicle.

The Projects

Pre-Ventilation

It's summer time, the sun is blazing down on the car and the black leather is like a hotplate. Anyone driving in such conditions knows the story: avoiding touching the hot surfaces makes any car journey in summer a pain rather than a pleasure. Valeo's idea is to cool the car down to acceptable temperatures even before you get in. A touch of a button on the remote control activates the Pre-Ventilation system. First of all, the programme slightly opens the windows and sunroof. Then it switches on the ventilation fan to force the hot air out of the vehicle and at the same time to cool the driver's and front-seat passenger's seats. The system can be switched off again by pressing the remote control. The windows and sunroof return to their initial position. When the driver and passengers get into the car, they find a pleasant temperature waiting for them. The activation signal is provided by the Valeo Key, a multifunctional key developed by Valeo for the Demo Car.

Identifier Access System

The Valeo Access System is one of the main comfort functions presented in the Valeo Comfort Demo Car. Wireless communication between the Valeo Key and the Valeo receiver module (Smart ECU) allows the bi-directional transmission and reception of data to provide the driver with information on the car's condition before the journey begins. The receiver module communicates with the vehicle's control units via the CAN interface. In this process, the control units that were additionally integrated by Bertrandt take on the role of a gateway. For opening and closing the doors, the original access authorisation remained unchanged. As soon as the system detects that a person using the Valeo Key touches the door handle, a Bertrandt control unit sends a command to the door control units telling them to open the door. In reality, the drivers hold a key with an integrated mini-display in their hand – or have it in their pocket ("Keyless Go System"). The key is about the size of a matchbox and allows users to remotely control the functions described above.
The requirements that had to be met during the development of these functions were very complex. The data structures for the commands within the vehicle were only partially available. Bertrandt's engineers used reverse engineering to complete the data and provide the basis for the dialogue between the Valeo Access System and the Demo Car. This enables the key to send commands to the vehicle, for example to activate the Pre-Ventilation system, to reposition the seat or to raise the windows. However, it also allows requests for information to be performed, for example "Is there enough fuel in the tank?" or "Is the tyre pressure correct?". The car then returns the required data, using, for example, the last address from the navigation system.
The Keyless Go System allows the vehicle to be opened and started, which means that the original key no longer needs to be used.
The system also provides clever details such as the possibility to use the key to enter previously fixed destination addresses into the vehicle's navigation system or to display the temperature of the car's interior.
A further function that enhances driving comfort is the possibility to store identifier access codes for up to three persons in the Valeo Key. In combination with the seat memory function that is already available in the M-Class, this adjusts the seat into the correct position for each person. This eliminates the need for manual seat adjustment – and avoids the problem of discovering that your knee hits the steering wheel when you start to drive, just because your daughter has been driving the car before you.

E-Media

By now, most people are probably familiar with an E-Media system in the centre console. Technically a "human-machine interface" (HMI), it usually consists of numerous buttons and/or joysticks and a display screen. For example, it is used to visualise the operation of conventional audio and climate control systems and other functions on the screen and allows them to be controlled via a graphical user interface. Valeo's aim was to tread new paths in the design of the system but without losing any of the familiar user-friendliness. It was to be futuristic in its handling, in keeping with Valeo's futuristic approach of "Growth through Innovation".
The result is a central operating element consisting of three joysticks. These are used to operate the three areas of audio, climate control and telephone, and, in the future, navigation.
The corresponding components such as the radio, amplifier, CD player and mobile phone interface are connected in a MOST ring and linked to a car PC on which the newly developed programme runs. The display is connected to the VGA output, while the joysticks communicate with the PC via the CAN bus. The joysticks and the colour design of the three areas on the display serve above all to enhance the user-friendliness of the system, making it easy to programme a radio station, for example, without the need to study a user's manual.
The main challenge in this project was in developing and programming the user interface. Suitable interfaces were required, for example, to allow easy access to functions of the air conditioning system. Bertrandt's engineers developed special adapter circuit boards for the air conditioning control unit. The adapter circuit boards are connected to the air conditioning system in such a way that they recognise states of the air conditioning system (e.g. the temperature in the vehicle), convert them into CAN messages and transmit them cyclically on the CAN bus. Of course, this data exchange also functions in the opposite direction, to ensure that the driver's air conditioning requests are sent to the air conditioning system.

Battery Management

During the course of the project, its basic scope was extended by the addition of a battery management system. The energy consumption analysis of the additional components revealed that all of the systems together consumed too much power when the car was operated only by battery and without the engine running when it was on show at fairs. For that reason, the engineers integrated a second battery into the vehicle and installed a battery charger to ensure that all of the systems were able to operate at all times. The state of charge of the two batteries is monitored by a further Bertrandt control unit and the power consumption and charging process are controlled accordingly.

Tour de France

After monthly workshops to coordinate the various project states and the handover of the finished vehicle at the end of May 2007, the final "Tour de France" began in June. For a whole week, the "Valeo Comfort Demo Car" was driven from Northern France to Southern Europe, through cobbled streets and the winding roads of the Alps. The test drive confirmed the quality and resilience of the systems installed, and these will now be able to demonstrate their reliability at fairs and other events. ■

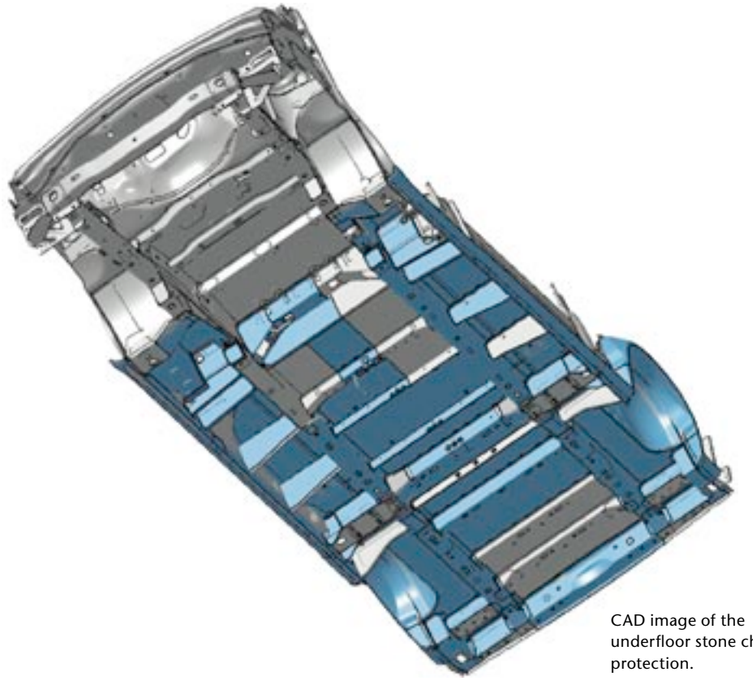
Lysann Kurpiela, Ehningen

Scope of the Valeo Comfort Demo Car *project in brief*

Analyses
- *Feasibility study*

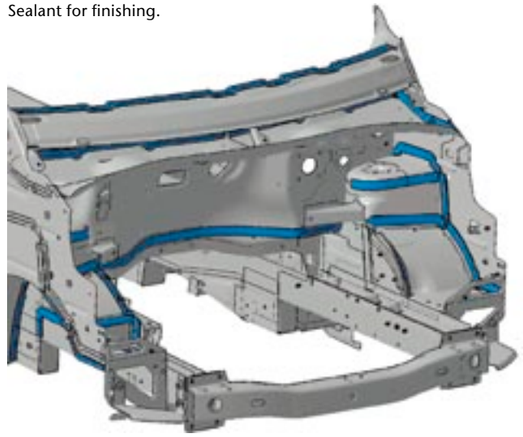
Project Management
- *Technical coordination*

Electrics/Electronics
- *Development of application software*
- *Reverse Engineering*
- *ECU networking*
- *MOST ring*
- *Component development/structure*
- *Parts management*
- *Installation of all components*
- *Testing the complete system*
- *Documentation*



CAD image of the underfloor stone chip protection.

Sealant for finishing.



Application of the sealant for finishing.

Application of the underfloor stone chip protection.

Bertrandt France

A “global” engineering project for the commercial vehicle division of Renault

A new challenge

Bertrandt France won the confidence of this important customer by being consistently in line with Renault’s strategy. The decisive factor was that Bertrandt was always receptive to Renault’s ideas, and had the ability to implement a project configuration that was new for both companies.

On 2 May 2006, Serge Petitdemange, head of the Body-in-White department, and Patrick Ory from the Body Construction team received the go-ahead for their joint adventure with the Coating/Corrosion Protection division of iDVU (Ingénierie Division Véhicules Utilitaires), the commercial vehicle subsidiary of Renault. The project is scheduled to run until 31 December 2008.
For the first time, Bertrandt France was given the responsibility for a complete functional area, which represents a milestone for the close relationship between Bertrandt and Renault.

Deployment in several areas

The aims of the project are:

- the construction of parts from suitable materials for the functional area “Corrosion Protection” for all projects in development and series production
- the construction of coating tools for all projects in the development phase

The project team

A nine-person Bertrandt team at the iDVU factory in Villiers Saint-Frédéric controls the project and functions as an interface between the Bertrandt site in Bièvres, where a further eight employees are connected via a “Securized Dedicated Platform”, and the various production plants of Renault and Nissan. Furthermore, Bertrandt is also deployed at the Maubeuge, Batilly and Barcelona factories.

Project phases

Project phase pre-development, involving the complete body

First of all, Renault provided Bertrandt with the digital design data for the body, the parts lists and specifications for the different functional areas. At the beginning, Bertrandt France developed a project plan for the various working steps (sealing seams, stone chip protection, sealants, primer-surfacer, coatings, etc.), before starting with the actual development. Then, the data was archived in the form of CATIA models in iVDU databases and the corresponding 2D plans, dimensional tables and surface calculations for the products were produced.
Using the CAD programme CATIA V5 allowed the implementation of new working methods and a significant increase in the degree of detail of the data. In order to achieve a more robust and functional development, new tools were also developed around CATIA V5 that allowed information from the CAD area as well as from other Renault tools to be integrated and processed more easily and more quickly.

Project phase coating tools

Bertrandt develops and manufactures the coating tools for all new commercial vehicles. During this process, knowledge is continuously fed back into further optimisation steps through feedback loops, and this takes place across the different iDVU projects. With this approach, Bertrandt is able to guarantee excellent quality management, from the initial concept through manufacturing right up to implementation at the supplier and at the customer’s production plant.

This first “global” development in the area of coating for the commercial vehicle sector has a strategic importance for the positioning of Bertrandt at Renault. It allows Bertrandt France to demonstrate that it can take over responsibility for a complete functional area – and therefore justify the confidence of the customer.
The engineers and technicians are particularly proud of having convinced the management with this first project for Renault iDVU and have already won new projects. ■

Patrick Ory, Sébastien Tomaszewski, Laurent Monseyron, Angel Moran, Nathalie Bottreau, Paris

The Renault *project in brief*

Corrosion protection

- *Body*
- *Underfloor*
- *Project plan*
- *Pre-development*

Tools

- *Development and manufacturing*

The toughest time in a car's life

Complete vehicle testing

Complete vehicle testing covers a wide range of subjects. Tests under extreme climate conditions, comprehensive component tests of complex systems and endurance testing represent only a small excerpt from the overall programme. Erwin Schleich from Bertrandt in Munich will take you on journey through the world of vehicle testing and across several continents.

Testing people and materials to the limit

Arvidsjaur, Lapland, in the depths of winter. The silence of the winter landscape close to the Arctic Circle in northern Sweden is broken by the noise of an approaching camouflaged prototype vehicle. From the beginning of December until April, all the major car manufacturers and suppliers can be found within a radius of around 100 km in this area of Sweden, making use of the winter climate conditions to test new vehicles or components. The complete vehicle testing team from Bertrandt is also there to run functional and endurance tests on vehicles at temperatures as low as -40 °C.

Not only the engine starting characteristics or the electronic functions of the vehicle are tested at these extreme temperatures. In ice and snow, the modern chassis control systems, such as ABS or ESP, and assistance systems, such as the Adaptive Cruise Control (ACC), also come under the spotlight. Other features of winter testing including creaking and rattling noises from the interior, the comfort of the seats in extreme cold and the influence of the "snow wake" on radiator grilles or door and boot lid openings.

On frozen lakes covered with a layer of ice up to a metre thick, the "icemakers" prepare handling courses and other handling tests around the clock. This gives the testers the best possible conditions and ensures that the tests are reproducible at any time.

Winter testing in Scandinavia subjects the vehicles to extreme conditions and also pushes people to their personal performance limits. It is not only extremely cold in Lapland during the winter months, but also very dark. Close to the Arctic Circle the sun shines only between 10 a.m. and 2 p.m. The team members spend day and night together in cramped conditions for up to three weeks. It is essential that everyone involved is a true team player. Cool-headed analysts with a comprehensive knowledge of complete vehicles, powertrains or handling are needed. There are no reckless amateur rally drivers to be found here.

Careful preparation of the test vehicles is just as important as the on-site analysis of the results. Several hundred different values are often analysed during the measurement process and, if necessary, compared with a different version of the software. Constant communication is maintained with the team back at the office. Measurements and test results are sent to colleagues in Munich online, so that, if required, adjustments can be made as quickly as possible.

Testing heat resistance under extreme conditions

It's time for a change of scene. The testers are not only at work in the frozen north, but also in other extreme conditions. As part of the heat testing in Dubai or South Africa or the heat and altitude tests in Mexico, the vehicles are subjected to temperatures of +50 °C or more. During normal operation, sometimes with a trailer, the figures from the air conditioning system and the engine cooling system on steep mountain passes up to heights of 4,000 m are recorded and then analysed.

Using state-of-the-art measuring equipment, a wide range of data is captured, in addition to the engine figures. Other measurement points record the temperature of parts of the chassis or bodywork or the extent to which the interior or underside of the vehicle heat up after it is parked.

An important feature of heat or summer testing is the fuel supply. Alongside variations in fuel quality in the hot countries, which can have a fundamental effect on engine performance, the different fuel nozzles used in the various countries must also be taken into account when filling up. It is also important to track down the sources of fuel smells inside or outside the vehicle. In addition, the tendency of the fuel filler to spray back fuel must be tested. This happens often if the filler cap is opened quickly following a tough journey in hot temperatures.

Networking and country specifications

As well as the influence of climatic conditions, the engineers and technicians in the Bertrandt testing team evaluate components such as the radio, the navigation system and the phone from a customer perspective.

The interaction of these closely networked systems is a fundamental part of modern vehicle architecture. The systems

Testing climate influences: Extreme conditions in Scandinavia (left) and in the heat and dust test in hot countries (right).

must therefore be tested in accordance with the different country specifications. The leading role is played by the test site in California where, alongside the system components, the drive train variants are also tested. As a result of US legislation, there are increasingly marked differences between US and ECE/European variants. Other important tests carried out abroad include those of right-hand drive and other vehicles in Japan and China. Bertrandt plans, controls and manages tests lasting one or more weeks from its Munich site.

Complex complete vehicle testing

Preparation, coordination and control

However, the complete vehicle specialists are not only at work in distant countries. Bertrandt now has around 140 people involved in this area. Their activities are as comprehensive and complex as the process of developing a complete vehicle. Their role begins with preparing the vehicle. Employees from the measurement engineering group fit the vehicle with measuring equipment and monitor it during the testing period. The project coordination group acts as a central interface for the development and updating of test vehicles with system components. This group is also responsible for managing the central distribution of hardware and software components at each stage of development to the relevant departments and the use of the components in the test vehicles. These system components are thoroughly evaluated during the course of the intensive vehicle test. Faults are fed back using appropriate IT systems or several rounds of escalation in a variety of committees involving the relevant departments.

Other control units or system components which are subjected to testing come from the assistance, safety or chassis control systems. As well as managing the endurance test vehicles and tracking and rectifying problems that occur during the test, the team is also responsible for running functional tests on the systems.

Drive train testing

One traditional area of endurance testing support involves the different engine and gearbox variants. Endurance tests include urban, mixed cycle (urban/extra-urban/motorway) and motorway driving, during which faults are recorded and analysed and the process of rectifying them is initiated.

Other tests are carried out on the powertrain, where the performance and consumption are analysed from the customer's perspective. In order to be able to evaluate the increasing number of engine and gearbox variants effectively, the Bertrandt engineers stage three-shift accelerated tests on a private test track in the south of France. These tests involve driving at full throttle on a high-speed oval track over a distance of 50,000 to 100,000 kilometres. This extreme process allows a vehicle life of 15 years in normal use to be simulated over a period of 5 to 10 weeks.

Driving manoeuvres

The classic complete vehicle test includes a wide range of other activities, such as a comprehensive selection of driving manoeuvres. These begin with driving through water, over kerbs and along specified rough tracks and end with loading on car transporters or trains. They cover the entire spectrum of possible uses for the vehicle from a customer perspective. Also included are thorough tests of accessories and special equipment, such as roof or bicycle racks and tow bars.

Simulating functionality and ergonomics

In the very early stages of vehicle development, the emphasis is on the usability and ergonomics of the driver's workplace. Are the radio and the air conditioning controls easy to reach? What is the visibility like? Is there sufficient storage? These are some of the questions that the ergonomists ask during the development process. In this area in particular, a vivid imagination and extensive experience are needed. The majority of these tests are carried out on computers or in a virtual studio.

Testing different country variants: Complete vehicle specialists are also at work in the Far East.

Testing for customer requirements, for example as in this trailer test. The vehicle and trailer are subjected to the toughest conditions in order to test usability and handling, among other things.

Focus on customer requirements and quality

Bertrandt's activities in the field of complete vehicle testing are extensive and varied. However, all of the team members have one task in common: they highlight problems and inform the relevant departments about areas for potential improvements. Every employee represents a critical customer who tracks the faults painstakingly using precise documentation right through to the final solution. These working methods ensure that car buyers will continue to be supplied with high-quality, innovative vehicles in future. ■

Erwin Schleich, Munich

Electrics/Electronics

Simulated. Developed. Integrated. Tested.

Today, technological innovations determine the functionality, safety and comfort of our cars. Among these innovations, electrical/electronic systems play a key role. Studies have shown that 20 percent of the average value of a vehicle is now already made up by software and by electrical and electronic components – and the trend is on the increase. This dynamic development in the market sector of vehicle electronics is constantly presenting new challenges for engineers and technicians to network their knowledge and ideas and to make their technologies beneficial for the user.

Bertrandt has been active in the automotive and aviation electronics market for more than a decade. As a partner for the manufacturing and supply industry, the development service provider has continuously expanded its range of products and services in line with the customers' demands and has networked its expertise throughout the Bertrandt Group in the Electronics Competence Centre. This step ensured that the company was well prepared to meet the market demands for assuming more responsibility in complex electronics projects such as system developments, complete assembly sections and competence clusters. Around 600 engineers and technicians are now involved in providing individual electronics solutions. The Bertrandt Electronics Competence Centre is a driving force behind the further development of expertise in specific areas. With its broad experience in complete vehicle development, Bertrandt is also able to assume overall responsibility. Its success can be measured by its results – as specifically or as completely as the customer requires.

Software

Frank Petznick
Head of Department – Electronics Development
Electronics Competence Centre Software and Simulation

The model-based approach to software development already plays a decisive role in the concept phase of a vehicle project. The ability to represent new functions of future vehicle generations first of all in a simulation environment is one of the primary tasks in software development at Bertrandt. Within this context, it is important to master the tool chain in order to be able to represent functions in a targeted manner directly in the vehicle and also on rapid prototyping platforms.

In the Bertrandt Group, the Electronics Competence Centre Software and Simulation defines standards and guidelines that allow such projects to be carried out efficiently. These guidelines are evaluated and adapted in accordance with the different tools. The experience gained with the different tool chains is made available to all software developers at different sites.
This procedure ensures that a constantly high quality is achieved in the creation of models. Furthermore, they can be implemented in an embedded environment either manually or with the aid of code generators.

The development of embedded systems is a further important task in software development at Bertrandt. Here, in addition to the above-mentioned guidelines for software development, integration with the hardware also plays a key role.

Component Development

Carsten Eckart
Team Leader – Electronics Development
Electronics Competence Centre Embedded Systems

The increasing complexity of new vehicles and shorter development times requires an adapted and flexible development process for component development. Among other things, this increasing complexity makes it necessary to divide up development steps and functions. The innovative force of this function development is reflected in software development. There, SPICE and CMMI are described as process models and are currently becoming established on their different capability levels.

One of the most important process steps – understanding and mastering requirements elicitation and analysis as the solid basis for the subsequent development – will characterise future component development. It places the hardware and software development project on a firm foundation and serves as a starting point for the testers in validating the components and their properties.

Managing this "distributed development" is one of the greatest challenges in component development. The aim is to harmonise the individual parts of hardware and software development and testing and thus to promote continuous development processes and to support the development from the initial requirement to the final validation.

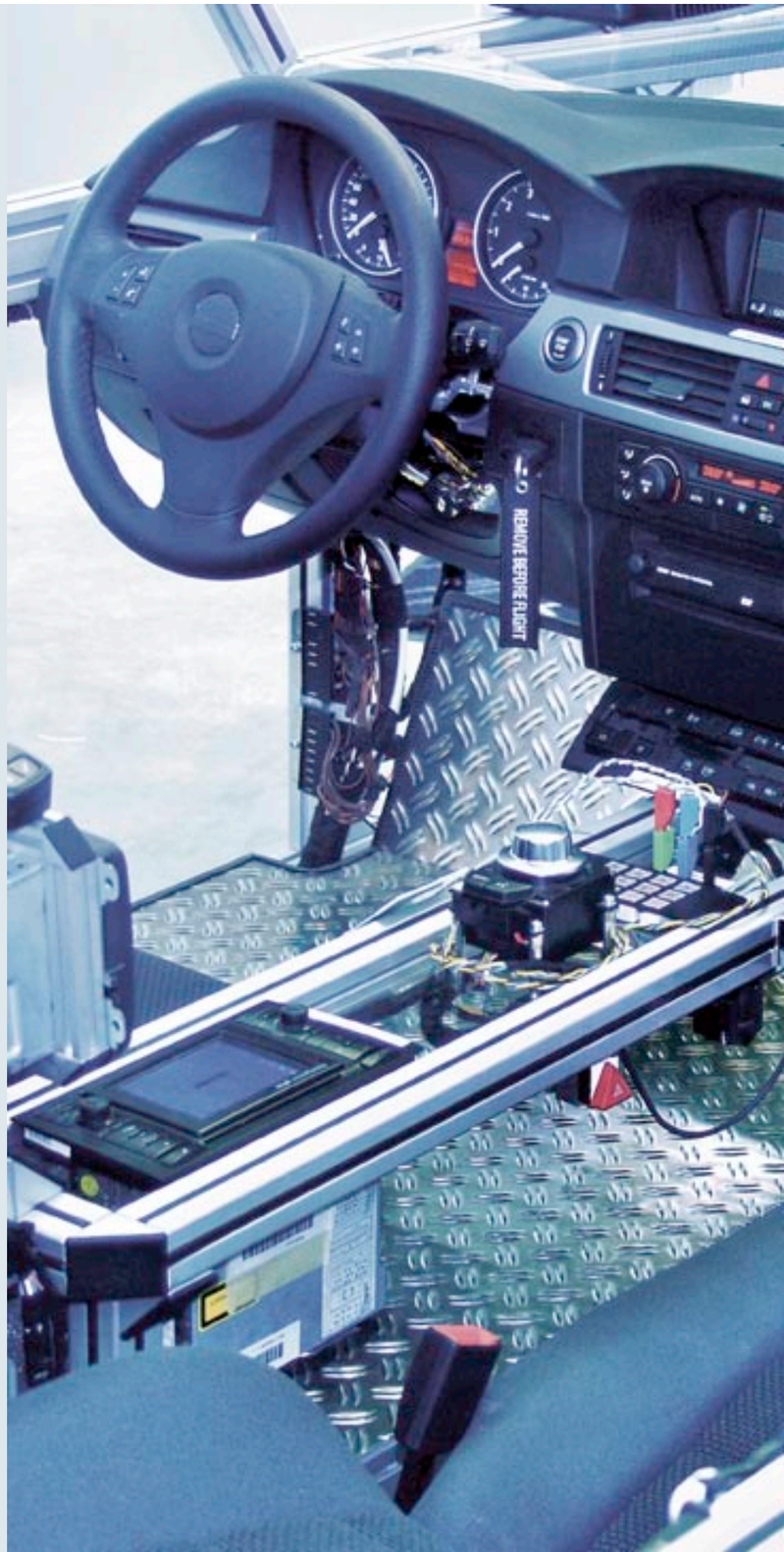
Vehicle

Klaus Härtl
Head of Department – Electronics Development
Electronics Competence Centre Testing

The high degree of system and functional networking in modern vehicle architectures requires procedures that allow high-quality testing both in breadth and in depth. A targeted approach, experience and the development and application of methods and standards are essential parts of the testing of components, systems and complete vehicles. At the Electronics Competence Centre Testing, experienced Bertrandt engineers continuously optimise testing procedures, which are subsequently applied in projects according to "best practice" methods. A homogeneous testing landscape in the form of standardised, validated tools, modular testing software and hardware solutions as well as scalable, generic testing systems are further key components that ensure efficient and cost-optimised testing.

The task of the Electronics Competence Centre is to make proven processes and solutions in the Bertrandt Group available for customer projects. Bertrandt has a continuous testing and process chain that ranges from the specification, conception and realisation of testing systems to the execution of component, system and vehicle tests under its own responsibility. With regard to vehicle integration, this also includes carrying out diagnoses, system networking tests and intensive vehicle functional tests in complete testing environments. Various solutions are offered according to the customer's requirements – from operational support right through to a testing house, underpinned by certified and accredited processes.

- Technology carriers
- Experimental set-ups
- System networking
- Bus communication
- Diagnosis
- Energy management analyses
- System architecture
- On-board electrical system development
- Reference vehicles
- Intensive vehicle tests
- Software logistics
- Function responsibility
- Special vehicle and special protection vehicle development

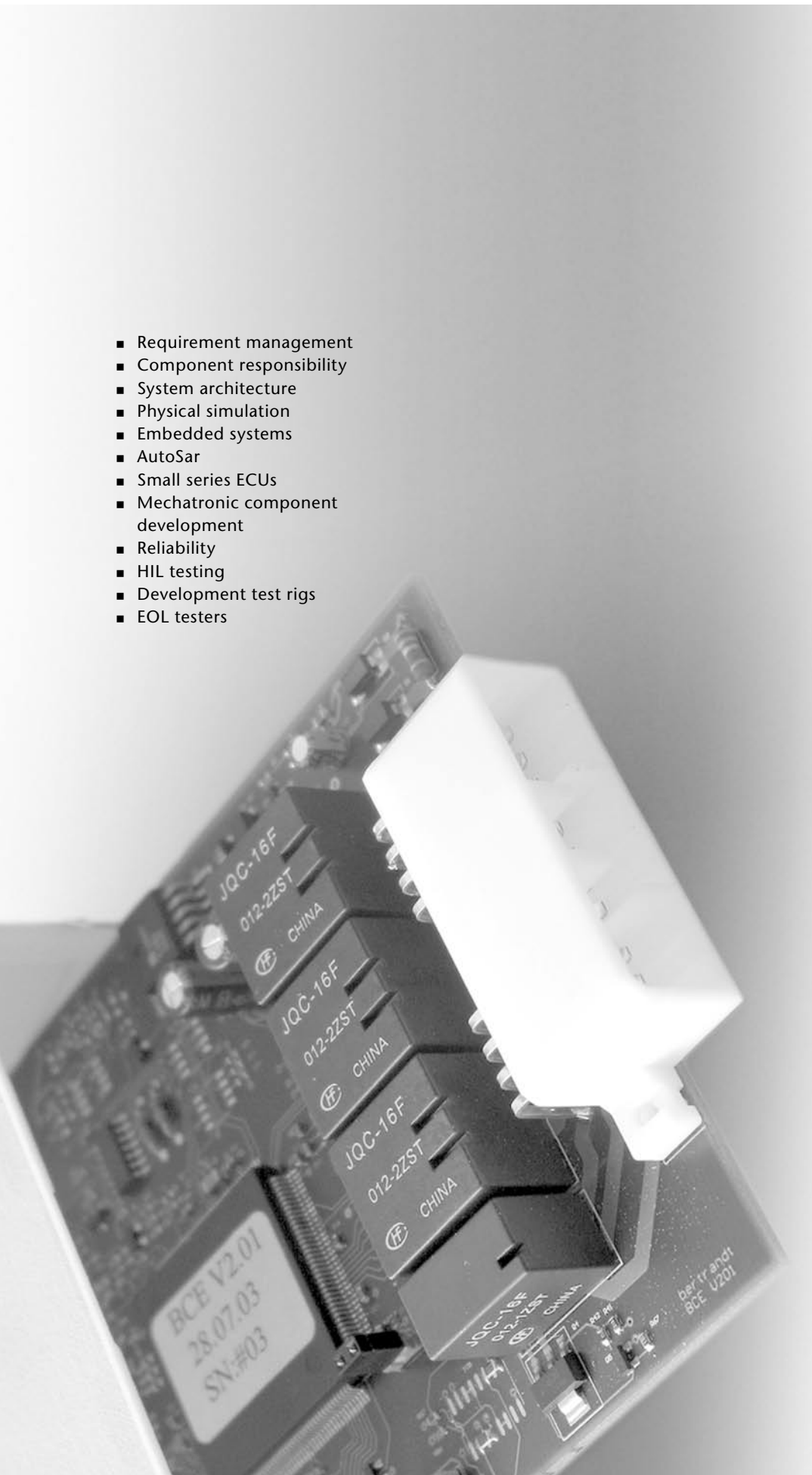


Software

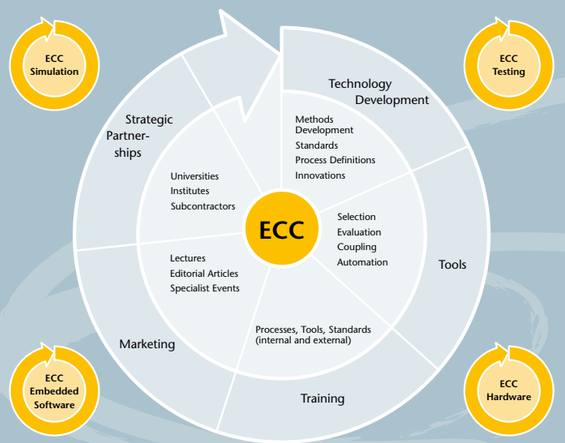
- Function libraries
- Guidelines
- Function simulation
- Tool development
- Tool coupling
- Software architecture
- Model-based software development process
- Module testing
- Test automation
- Series code
- SPICE process management
- IEC 61508/ISO 26262

Components

- Requirement management
- Component responsibility
- System architecture
- Physical simulation
- Embedded systems
- AutoSar
- Small series ECUs
- Mechatronic component development
- Reliability
- HIL testing
- Development test rigs
- EOL testers



Complexity Management in Electronics Development

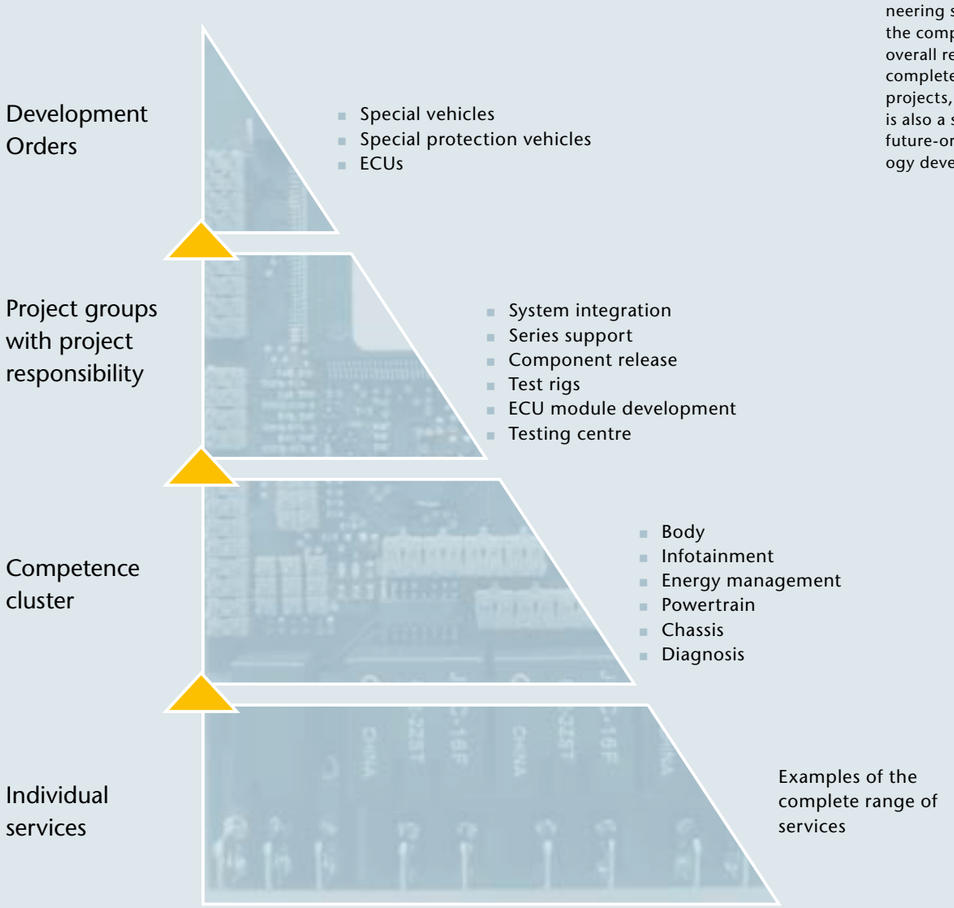


The Electronics Competence Centre (ECC) intensifies expertise in defined areas of the range of services. In accordance with customer requirements, the electronics specialists carry out projects for the Bertrandt Group, for example regarding the use of new technologies or tools.

"I see the networking of technology and human beings as an elementary part of addressing the complexity of electronics."

Christian Ruland, Head of Electronics Division

The importance of electronics in the automotive industry has changed considerably in recent years. As one of the greatest innovation drivers in the industry with continuous growth rates, electronics today combines a wide variety of complex functions in all areas of a vehicle. This has corresponding consequences both for manufacturers and for their suppliers and development partners.



In addition to providing a broad range of engineering services with the competence to take overall responsibility for complete development projects, Bertrandt is also a specialist for future-oriented technology developments.

▸ Relatonics as a complexity manager

In the Electronics Division, technological changes as well as new approaches and working methods in development are designed. The aim is to ensure that the technology is adapted to the user interactively and with as much automation as possible, and not the other way round. The systems needed for this require a corresponding intelligence that is extremely similar to the human brain. These systems take on the tasks of structuring, coding, compressing, saving and generating data right through to controlling non-linear dynamic processes and motion sequences.

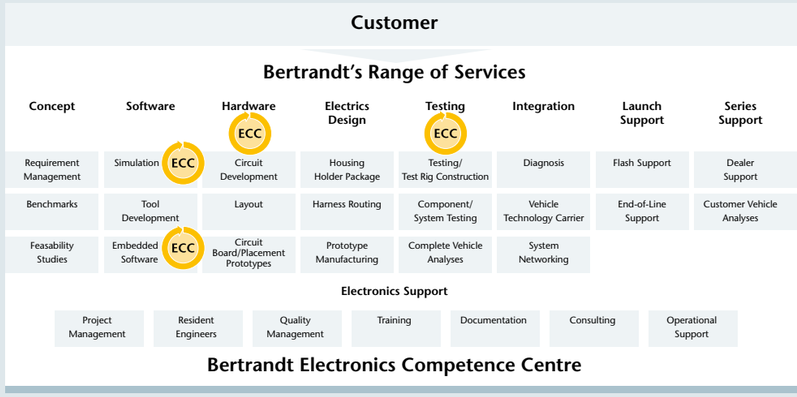
For such complex interrelationships, abstraction in the sense of "analysis and progressive granulation" alone is no longer sufficient. Therefore, the concept of "relatonics", which means considering the architecture of the dynamic interaction between individual components as a separate form of relationship, is becoming increasingly important for the functionality of complex systems.

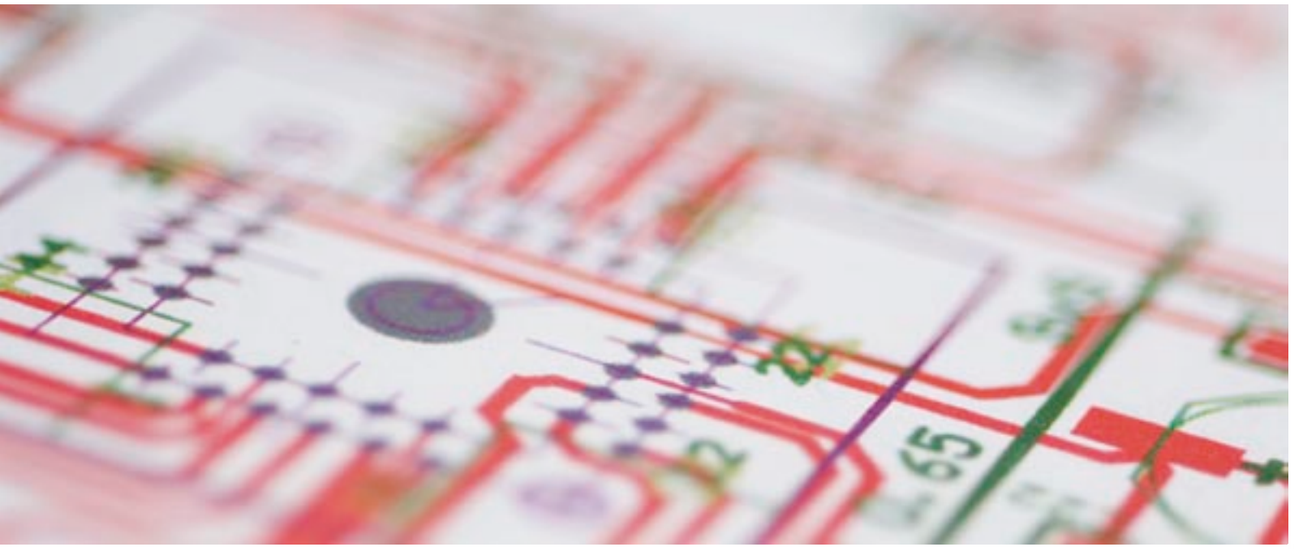
It is necessary to include approaches towards "thinking in relationships" in a development, and not only in a technical respect. It is much more a question of the ability to recognise technical patterns and to put them into defined and standardised interfaces and methods. However, it is only the coupling of methods resulting from an analysis of human behaviour patterns that will lead to an overall view of the situation. Approaches from other sciences such as neurophysiology, which are technically represented in neuroinformatics, could make a considerable contribution towards mastering complexity. The starting point must therefore be a functional design that suggests a close coupling with the vehicle design in order to ensure the relatonics between the electronics and the mechanical systems right from the beginning.

▸ Striving for simplicity beyond complexity

Just as "K.I.T.T", the famous talking car from the American television series "Knight Rider", was a vision of an "intelligent vehicle" in the 1980s, the focus today is not only on mastering complexity in the vehicle by electronics but also on the electronic systems themselves.

In keeping with Einstein's comment that "Imagination is more important than knowledge. Knowledge is limited", what we need in the future are visionary ideas that are advanced by human beings with the aid of suitable technologies. Instead of being satisfied with simplicity on this side of complexity, it is also important to strive for simplicity beyond complexity. ■





Cooperation as an Integrative Component of an Electronic Systems House

The growing number of electronic components in vehicles and the higher complexity of the architectures and systems are leading to changes in the requirements that have to be fulfilled by development partners in the automotive industry. The conflict between increasing development and outsourcing volumes on the one hand and the stagnating availability of qualified developers on the other is leading to different constellations regarding positioning and cooperation. As an electronic systems house, the development partner Bertrandt integrates the most varied services in order to meet whatever requirements the customer may have with a tailor-made solution.

Changing market requirements demand new forms of cooperation

New requirement profiles mean that market players in the field of electronics development are repositioning themselves in different ways. In some segments, there are highly specialised companies with a strongly local character, whereas in other areas small start-up companies are emerging from universities and their institutes. Across the board, human resources service providers are acting as employment agencies to supply temporary workers.
However, these constellations only partly fulfil the customers' expectations. An important aspect from the point of view of a service provider is still the close proximity to the development departments of the customer, with the aim of ensuring extremely high mobility and decentralisation. At the same time, service providers are increasingly expected to offer complete development competence in the different vehicle domains, such as infotainment systems or the chassis, which in turn demands a wide range of services and a correspondingly large company.
The complexity of the systems requires either a high level of control on the part of the customer or partners who are prepared to take responsibility for the results of their work and, due to the lifetimes of the products, to guarantee a high degree of continuity and security. The resulting positioning of Bertrandt in the field of electronics is shown by its continued development from an engineering partner – and one who already fulfilled many of the above-mentioned requirements due to its own organisation – to a complete electronic systems house. One component of this is its integrative role, which offers customers higher value-added and represents a corresponding win-win situation for the companies involved. As a result, electronics development at Bertrandt is characterised by an extremely broad spectrum of services – from the initial concept to series production support.

Examples of cooperation

Optimising tool environments

In order to offer a range of services that is both wide and deep, Bertrandt continuously examines possibilities of cooperation and their corresponding models. Everyday project business produces many possible approaches towards cooperation. The ability to master tool chains as part of the development process is a vital prerequisite for a development service provider like Bertrandt. First of all, the different tool environments of the customers play an important role, complemented by considerations regarding cost and performance within their own development projects. In many cases, special couplings between individual tools are required in order to generate added value for a project.
Bertrandt can provide valuable support in the strategic further development of tool environments. On the other hand, for the implementation of very innovative, new approaches or for the development of tool couplings, it is important for Bertrandt to cooperate closely with these manufacturers. In such cases, strategic development partnerships help to secure the best result for both sides.

Hardware development up to series production

Hardware development can also involve cooperation that stems from different project approaches. Bertrandt develops hardware to customer order or for its own projects. The internal development departments also build prototypes. For a possible small-series production run, a partnership with the corresponding

companies is a promising solution. The optimisation of a layout with regard to specific requirements, for example in thermal or electromagnetic processes, can also be sensibly carried out within the framework of cooperation.
Bertrandt's expertise in the field of networked vehicle systems and its knowledge of the functional requirements can offer the cooperation partner an excellent extension of its own portfolio.

Module development in the software testing house

Bertrandt's range of services also includes the development of software modules, in both model-supported and classical development processes, as well as the definition and implementation of testing methods and processes. The development teams work in accordance with the guidelines specified in SPICE and CMMI. Interesting approaches towards cooperation can be found, for example, in an outsourced software testing house, as offered by Bertrandt. The partners can concentrate their resources in a targeted manner on their own core issues.

Continuous expansion of the range of services

Due to Bertrandt's wide range of services, there are many new technologies that have to be mastered, such as new bus systems or drive systems, to ensure that they can continue to offer an optimum range of services in the future. It is not always sensible, however, to build up this special knowledge in full depth within the company itself. Instead, this can also form the basis for cooperation with a company that specialises in these technologies.

From cooperation to strategic partnership

The challenges in the field of electronics development are many and varied, but equally varied are the forms of cooperation. Many links can be established in cooperation with the customer by not only talking about a specific project but also by discussing the development of a further partnership. For Bertrandt and its cooperation partners, this offers the possibility to achieve higher sustainability from investment in equipment and in the qualification of employees. This is reflected back to the customer in the form of an efficient project and by a partner who understands the requirements even better.
Potential partnerships can also develop from concrete projects. Bertrandt implements complex scenarios in the field of electronics, for example in the development of networked testing environments or complete electronic control units. The special expertise that is required in such projects can also be integrated more efficiently in cooperation with a partner company. This is often a sensible solution with regard to scheduling and financial considerations. In the past, such project-based cooperation has frequently resulted in strategic partnerships relating to a subject area that were successfully applied to several projects.

Defining the framework conditions

Of course, when it comes to establishing partnerships, the participants are faced with the question of how the subsequent obligations can be formulated in a suitable manner. The aim is to achieve maximum synergy for all those involved. What is more, all partners must still be able to act independently without being restricted by the cooperation. This can result in potential conflicts that have to be discussed in advance, thus allowing the partners to find a joint solution as quickly as possible and to benefit from a win-win situation.

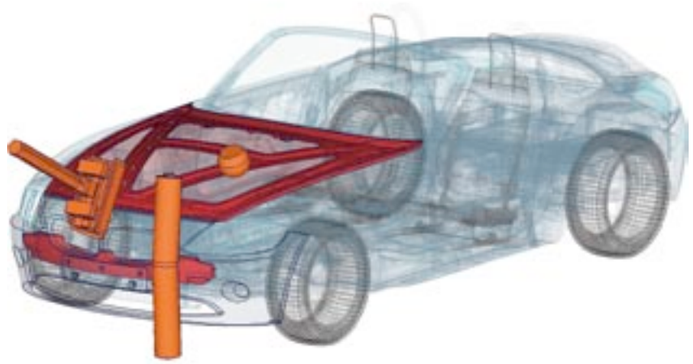
Bertrandt as an integrator

In the past few years, Bertrandt with its Electronics Competence Centre has achieved a position on the market – with regard to both volume and decentralised services – that allows the company to take on an integrative role with its system house and to guarantee comprehensive project responsibility. In this way, the Electronics Competence Centre also complements the mechanically based services and places its orientation as a mechatronic system house in module and system development on a firm foundation. ■

Christian Ruland, Frank Petznick, Ingolstadt

Function Development in a Matrix

Vehicle development has become more complex due to a number of influences and requirements. Often, these result in conflicting objectives for material properties, manufacturing processes, production specifications or legislative requirements, thus leading to an interdisciplinary development of modules or complete vehicles. Against this background, the functionality of individual components within the complete vehicle system is of major importance. In recent years, Bertrandt has networked its range of services in order to meet the increasing requirements in vehicle development.



Function development shown by the example of pedestrian protection in the front-end module.

Target-Oriented Interlinking of Interdisciplinary Resources in the Bertrandt Engineering Network

Project landscape: emphasis on module and system development

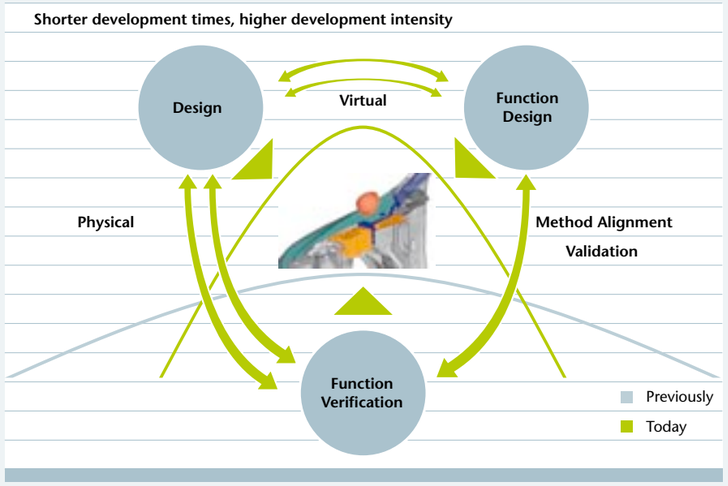
Continuous optimisation of the product development process from initial design to start of production (SOP) and the ensuing reduction in development time have led to changes in the way in which projects are handled. Whereas, in the past, the focus was more on allocating contracts in the classical individual disciplines of design, computation or testing, the project landscape has now clearly moved in the direction of module and system development that takes into consideration all of the requirements and functions. This interlinking of disciplines and structured project management allows the new needs of customers to be satisfied more efficiently.

Internal organisation: supporting holistic development

Bertrandt has not only invested specifically in classical development areas and Competence Centres but has also networked its spectrum of services, thus allowing it today to offer its customers the complete development of different modules and systems from a single source. As a basis for this, internal organisational structures were created that support the continuous expansion of the competence network to include holistic function development.
An important building block in this structure was the implementation of interdisciplinary committees with a company-wide organisation that are able to network knowledge beyond the boundaries of individual company locations. This paves the way for the establishment of interdisciplinary knowledge management within the Bertrandt network and is supported as an ongoing task.

Function development: linking of interdisciplinary resources

The term "functionality" describes the successfully implemented ability of a product, a component or a module to perform a certain task or number of tasks. Typically, an individual component bundles a certain required functionality and includes many different individual functions.
In order to develop these individual functions within a system or a module in spite of the large number of requirements that have to be met, and then ultimately to include them in a finished component, function development in a matrix is used. This can be illustrated by the function-based development "Pedestrian Protection in the Front-End Module", which shows the interdisciplinary linking of resources that this involves. If we consider the composition of the systems contained in the front-end module of a vehicle – for example, the engine, the air conditioning and cooling system, the Body-in-White structure, the bonnet, the sides, the lighting unit or the bumper covering – the sum total of all the requirements of each individual component will result in conflicts of objectives regarding pedestrian protection. The central task is therefore to transfer the requirements of pedestrian protection to all other competence centres involved in front-end development – from the concept phase through the prototype phase right up to series production development – in order to fulfil the actual function. This can only be achieved if the engineers and technicians from the individual disciplines involved are able to work together in the early phases of a project and during the ongoing process in order to jointly recognise possible conflicts, find solutions and then implement them.

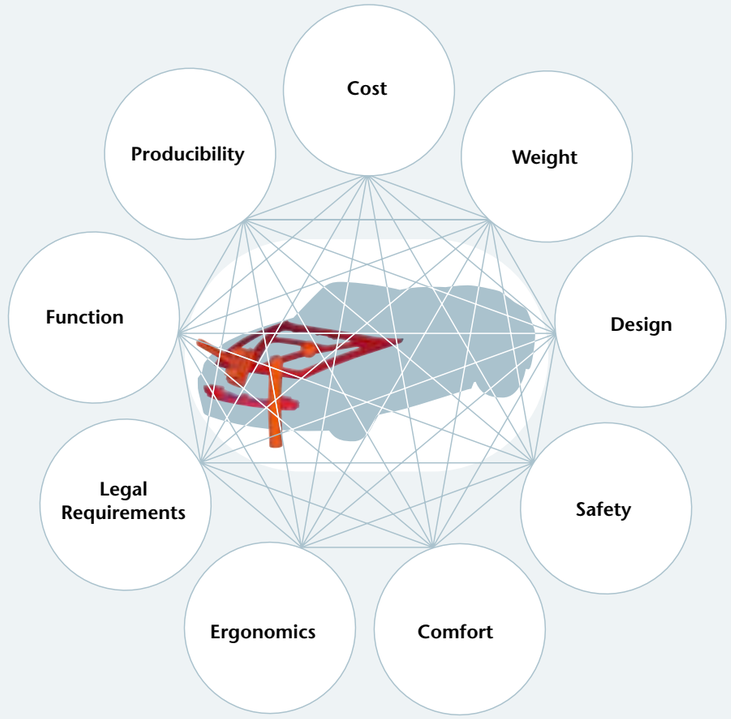


The targeted networking of individual disciplines enables efficient function development.

Function Forums: networking knowledge

The "Function Forum" platform that has been set up at Bertrandt's different sites plays an important role in this. In these interdisciplinary sessions, the experts aim to find solutions to problems involving conflicting targets in ongoing development projects, as well as to further develop processes and to integrate the requirements of current and future legislation. Pre-development issues are also defined and elaborated, for example in degree dissertations.
Interdisciplinary Function Forums are currently held on the subjects of the cockpit, seats, greenhouse, body/occupant cell, doors/closures and front end. These forums bring together experts from the corresponding areas of design, computation, testing, vehicle safety and project management. The experts, who previously focused on their own disciplines, get to know and understand the language and needs of other Competence Centres. In this way, the development teams can transfer their special experience into neighbouring disciplines and apply it there. The latest developments – such as changes in American legislation or current consumer protection measures – are discussed during the forums and possible effects on modules and their development processes are assessed.
The further development of the technological expertise of the different offices and the Competence Centres involved is advanced by performing and documenting benchmarks within these forums. In order to ensure that the continuity of knowledge development in the Bertrandt network is maintained, the leaders of the group-wide technology forums report on the results, current effects and future working measures from the individual Function Forums to the different Bertrandt sites. This targeted feedback on specific issues to the various Bertrandt sites ensures that Bertrandt's "Network for Strength" is optimised in the interests of its customers. ■

Andree Hündling, Michael Neisen, Ingolstadt



The most varied requirements are considered within the context of function development in order to develop products that are optimised with regard to quality, cost and functionality.

High-end visualisation

Bringing the future to life today with virtual reality

A move towards the future may sound as if it happens in leaps and bounds, but in fact it is made up of individual steps. One step along this road was the master's thesis of a design student from Pforzheim produced in cooperation with the Design Services Competence Centre at Bertrandt AG and the design company Motorcity Europe. Against the background of the latest high-end visualisation technology, the "LuxuryCell" show car demonstrates how traditional clay models and state-of-the-art digital visualisation techniques can be combined to best effect. In addition, the authors explain how virtual reality can be used to optimise the development process of future mobility solutions.

Tangible and luxurious fantasies

Luxury on wheels: this was design student Jeff Maugan's vision of a show car. During the process of transforming his vision into reality, he received support from Bertrandt and Motorcity Europe. The interior of the show car is highly innovative when compared with conventional designs. The open layout of the interior, which gives the impression of a lounge, allows passengers to travel with rather than next to one another. The appearance and perceived quality of the car are based on the principles of luxury and well-being. The focus of the design is clearly on form rather than function.

Combining digital and physical design processes

If we rewind the video, the challenges, similar to those faced by every car developer, will become clear. The tight timeframe and the limited budget resulted in the decision to produce a combination of a digital model and a physical clay model. Before the vehicle was created in clay, the partners developed a digital model of the design. The subsequent 1:3-scale clay model was produced on the basis of the digital data and optimised by hand in a series of cycles in the Bertrandt Group design studios.

High-end visualisation of digital designs

The use of high-end visualisation enables digital designs to be represented and evaluated in real time as photo-realistic graphics. As a result, any necessary changes can easily be identified and highlighted. This also allows a wide range of variants to be produced and the number of prototypes or models that had previously been necessary to be reduced.

A variety of software packages is available for high-end visualisation. The purpose of all the software derivatives is to represent digital designs in photo-realistic quality. For the "LuxuryCell" show car, several software applications were combined on the basis of an alias model in order to produce the best possible results. The packages included ICEM-Surf, Maya and 3D-Studio-Max. DeltaGen was used for the project and customer presentations.

Even more realistic

If we take a step away from the LuxuryCell project and look instead at the digital vehicle designs in modern development projects, it is clear that with the latest technology this data can be used to bring the vehicles to life. With Powerwall and Cave you can sit in or stand next to a virtual vehicle. A combination of virtual presentations and physical models brings together the spatial perception and the operation of the vehicle. The result is that the analysis and development processes can be made more efficient and targeted more accurately. This promising concept is referred to as mixed reality.

Powerwall

With a number of projectors that use back projection to portray an image in cinema format on a frosted pane of glass, a 3D simulation of a vehicle can be produced. As well as 2D projection, 3D projection in stereo mode is also possible. As a result, the huge volumes of data are transformed into an accurate representation of the current status of digital development.

In the case of a tracked system, a flystick and a special pair of glasses can be used to rotate and observe the digital model. The simulated car moves in relation to the glasses and therefore gives the observer the best possible view.

Cave

Cave, a five-sided projection system, allows the observer to enter the 3D model and makes details significantly clearer. The user is surrounded by projection surfaces that are also brought to life using back projection. Using a special 3D pair of glasses and special gloves, the complete environment, including the switches, the windscreen, the tachometer and the interior fittings, becomes visible. Physical models can be integrated into the Cave, which enables users not only to see the radio, for example, but also to use it.

High-end visualisation as a service of the future

These systems offer a wide range of possibilities for vehicle development which are nowhere near being exhausted.

The complete vehicle becomes available long before the first hardware or the first prototypes. Where designers previously used cross-sections and images to try to bring certain characteristics to life, they can now analyse them using the current digital designs. High-end visualisation is also becoming increasingly indispensable in practical testing. Almost any tests can be simulated, including driving through water, visibility tests and driving over kerbs. However, physical models will still be needed in the future, but in smaller numbers. The challenge of the future is to optimise the links between the virtual and the physical design process, in line with the requirements of the different project types and processes.

High-end visualisation at Bertrandt

At Bertrandt, the high-end visualisation of partial or complete components has already become an essential part of a number of projects. Within three to five years, photo-realistic visualisation in real time using VR software packages will be a standard process. The number of different programmes for high-end visualisation will continue to grow, in part as a result of the increasing specialisation of the application areas.

The targeted use of visualisation packages also plays a central role in training and development at Bertrandt. The objective is to meet and, where possible, to exceed existing and future customer expectations in a wide range of areas, such as sales, marketing, design and engineering.

From leaps and bounds back to individual steps

The show car represents the successful combination of tried-and-tested and state-of-the-art technology. Currently, smaller projects like the LuxuryCell can be implemented professionally on the basis of the effective interaction of the different disciplines using high-end visualisation with a reasonable amount of effort. Virtual reality can show us today what tomorrow's model range will look like. ■

Michael Brandl, Munich;
Daniel Hauser, Ingolstadt;
Alf Heidrich, Lysann Kurpiela, Ehningen

Real or virtual? The effective interaction of the different disciplines can be used to produce a professional high-end visualisation with a reasonable amount of effort.

Dimensional Management

Today, many German car makers and automotive suppliers are successfully applying Dimensional Management. Its aim is to enable the quality of the products to be planned in every phase of the development and to optimise the processes between design and manufacturing. Since the time available for development is continuously being shortened and global strategies require standardised concepts, Dimensional Management will face new challenges in the future.

Integrated solutions for higher quality in the development process

Dimensional Management in the development process

Bertrandt sees Dimensional Management as an integrated process. The continuous monitoring of simulation and design with regard to the subsequent manufacturing process is aimed at improving product quality and resolving possible areas of conflict. At Bertrandt, standardised processes and documents form the basis of optimised development. As part of this, Dimensional Management is linked to certain milestones in the production development process. All releases – from the design freeze through development right up to the release of tools and machine materials – are based on different Dimensional Management documents. For this purpose, the Dimensional Manager collects the information required and makes it available to everyone involved in the development. For example,

- the dimensional concept is coordinated, documented and visualised in 3D models,
- logs and change documentation provide information on decisions made by the Dimensional Management committee,
- the results of the Dimensional Management process are recorded in a standardised manner and can be accessed via EDM systems by those involved in the development as part of the product documentation.

Together right from the start: The right concept

Linking with other areas of the development process already results in a high level of maturity at an early stage, which means that fewer modifications need to be made until series production. At the same time, however, there are also challenges that need to be faced.

One example is the clamping and fixing concept. A complete and continuous clamping and fixing concept should be defined before the first component release, even though a final dataset is not yet available. In this case, the Bertrandt engineers apply two measures:

1. The dimensional concept as the basis for the clamping and fixing concept is already determined well in advance. Changes are logged individually.
2. The Simultaneous Engineering process ensures that the dimensional concept is refined into a complete clamping and fixing concept before the component release.

This simple example shows the close intermeshing of different areas within a product development, all of which have access to the results of the Dimensional Management process.

Communication and interaction: Defining interfaces

This interaction between different development areas means that the definition of interfaces is important. An interface is a standardised area within a process that is always performed in the same way. Quality Management (TQM) helps to identify this interface. It receives a form of documentation that allows all important information to be transported with sufficient accuracy from one area to another. This can be an Office document, a standardised nomenclature within the simulation models or the agenda of a regular meeting. In spite of the standards, engineers and technicians critically examine the interface documents at the beginning of the project and query the processes. The aim of this is to recognise deviations and to improve the execution of the project by means of further developed documents and CAx methods.

Electronic support: Continuous software coordination

A further aspect is the application of the correct software versions. Due to the increasing importance of dimensional simulation, new programmes (e.g. aesthetica) that focus on certain partial aspects of the tolerance analysis are constantly coming onto the market. Established tools (Simtol, 3DCS and VisVSA) expand their functional scope. As a result, OEMs tend to favour different programmes, just as the Dimensional Management process has different perspectives of the dimensions and tolerances.

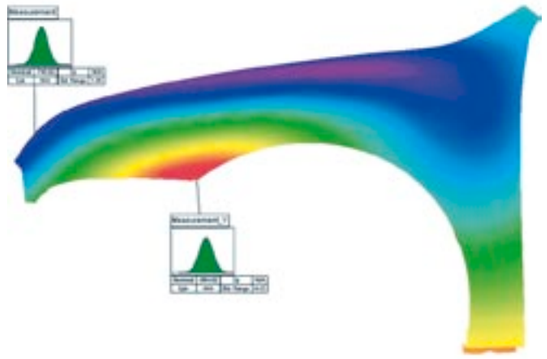
From today's point of view, software that meets all the requirements at once will not become available in the short term. Therefore, dimensional managers have to rely on different tools. For that reason, Bertrandt uses all current formats in order to tailor the Dimensional Management process flexibly to the needs of the customers.

As individual as possible, as uniform as necessary: Standardised concepts

In addition to ongoing standardisation, the parameterisation of the CAD world represents a further challenge for the development process: the need for standardised concepts for the most varied requirements. Bertrandt's approach is to produce a template that brings together the most important standard concepts from different assembly concepts and then to compile a selection according to the effort involved and the quality requirement. The template method has a positive effect in that once concepts have been developed, they can be used again in subsequent projects. In this way, templates already form the basis for a high level of development quality in the concept phase.

Function development in a team: Implementing FEM coupling

From Bertrandt's perspective, comprehensive and early dimensional planning is an important step in optimising the development process with clearly defined interfaces. Close cooperation between technical computation and design makes a major contribution to this. This can be shown by the following example. Due to the need to observe elastically deformable components within the tolerance analysis process, a new interface between dimensional simulation and technical computation is produced. 3D dimensional simulation tools such as VisVSA, aesthetica and, most recently, 3DCS can import FEM grids into an existing tolerance simulation and analyse the effects of tolerance-related assemblies on flexible components. This shows the potentials of linking the two disciplines. Having been tested in various pilot projects at Bertrandt, the intensive exchange between the areas and the optimum data exchange form the basis for efficient and high-quality development.



A wing has two contradictory assembly directions: it is aligned with the door joint and with the transition to the bonnet. The red area shows the maximum deformation due to assembly under the influence of tolerances. In the blue area, only minor deformation is to be expected.

Coherent action: The basis for quality

Since becoming established, Dimensional Management has been continuously developed further. New barriers have been overcome and a holistic observation of tolerances in the product design process has been further advanced in all areas. It is only with an awareness that quality is not achieved by figures but by actions that Dimensional Management becomes effective. Therefore, for all employees, the aim of achieving the highest quality in their own work forms the basis for good product development. ■

Andreas Seidel, Ehningen

The Bertrandt Three-Wheel Car

Diploma students develop environmentally friendly mobility

Climate change and environmental protection are highly relevant issues today. Like all other sectors, the automotive industry is also called upon to play its part in reducing CO_2 emission by producing low-emission vehicles. Within the framework of students' diploma theses, engineering partner Bertrandt developed a low-cost road vehicle that combines individual mobility with an environmentally friendly use of resources.

Initial idea and objective

As long ago as 2004, Bertrandt, under the leadership of Dipl.-Ing. (FH) Torsten Einicke from the Body-in-White Competence Centre began to consider the concept of a vehicle that combined properties such as a low purchase price, low fuel consumption and sufficient mobility. The aim was to develop a complete vehicle and to make use of the entire range of Bertrandt's services, in a similar way to the Bertrandt Competence Car and the smart crossblade, for which Bertrandt acted as general developer. At the same time, the project was aimed at furthering the knowledge and skills of young employees. For example, the concept development of individual vehicle areas, such as the Body-in-White, the powertrain and the chassis, was carried out on the basis of diploma theses.

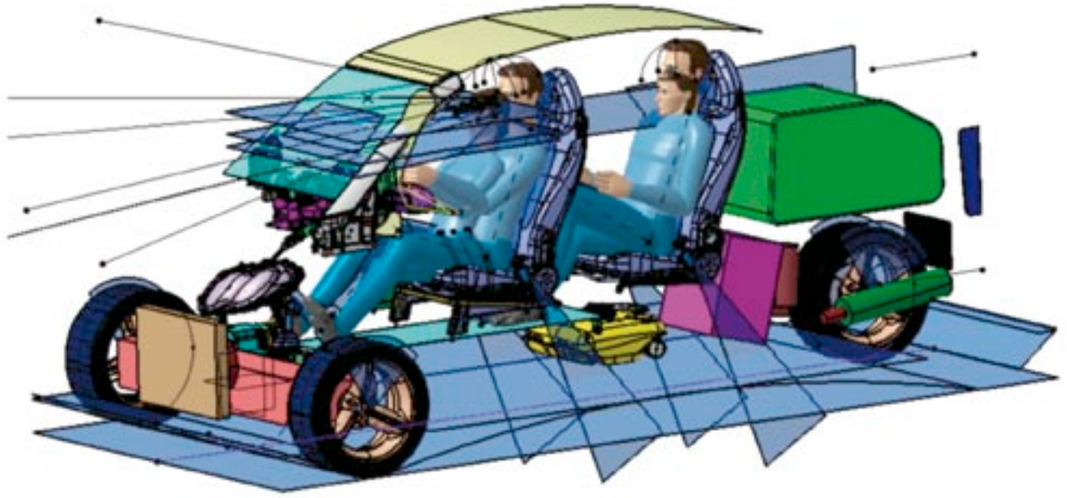
The initial idea of the project was that, according to a study, 80 percent of daily commuters are alone in their vehicles. Therefore, a two-seater car, with an acceptable luggage capacity, is entirely sufficient for everyday requirements. For that reason, the decision was made in favour of a three-wheel vehicle, which is the classical mixture between a motor cycle and a passenger car. It combines the comfort and safety of a car with the weight, road space requirement and price of a motor cycle.

The vehicle concept

The "Bertrandt Three-Wheel Car" project is based on an inexpensive urban vehicle that will provide individual mobility and safety at a low price. The aim is to offer sufficient space and luggage volume for two persons in a tandem seating arrangement.

The arrangement of the seats one behind the other minimises the frontal surface area of the body, thus reducing fuel consumption. The car has a steered front axle and a rear axle driven by a rear-mounted engine. Tilting technology is not integrated. The target was to achieve a maximum unladen weight of 800 kilograms. Furthermore, the three-wheel car will have a closed body design with a door on the left-hand side. The luggage compartment is located conventionally in the rear and, with a maximum capacity of 200 litres, has the luggage volume of a standard compact car. The underfloor is to have a sandwich design in order to accommodate various components such as the fuel tank.

In order to achieve an attractive purchase price, the plan was to implement a large number of shared parts from comparable sub-compact cars into the vehicle. Furthermore, each component would be scrutinised with regard to cost and then optimised if necessary. On this basis, the dimensional concept and package of the vehicle were defined in the first development step, which was the subject of the diploma thesis presented by Michael Stockmann, who is now employed in the field of Dimensional Management at Bertrandt. This was preceded by a detailed benchmark analysis and an examination of all the necessary legislation (EU Directives) to allow a three-wheel vehicle with a production volume of 10,000 units per year to be licensed for use in Europe. Beyond this legislation, the three-wheel vehicle was also able to fulfil the safety requirements of a passenger car. The vehicle is to have a top speed of 130 km/h.



After the initial design of the occupant and vehicle package, in which the aim was also to achieve the comfort of a medium-sized passenger car, the first design drafts were developed.

The powertrain

In January 2006, the project was continued by two further diploma students of engineering, Christian Schramm and Michael Johne. Taking all specifications into account, they developed the Body-in-White and powertrain concept.

The subject of the diploma thesis presented by Christian Schramm was the powertrain for the three-wheel vehicle. His concept was based on a benchmark analysis that showed the current state-of-the-art in powertrain technology and studied whether an application in the three-wheel vehicle was sensible with regard to the aspects of cost, weight, low fuel consumption, sufficient power output and compliance with emissions legislation for passenger cars.

The study showed that a combination of a compact petrol engine and a five-speed manual transmission best fulfilled the requirements of the Bertrandt three-wheel vehicle. The decision was made in favour of the MPE 750 engine from Weber Motor, a company based in Markdorf, near Lake Constance. The engine is a two-cylinder inline unit with a displacement of 750 cc and, in the version chosen, offers a sufficiently high power output of 44 kW with a weight of 44 kg. This engine is currently used, for example, in snowmobiles and boats as well as in concept vehicles.

The engine is combined with a single-plate dry clutch and a five-speed manual transmission. The transmission was modified as the driving torque is transmitted to the rear wheel via a chain. In addition, the connection of the gearbox to the engine also had to be changed. The engine/gearbox unit was then integrated into the existing package model. Subsequently, it was possible to define the interfaces for the Body-in-White.

The cooperative collaboration with Weber Motor AG meant that information and CAD data could be made available for the continuation of the project.

The Body-in-White

For the development of the Body-in-White concept, the first task was to examine suitable materials, as well as costs, weight and the requirements regarding current crash standards. Based on this knowledge, a structural model of the occupant cell was developed and a detailed manufacturing study of the side wall assembly was carried out. This was followed by a technical and cost evaluation of different materials for the side panelling. As a result of the evaluation, a steel composite material was chosen.

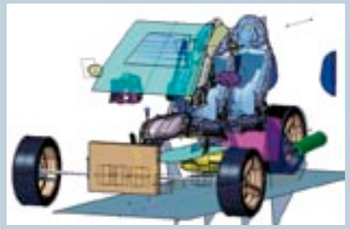
The concept shows the possibilities of implementing a steel body at a low cost in small-series production. This is achieved by the small number of components involved as well as by the use of proven manufacturing and joining processes. The reduction in the number of components is made possible by using a load-bearing reinforcement tube in the roof frame as well as by the intensive application of structural adhesives and foams.

Summary and outlook

The development of the Bertrandt three-wheel vehicle is currently being continued in further studies and diploma theses. The next steps will be the development of the chassis structure and the detailed Body-in-White concept. The completion of the concept phase will be followed by the detail design stage. The plan is to subsequently construct a demonstrator vehicle to be shown at trade fairs. ■

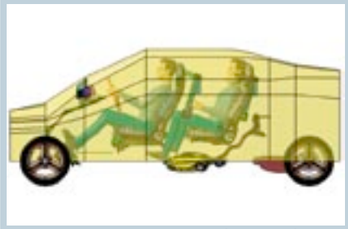
Michael Stockmann, Ehningen

CAD examination of the overall vehicle package:

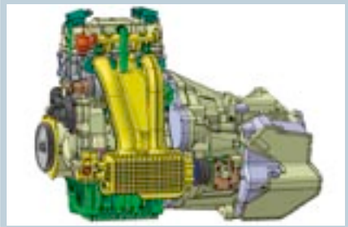


Field of vision.

Headroom.



Package enclosure.



Engine/gearbox unit.

Body-in-White concept, including engine/transmission unit.

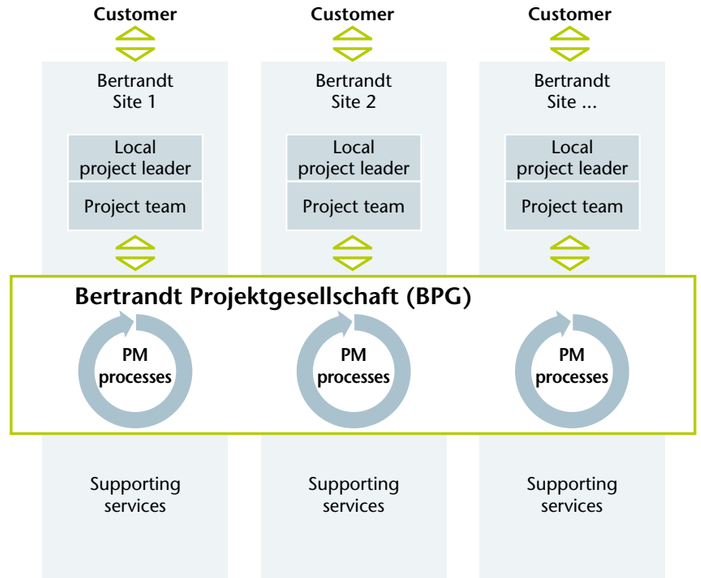
Bertrandt Projektgesellschaft (BPG) was founded in 2002 to allow Bertrandt to manage complex module and derivative projects successfully. As a service provider, BPG's project management expertise is available to the entire Bertrandt Group. Customers benefit from its professional processes and tried-and-tested standards for the development of the vehicles of the future.

Five years of Bertrandt Projektgesellschaft

A story of success

All the Bertrandt sites benefit from the cross-departmental function of BPG. It enables the continuous exchange of experience in the Bertrandt Engineering Network as well as at a departmental level.

Function of BPG within the Bertrandt Group



Previous history: Project management as a response to complex project tenders

Since the start of the decade, car manufacturers have increasingly been putting complex projects out to tender and giving greater responsibility to development service providers. External partners frequently have to manage development projects consisting of several modules from a number of different technical fields. For example, alongside a partner who will take responsibility for the body work, customers also require services ranging from the development of interior fittings and functional validation right through to the competence to implement and manage derivative projects.

The increasing technical complexity and variety of the projects results in the need for comprehensive control and organisation functions, together with project management processes and cross-departmental functions, in order to ensure that the project runs smoothly.

The solution: BPG as the service provider for the Bertrandt Group

In order to be able to successfully manage complex module and derivative projects for which it had sole responsibility, Bertrandt founded the Bertrandt Projektgesellschaft in 2002. Its objective was to establish a central organisation that brought together all the relevant cross-departmental functions and project management processes for the implementation of large projects. Its expertise was to be available to the entire Bertrandt Group on a networking principle. The growing experience of Bertrandt Projektgesellschaft in managing large projects has transformed it into a competent service provider for all the Bertrandt Group sites. It offers professional support in the tender and quotation phase and during the implementation of the project. The focus is on avoiding risks by integrating project management processes in a timely fashion.

Continuing development: The process construction kit and project management tool

One of the primary objectives of BPG is to continue to develop its existing project management processes. This involves the efficient and systematic use of standardised processes and tools.

A particular challenge for the service provider was to develop a process construction kit that would provide the necessary processes and documents for a wide range of project scenarios with different levels of development and responsibility. Its experience of national and international projects allows BPG to offer not only knowledge transfer to the various Bertrandt sites, but also a highly effective project management tool for the successful implementation of projects. BPG's services are available at any time throughout the entire Bertrandt Group.

In practice: Coordinating projects and ensuring process conformity

Another core service of BPG involves ensuring the conformity of processes in cross-departmental functions and project management methods at all Bertrandt's sites. In regular meetings with the site management teams, new processes are discussed and agreed across the network. BPG becomes involved in ongoing projects, analyses the process-oriented use of standards and recommends improvements. If necessary, it provides active support for project coordination, which ensures that projects are set up correctly from the start and will continue to run smoothly. Once the processes have been established, the BPG team is available to provide support and consultancy for the project.

Benefits: Rapid response and standardised tools

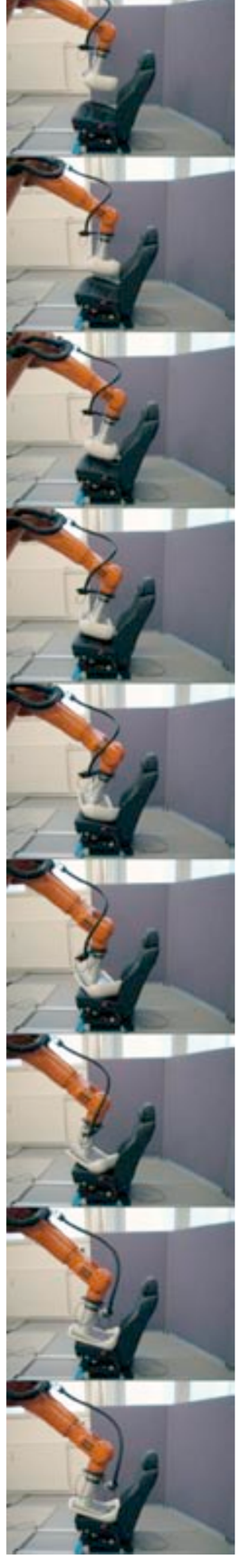
There are a number of benefits for all those involved. For example, comprehensive documentation of the project activities and results, together with the use of a professional data management system, makes it easier for customers to track the progress of the project.

The standardised use of BPG tools allows internal team members to respond rapidly to new challenges in the project. By consistently planning and monitoring project activities, unforeseen risks can be avoided at an early stage. Using standard processes and tools not only brings benefits during the operational phase of the project, but also removes the fear of the unknown and allows the project team to concentrate on the technology and functionality of the end product. In addition, a standardised project management approach results in the development of a supportive routine. Both our project teams and our customers have experienced the benefits of the system and become familiar with using it.

Summary: Professional project management offers benefits for everyone

Bertrandt Projektgesellschaft is responsible for the professional application of project management methodologies in large, complex projects. Assigning specific members of the BPG team to the individual Bertrandt sites results in the clear allocation of responsibilities. The use of standardised processes and tools throughout the group ensures that, despite employing more than 4,400 people, the company has a uniform structure and integrated internal processes, with benefits for everyone in the development chain. As a result, the company can provide targeted development services of the highest quality. ■

Gernot Bürger, Ehningen



Vehicle safety

Fatigue and functional tests using the “Occubot” seat testing system

The “Occubot-System” in action: realistic results from the flexible adaptation of the path.

The “Occubot-System”, which is in use at Bertrandt’s Munich site, allows flexible tests to be carried out on vehicle seats. The benefit of the system is that constant adjustments can be made to ensure that the loads applied to the seats in the test are as close as possible to those that occur in real life.

Functional investigations and life tests of components, modules and complete vehicles are an important feature of vehicle development. The seat module, for example, has become increasingly complex over recent years. Alongside the traditional static and dynamic life tests on the seat structure, the constantly growing number of add-ons, such as air conditioning and massage functions, active headrests or occupant recognition systems, have to be tested in function and fatigue tests.

The “Occubot-System” for seat fatigue tests enables special, flexible test conditions to be set up. This is made possible by the Kuka industrial robot, which positions the seat dummy on freely defined paths. The use of a six-axis force/torque sensor allows for iterative control and the constant adaptation of the path to the wear on the test object. From one test cycle to the next, the load on the seat becomes increasingly similar to the stresses that occur in real life.

The “Occubot-System” used by Bertrandt will continue to allow dynamic adaptation to new requirements and applications. Flexible path curves will make it possible to programme biometric ingress and egress processes quickly and efficiently. ■

Börje Brezger, Mario Cannata, Munich

Play Your Part in Development – CATIA V5 in Cologne

Training and further training programmes for CAD designers

Bertrandt is offering practical and high-level training and further training programmes for qualification as a CAD designer, CATIA V5, at its Cologne site.

Dates

- 26.11.07 to 15.01.08 (8:00 a.m. – 5:15 p.m.), Christmas break: 24.12.07 to 02.01.08

For detailed information on the training programmes, please visit: www.bertrandt.com/bildung

Bertrandt is now making the expertise that it has acquired in more than thirty years of development for the automotive industry available in tailor-made CATIA V5 training programmes. Based on the experience gained by around 4,400 employees at 19 locations in Europe and the USA, these training programmes are designed to meet the concrete requirements of the industry and provide training at a high quality level. As a legally recognised programme for professional further training, the courses in CATIA V5 cover such areas as Solids, Surfaces, Drafting, Kinematics and Sheet Metal. The courses are held in small groups and are moderated by experienced trainers.

In addition to its commitment to the training programme, Bertrandt also offers to support the students in accessing the job market due to its many contacts in the automotive industry. Skills in CATIA V5 are valued not only by customers but also by Bertrandt itself. Qualified employees at the development service provider can expect to encounter numerous projects in cooperation with highly reputable customers. Bertrandt welcomes dynamic and flexible employees who want to contribute to the development of large-scale solutions. ■

Nicole Litti, Cologne

Until now, there has not been a suitable professional training for a career that meets the current and future requirements of modern product development. This gap is now being filled by the introduction of a new professional training opportunity: "Technical Product Designer". Bertrandt in Tappenbeck near Wolfsburg is already training eight young employees in this new career – and the trend is upward.

Technical Product Designer

A Career with Perspectives

Securing future employees

A highly qualified workforce is a key precondition for the growth potential and competitiveness of a company. In order to counteract the demographic development and to ensure a sufficient supply of qualified staff in the future, Bertrandt has now introduced a new professional training opportunity that is optimally tailored to its requirements: Technical Product Designer.

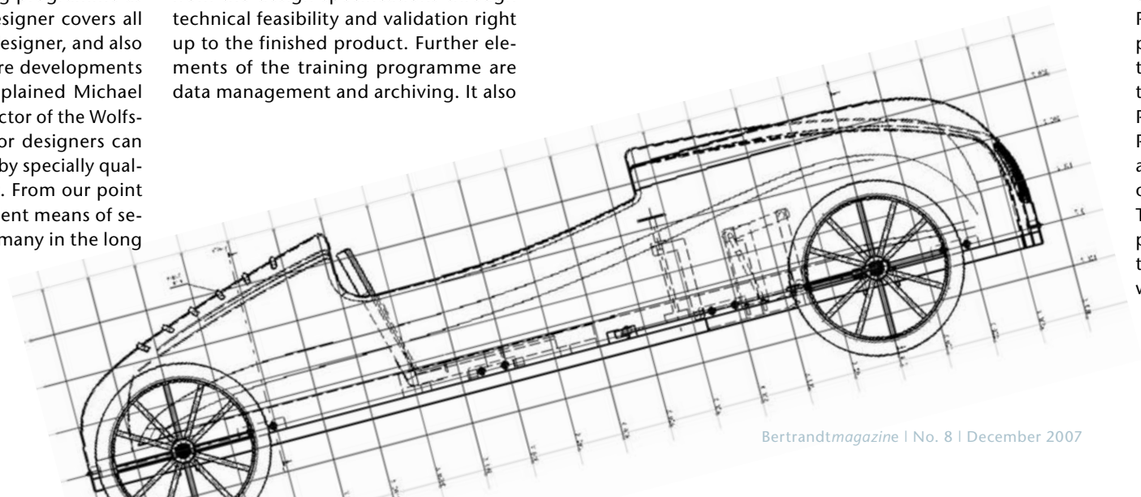
"The three-year training programme as a Technical Product Designer covers all the skills required of a designer, and also takes into account future developments in product design," explained Michael Schulz, commercial director of the Wolfsburg site. "Vacancies for designers can therefore soon be filled by specially qualified product designers. From our point of view, this is an excellent means of securing CAD jobs in Germany in the long term."

Highly practical training

The three-year training programme addresses the entire process chain of product development. In addition to aspects of process and product management and technical documentation, the main emphasis is on CAD-supported product development.

The Technical Product Designer complements the work of development engineers throughout the entire process, from the design specifications through technical feasibility and validation right up to the finished product. Further elements of the training programme are data management and archiving. It also includes courses on fundamental economics and commerce, as every development process also involves economic considerations.

"The new career profile is characterised by a high practical relevance and is therefore clearly designed to meet the requirements of future product development," said Jan-Peter Scheele, initiator of the innovative training concept.



"Soap-bert-box" project

Eight students already had the opportunity to demonstrate the knowledge and skills they had acquired in the first year in an in-house competition. Three teams took part in the "soap-bert-box" training project, in which they had to design and build their own soap box vehicle. In the course of the project, the students became familiar with all phases of vehicle development, from design to production, in accordance with the Bertrandt Product Development Process (PDP). In particular, they considered four phases: the Study Phase, the Definition Phase, the Realisation Phase and the Production Phase. The application of the Bertrandt PDP taught the students in this project all they needed to know about the development of a vehicle in its entirety.

Training supervisor Thomas Klingner was pleased with the results of the competition. "The design of the soap box cars was based on a detailed development," said Klingner. "What is more, building a soap box car with one's own responsibility requires a high level of teamwork."

It was not long before the prototypes had to demonstrate their genuine racing ability – at this year's summer garden party at the Bertrandt office.

There will soon be more than just eight students in this training programme in Wolfsburg. The experience gained by the management so far has confirmed the need to train future employees in this field in a targeted manner in accordance with requirements. As a result, the number of trainee designers is to be increased by a further ten young people who will start their careers as product designers at Bertrandt. The offices in Cologne, Ingolstadt and the Technikum in Ehningen are also planning to take part in the training concept initiated at Bertrandt's Wolfsburg site. ■

Stefan Matthies, Wolfsburg

Bertrandt-Consulting

Business Expansion Workshop for and with Harada

Participants in the Business Expansion Workshop: various Competence Centres and levels of hierarchy ensured an objective generation of information.

The Cooperation

Since 2003 Bertrandt Cologne has been working with the Japanese Automotive infotainment antenna supplier Harada. Founded in the 1950s, established globally and supplying the majority of OEMs, in concrete Harada designs, develops and manufactures products for GPS, GSM, Digital Audio & Video Broadcasting (DAB/DVB), Bluetooth and AM/FM Radio.
Bertrandt's engineering support of Harada for an increasing number of carlines at Ford was the basis for a new cooperation in 2006 involving engineers and CAD support direct at the OEM whilst second level support for sales, logistics, quality assurance and project co-ordination is based at the Harada office located directly in Bertrandt Cologne facilities.
The intention to achieve a win-win situation by acquiring new customers and expanding business with existing customers for Harada is connected directly to the provision of resident engineers by Bertrandt.

Business Expansion Workshop

Mr Dominic P. Hancock and Dr. Oliver Schlösser from the department "Supporting Services" at Bertrandt Cologne visited Harada's R&D facilities located East of London (UK) in March 2007 where they facilitated a business expansion workshop focused on the German market. The objective of the workshop was to obtain transparency of Harada competitiveness as well as their product portfolio and customise Bertrandt services to this unique portfolio.
Starting off with a focus on competitiveness, product portfolio and the customisation of Bertrandt's services to match with Harada's portfolio, the first task was the evaluation of product technology and price against the market average. A methodology like this defined the competitiveness of the products in the German market. It further enabled the workshop participants to get a common understanding of the competitiveness of Harada products.

Going into more detail the group continued to position their products on the product life cycle. As a result, "stars" and "cash cows" could be differentiated from less successful products which would either involve high investment costs and uncertain future market potential ("question marks") or mature products ("dogs") where the market size is already shrinking. Moreover, the future development of the individual products were evaluated and forecasted.
Furthermore the group elaborated the question, which market segments must be penetrated by the individual products of Harada due to their competitive advantages. Therefore, the relevant criteria for competitiveness within the Tier-1 market were revealed and compared to those of the Tier 2 market. It became transparent that the competitive environments in the various market segments are very different.
Finally, the team broke down the common findings into more concrete tasks and assigned activities to team members with an agreed due date as preparation for the next stage.

New Experiences

Running a workshop in a foreign culture, with participants from Japan and the UK as well as from various departments such as engineering, sales, logistics and quality, enabled the generation of information from different perspectives. The information became less bias due to the involvement of these diverse departments and the entire hierarchy, operational to top management, from within the Harada organisation. Due to the better understanding of mutual business objectives obtained by the workshop, the relationship between Harada and Bertrandt has grown stronger. ■

Dominic P. Hancock, Dr. Oliver Schlösser, Cologne

Annual Congress

"Zulieferer Innovativ 2007"

For the ninth time, Bayern Innovativ GmbH in cooperation with VDA Frankfurt, the trade and industry development company IFG Ingolstadt GmbH and the Bavarian Ministry of Economic Affairs, Infrastructure, Transport and Technology organised the congress "Zulieferer Innovativ 2007".

The opening address to the congress was given by Hans Spitzner, Bavarian State Secretary for Economic Affairs, Infrastructure, Transport and Technology. Around 1,260 participants from 25 countries then had the opportunity to hear a number of lectures on topical issues. The main subjects were:

- Interior – Emotion & Functionality
- Powertrain – Dynamics & Efficiency
- Cooperation – Trends & Best Practices

This year, Bertrandt presented the Electronics Development and Powertrain Competence Centres at the congress. A large number of people visited the stand to find information on the exhibits and the latest developments as well as to establish new contacts. The training engine and the real-time test rig in particular were the main exhibits that attracted the visitors to the Bertrandt stand. ■

Kerstin Günther, Ingolstadt

Positive Response for Bertrandt

More than 40 participants at the 2nd Capital Market Day

Dr.-Ing. Bernd Bohr, chief executive of Robert Bosch GmbH.

Prof. Dr. Hans-Jürgen Flüh, director of the Faculty of Automotive Technology and Aircraft Engineering at the University of Applied Sciences Hamburg.

The automotive and aviation sector is characterised by dynamics, globalisation and changing conditions. At the Capital Market Day on 14 May 2007, Dr.-Ing. Bernd Bohr, chief executive of Robert Bosch GmbH, explained how the supplier is successfully meeting these challenges. Prof. Dr. Hans-Jürgen Flüh, director of the Faculty of Automotive Technology and Aircraft Engineering at the University of Applied Sciences Hamburg, gave a number of insights into the aviation industry. Chairman of the Executive Committee Dietmar Bichler presented the half-year figures and described the current developments at Bertrandt.

Highlights of the first half year

Around 40 participants attended the 2nd Capital Market Day in Ehningen. To open the proceedings, Dietmar Bichler presented information to analysts, journalists and bank representatives on the key financial figures of the first half year 2006/2007.

Internationality and innovations

Dr.-Ing. Bernd Bohr presented a paper on global trends and explained which challenges the automotive industry will face in the future. In his lecture, he spoke about such topics as system networking, which can make a contribution towards avoiding accidents and protecting the environment.

The fascination of aircraft

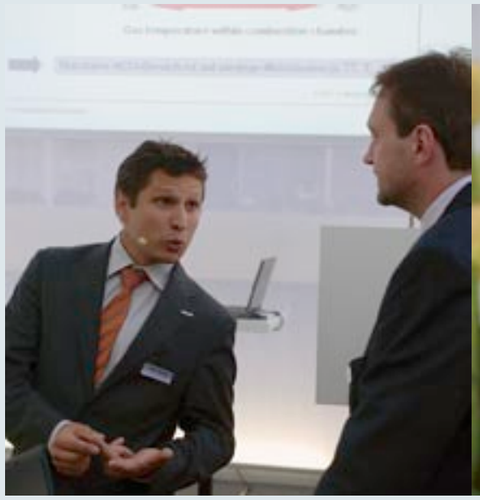
In his presentation, Prof. Dr. Hans-Jürgen Flüh gave a number of interesting insights into the world of aircraft engineering. He reported on the use of conventional lightweight materials and innovative fibre composites.

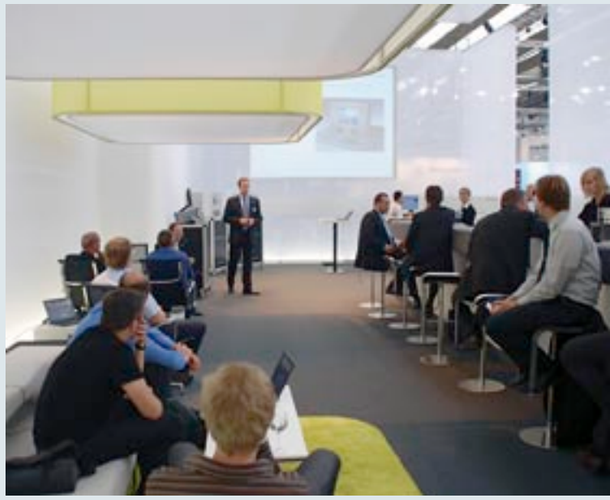
Trends and growth opportunities for Bertrandt

In conclusion, Dietmar Bichler discussed the current trends in the mobility industry and the ensuing opportunities for Bertrandt in the individual Competence Centres. Bertrandt sees further opportunities for growth in the context of the current market development. ■

Sandra Köhler, Ehningen

Experience Bertrandt: Hall 8, Stand A19





IAA 2007

As a high-performance partner for manufacturers and suppliers in the automotive industry, Bertrandt AG presented its expertise and services at the IAA International Motor Show in Frankfurt from 11-23 September. Once again this year, the company focused on providing both information and relaxation for visitors under the motto “Recharge your Batteries”. In addition, special Competence Centre days were held for the first time from 17-21 September, and included a variety of exhibits and expert presentations.

Communication in a lounge atmosphere

“Recharge your Batteries” was the motto of this year’s stand concept. The focus was on informative discussions in a pleasant and relaxing lounge atmosphere, and this was supported by the stand design and catering. Customers and business partners clearly enjoyed this relaxing environment. For several years now, Bertrandt’s stand concept has been successful in providing an oasis of relaxation within the mega-event that is the IAA.

Presentation of the Competence Centres

In order to provide an even more individual service for its customers, Bertrandt founded Competence Centres in 2004, and new ones have been added over the past three years. During the week when the show was open to the public, the various Competence Centres were once again explicitly presented to customers and business partners. A wide range of exhibits and presentations from the Competence Centres for Electrics/Electronics, Interior/Design Services, Powertrain, Body-in-White, Simulation and Testing & Trials gave the visitors an overview of the wide range of services offered by Bertrandt. A further highlight was the “French Day”, which offered visitors an interesting insight into the company’s decades of engineering experience on the French market. This day in particular and the IAA as a whole were very inspiring, above all for Bertrandt’s French colleagues, who were able to make interesting customer contacts.

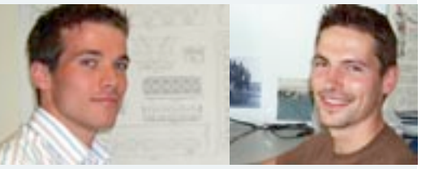
Fascinating exhibits and presentations

The exhibits presented by the Electronics Competence Centre included a real-time demonstrator and a newly developed, dynamic radio station landscape. In addition to its exhibits, the Interior/Design Services Competence Centre gave presentations on such subjects as “Module Development in the Vehicle Interior” and “Function Development”. While the Powertrain Competence Centre showed exhibits on key aspects of vehicle powertrains, Bertrandt engineers gave lectures on the latest issues relating to testing, simulation and the Body-in-White, including such subjects as vehicle acoustics and tolerance management.

Successful Concept

Well-informed customers and business partners, intensive networking and interesting conversations were the pleasing result of this successful concept. The Bertrandt stand was never short of visitors, both on the trade days and during the week when the show was open to the public.
After so much success and positive feedback, we are already looking forward to the next IAA! ■

Sandra Köhler, Ehningen



Andreas Thumm (left)
- Since 2004: student of vehicle/ system engineering, BA Stuttgart
- Currently writing his diploma thesis in the powertrain sector
- Career preference: Development Engineer

What do I like about Bertrandt?
With regard to the working atmosphere, I really like the friendly relationship I have with my colleagues and supervisors.
As far as my training and studies are concerned, I greatly benefited from the broadly based and varied range of work within the Bertrandt Group.

Benjamin Drechsler (right)
- Mechanical Engineering, Manufacturing Technology, University of Mittweida
- Diploma student in the field of Testing/Vibration Technology
- Career preference: Development/Testing Engineer

What do I like about Bertrandt?
The broad range of activities and the friendly colleagues. Working together in teams is very good and the communication channels are short.

University Marketing

Contact events: good platform for a future career at Bertrandt

Managers and engineers from Bertrandt answer questions from potential employees at more than 50 university events – just one of the many ways to get into contact with students at an early stage.

Three years have gone by since the young school-leaver Andreas Thumm first made contact with Bertrandt at a recruiting fair. Now a student at the vocational academy, he is currently writing his diploma thesis to advance his own developments in the field of engine development. Such meetings between pupils, students and Bertrandt employees are just one example of the company's highly productive participation in recruiting events. Bertrandt recruiters visit more than 50 university events a year to provide information about the various career opportunities at the company. In addition, Bertrandt's extensive university marketing activities are rounded off by excursions, events and sponsoring. A special highlight this year is the support for the Formula Student teams of the BA Ravensburg, the HAW Hamburg and the FH Braunschweig/Wolfenbüttel, who already took part in the international university competition last year with the involvement of Bertrandt.

Bertrandt's "young stars" at work

Besides Andreas Thumm, Benjamin Drechsler is another of the almost 150 students at the Bertrandt Group who are gaining valuable practical experience within the framework of their studies. Both students are working on diploma theses with a highly practical relevance. Like many other students, they got to know Bertrandt at one of the many recruiting events – and were immediately impressed. ■

Markus Chrustowski, Melanie Schulze, Ehningen

Bertrandt in Brief

+++ "Newspapers at School" Project

In November 2006, Bertrandt took part in the "Newspapers at School" project, which aimed at making school pupils familiar with newspapers as a sector of the media. Interested pupils had the opportunity to carry out research directly at Bertrandt sites. Their stories were then published. +++

+++ Bertrandt in the Magazine "Wirtschaftswoche"

According to a wide-ranging study carried out the business magazine "Wirtschaftswoche", Bertrandt is in 30th place in the list of the companies in Germany with the strongest growth. This makes Bertrandt one of the top job creators in 2006, well ahead of several renowned companies. +++

+++ Aviation

On 27 January 2007, Bertrandt AG acquired a 33.33 percent stake in EUROAER GmbH, whose services cover the entire process chain of aviation development. This move consolidates Bertrandt's Tier 1 status with the aircraft manufacturer Airbus. +++

+++ Accreditation

Bertrandt is undergoing the re-accreditation of its testing and laboratory facilities, which have been accredited since 2003. As part of this process, the range of services has been expanded by the addition of vehicle safety and environmental simulation. +++

+++ Bertrandt Services GmbH

Since February 2007, Bertrandt has been offering customer-related human resources concepts via its subsidiary Bertrandt Services GmbH. Within the growth sectors of electrical engineering, energy, IT, mechanical engineering, medical technology, pharmaceutical/ chemical engineering, telecommunications and insurance/banking, the focus is on long-term partnerships in the technical and commercial fields. +++

+++ Future Day

On 26 April 2007, Bertrandt's Future Day gave young people the opportunity to expand their choice of a future career by considering a job in engineering. Bertrandt in Wolfsburg provided its guests with interesting insights into practical work. +++

+++ Certification

Bertrandt's management system, which has been certified since 1997 and which was again successfully confirmed at several sites by the certifying body DEKRA in June 2007, secures the company's competitiveness and fulfils the requirements of the target markets. The monitoring process included the ISO 9001 quality management standard, the ISO 14001 environmental management standard and the ISO 27001 Code of Practice for Information Security Management and VDA prototype protection. +++

+++ Specialist Conferences

As a development service provider, Bertrandt recognises trends and helps to design the future. Specialist conferences are a good opportunity to communicate the range of services to interested visitors. At the specialist conference "Progress in Automotive Electronics" in July 2007, Bertrandt presented subjects such as networked system developments and process know-how for individual customers on the basis of three exhibits. +++

+++ Quarterly Report

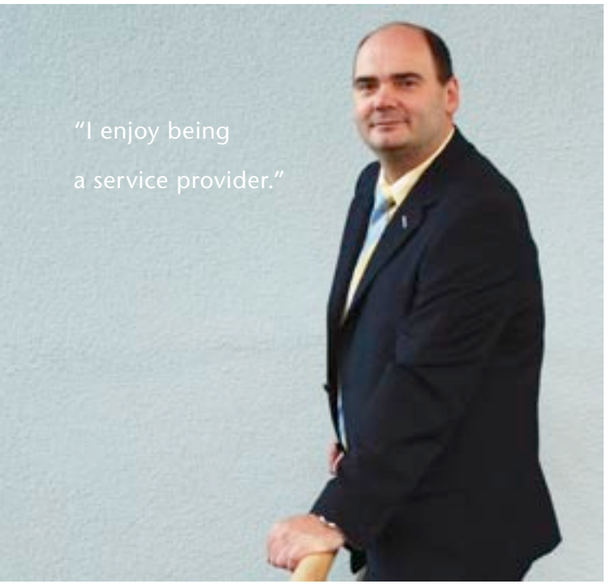
The Bertrandt Group was able to continue its dynamic development. After the first three quarters of financial year 2006/7, sales were 246,814 TEUR. Compared to the previous year, this corresponds to an increase of 42 percent. EBIT was 21,477 TEUR, an increase of 118.2 percent over the same period of the previous year. On 30 June 2007, Bertrandt had a workforce of 4,362 employees. (30.09.2006: 3,577). +++

Corporate Calendar

04.12.2007	bonding, Hamburg
05.12.2007	VHK Forum Munich (TU)
06.12.2007	Balance Sheet Press Conference, Stuttgart
06.12.2007	Analysts Conference, Frankfurt a. M.
07./08.12.2007	Euromold, Frankfurt a. M.
10.-12.12.2007	bonding, Aachen
06./07.02.2008	Euroforum Electronic Systems in Motor Vehicles, Munich
February 2008	Quarterly Report to 31.12.2007
13.02.2008	Annual General Meeting, Sindelfingen
05./06.03.2008	VDI Knowledge Forum: Plastics in Automotive Engineering 2008, Mannheim
21.-25.04.2008	Hanover Fair (Bertrandt Services)
Mai 2008	Quarterly Report to 31.03.2008
08. Mai 2008	3. Capital Market Day, Ehningen
August 2008	Quaterly Report to 30.06.2008

Jürgen Michels

"The automotive industry is exciting. There's always something happening that you need to be prepared for. Routine is not an option in our industry." Jürgen Michels (42) speaks from experience. He has been working for Bertrandt for twenty years now – gaining two decades of experience in the mobility business for a world that is always on the move.



In these two decades, Bertrandt has developed from being an engineering service provider to become a partner for the international automotive and aviation industries, combining all steps of the product development process into holistic solutions. Jürgen Michels helped to advance this process in his field. Today, as Managing Director, he is responsible for development and positioning at Bertrandt Technikum GmbH and Bertrandt Ingenieurbüro GmbH in Hamburg.

He has fond memories of his early days in the company. "My first job was as a designer in Stuttgart in December 1987 and I really got off to a good start at Bertrandt," Michels says looking back. He was quickly promoted to project leader for engines and subassemblies and within his first ten years with the company he rose from department head to become Managing Director of the Stuttgart office. In this post, he moved to Bertrandt Ingenieurbüro GmbH in Sindelfingen in 1997, which is today the Technikum in Ehningen.

This was followed by the period of the first end-to-end vehicle development. Under his leadership, several Bertrandt offices took responsibility for developing a ready-to-drive prototype, which was then presented at the International Motor Show in Frankfurt in 1999. "During the development of the Bertrandt Competence Car (BCC), we worked outside reality," Jürgen Michels recalls. "The BCC not only includes a great deal of engineering expertise, it also represents a lot of the emotions of those who worked on it. It was a fantastic experience."

Although it was something of a sensation at the time, the Bertrandt engineers succeeded in repeating this achievement in 2002, with the complete development of the smart crossblade. Today, derivate development is the highest aggregation stage of Bertrandt expertise, in addition to complex module developments and the many services that are related to the development process. In this context, Jürgen Michels also proudly remembers the Mercedes-Benz CL-Coupé. "A technical highlight in every respect, and one in which we were able to live up to our most essential priority: fulfilling the customer's wishes," Michels recalls.

What is important for him in his professional life? "Definitely sustainability, continuity and openness," Michels answers without hesitation. And this also applies to his management team. Although they have considerable freedom to act independently, he expects clear statements from them and does not want "yes men" around him. "I am responsible for implementing our strategy," says Michels. He is fully aware that discussions can be controversial at times. "But at the end of the day, we need robust decisions that take us a step further."

When asked about other formative experiences, Jürgen Michels mentions his time as a member of the managing board. For four years, he shared the responsibility of running the Bertrandt Group at the highest level, before deciding to return to being head of various subsidiaries. "I wouldn't want to have missed this time for the world, but I realised that I really enjoyed working in an operative environment. Close contact to the customer, developing new ideas and finding solutions – that's my world."

Close contact to the customer, especially at an international level, also requires flexibility, and Jürgen Michels had first-hand experience of this in his projects at the French subsidiaries. "At first, I was surprised at how Germany is seen from the French perspective," Michels remembers. Positive words such as "diligent" or "hard-working" were accompanied by less flattering terms such as "inflexible" or "boring". "This intercultural experience deepened my understanding of different perspectives and cultures and it definitively expanded my awareness," says Michels, recalling his experiences abroad.

The most recent highlight for Michels was the opening of the Hamburg office, which is mainly involved in serving the aviation industry. "The customer is a different one, but we can set a lot of things in motion in the aircraft industry too," Michels says with a smile, as he was the one who initiated this latest expansion of Bertrandt's customer portfolio.

As a keen paraglider, his involvement in the field of aviation is just as close to his heart as automotive development. But in spite of this indirect link between his hobby and his professional focus, paragliding still offers him welcome relaxation from his strenuous job. "When I'm in the air, I have time for myself, I can relax – and I can still see my partner, at least from a distance," he says jokingly.

And, when he's back on solid ground, Jürgen Michels enjoys his old farmhouse and his garden. There's always something to keep him busy. "I suppose I'm just a person who likes to get things done," says Jürgen Michels – both in private and professional life a man of commitment, drive and passion. ■

Anja Schauser, Ehningen

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