

Bertrand*magazine*

No. 14 | September 2014



TESTING AND VALIDATION

Many years' experience of project planning and integration

MERCEDES-BENZ ACTROS, ANTOS AND AROCS

Developing the cab side module

ColognE-mobil

Electric vehicles for urban roads

RENAULT CLIO 4

From design to volume production

EDITORIAL
INFORMATION

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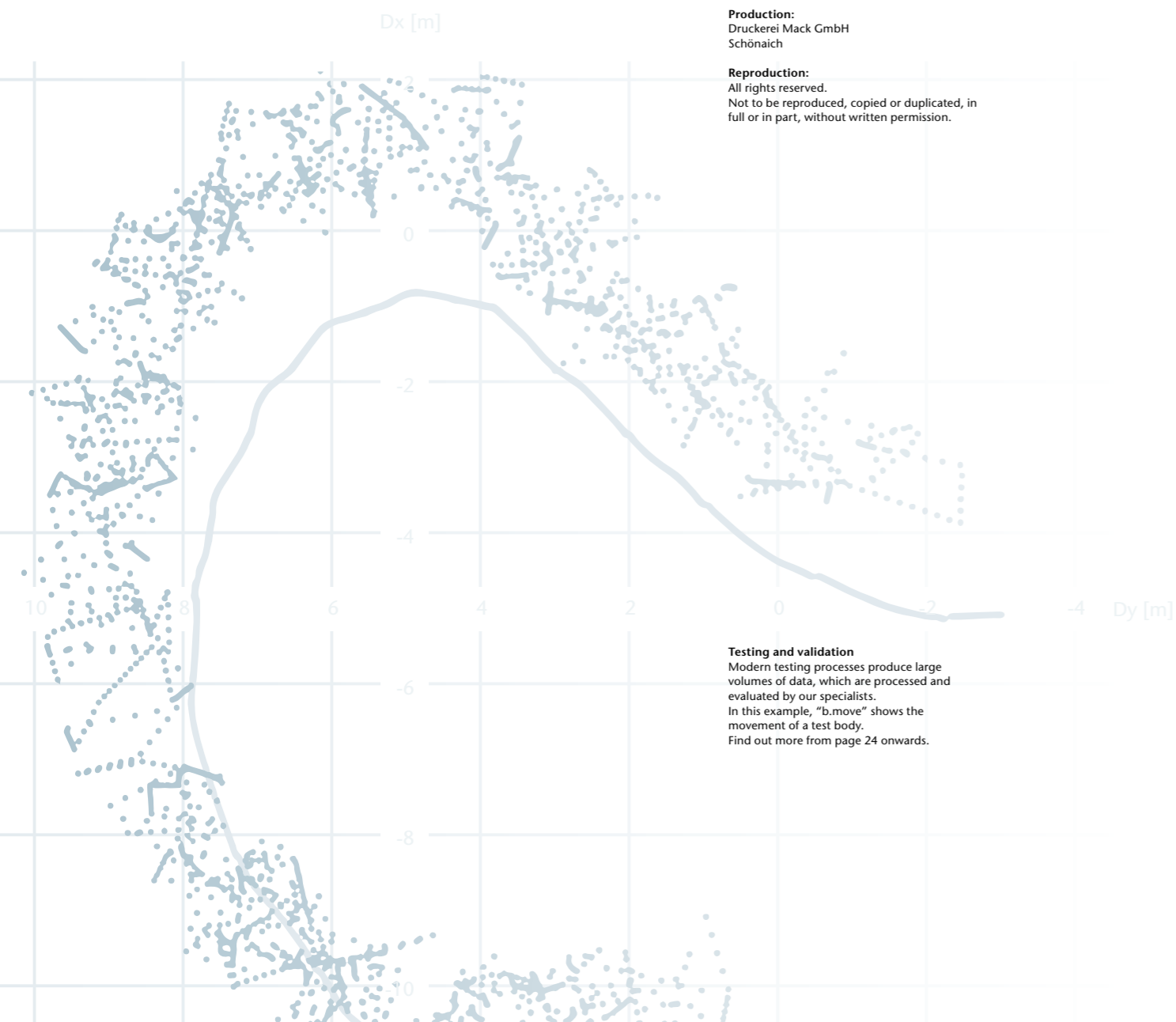
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Testing and validation
Modern testing processes produce large
volumes of data, which are processed and
evaluated by our specialists.
In this example, "b.move" shows the
movement of a test body.
Find out more from page 24 onwards.



EDITORIAL

Dear reader,
Innovation and a global presence are key
success factors in the automotive industry.

If we look first at innovation, it becomes clear that the main market players are keeping pace with current trends for environmentally friendly transport, safety, comfort and networking by developing forward-looking concepts. As a technology specialist, we provide our customers with support for the development of modern products and solutions in all areas of vehicle manufacturing. The main theme of this issue is our testing and validation department. Take a tour around our state-of-the-art testing facilities, which are constantly under development and consistently meet high standards of quality and performance. In the magazine we also present our portfolio of connectivity services with the slogan "Integration. Communication. Electronic intelligence." Our in-house low-cost engine is an alternative concept for the development of environmentally friendly mobility solutions. Our wide variety of development services are reflected in our customer projects, such as the comprehensive development support for the Renault Clio 4 and the creation of a cab side module for the new range of Daimler trucks. We are also playing a prominent role in the "colognE-mobil" project, which involves designing electric transport solutions for urban areas. If we now turn to Bertrandt's global presence, we can see that the group is continuing to grow in parallel with its customers in Germany, in Europe and in the rest of the world. We have opened new sites in Stuttgart and Hanover and extended some of our existing facilities. Our site in Hungary enhances our European presence and we have recently established a second location in China in the city of Changchun.

I hope you enjoy this opportunity to
find out more about Bertrandt.

Dietmar Bichler



MERCEDES-BENZ
ACTROS, ANTOS
AND AROCS



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ColognE-mobil



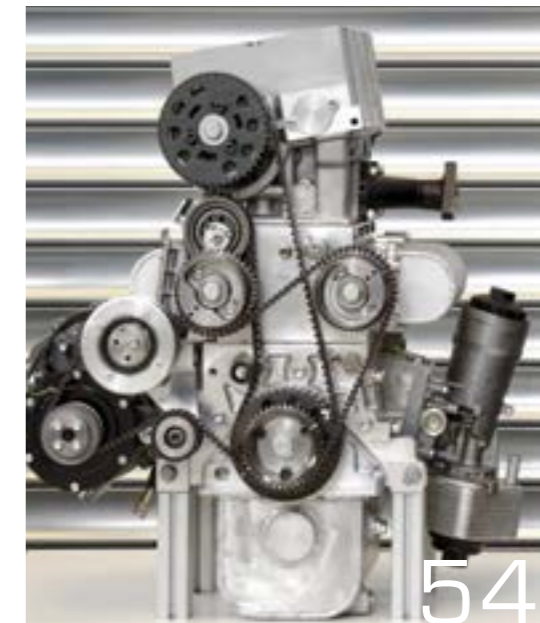
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EXTRA

Enclosure:
"Bertrandt's development services at a glance"



Bertrandt Group

AUTOMOTIVE SUPPLIER OF THE YEAR 2012 AWARD FROM CONTINENTAL

The Automotive Group of the international automotive supplier Continental has presented its Automotive Supplier of the Year 2012 Award to 13 of its more than 900 strategic suppliers in recognition of their outstanding services in a variety of areas. Bertrandt was rated the best supplier in the field of engineering services. ■

Bertrandt Group

FINALIST IN RECARO'S BEST SUPPLIER AWARD

Every year, the aeroplane seat manufacturer Recaro Aircraft Seating recognises its best suppliers with the Recaro Supplier Award. During Recaro's international supplier conference in Hamburg, Bertrandt was presented with the award in the non-production material category, putting it among the top three in a group of 100 of the most important

Recaro suppliers worldwide. The award is based on regular assessments of quality, adherence to deadlines and efficiency. ■



Bertrandt Group

AMONG THE TOP FOUR ON THE EUROPE'S 500 LIST

Europe's 500 is the European organisation and networking platform for growth companies and their entrepreneurs which identifies the most successful European companies. Its ranking process is based on analysing several criteria, such as entrepreneurial commitment, independence, turnover and growth. In 2013 Bertrandt was ranked in fourth place on the list of Europe's 500 fastest growing companies. ■

Design Modelling and Rapid Technologies

STEERING WHEEL EXHIBIT DEMONSTRATES CFRP EXPERTISE

The steering wheel is a key design element of vehicle interiors. For many years the rim and the hub of steering wheels had relatively simple designs. Recently these components have become much more sophisticated with the addition of a range of control functions and beautifully crafted leather covers with decorative seams. Our technical product designers created a steering wheel hub cover in an in-house style and produced the accompanying component using CFRP as part of their final examination. The process of manufacturing the hub from CFRP fabric consisted of a number of stages including the design draft, the surface design, CAD development, CNC programming, milling, finishing, hand trimming, documenting the measurements and applying the final coating. ■



Vehicle Body/Interior Development

B.MOTION GESTURE CONTROL SYSTEM

The growing number of infotainment systems in vehicles brings with it an increasing risk of drivers being distracted. When using conventional controls, drivers have to look at the buttons or switches, but new concepts offer alternative methods which allow drivers to keep their eyes on the road. Bertrandt identified this new trend and developed an initial prototype for a concept based on a gesture control system. This enables drivers to control functions using hand movements without taking their eyes off the road ahead. A 3D motion sensor identifies the gestures and evaluates them for plausibility before converting them into commands for the corresponding functions. The integration of a sensor into the central armrest not only ensures that the functions are easy and ergonomic to use, but also enables the driver's hand to be positioned precisely in the sensor's detection field. ■

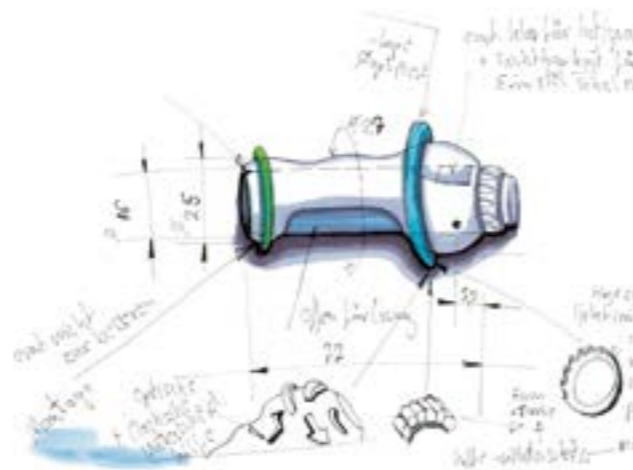
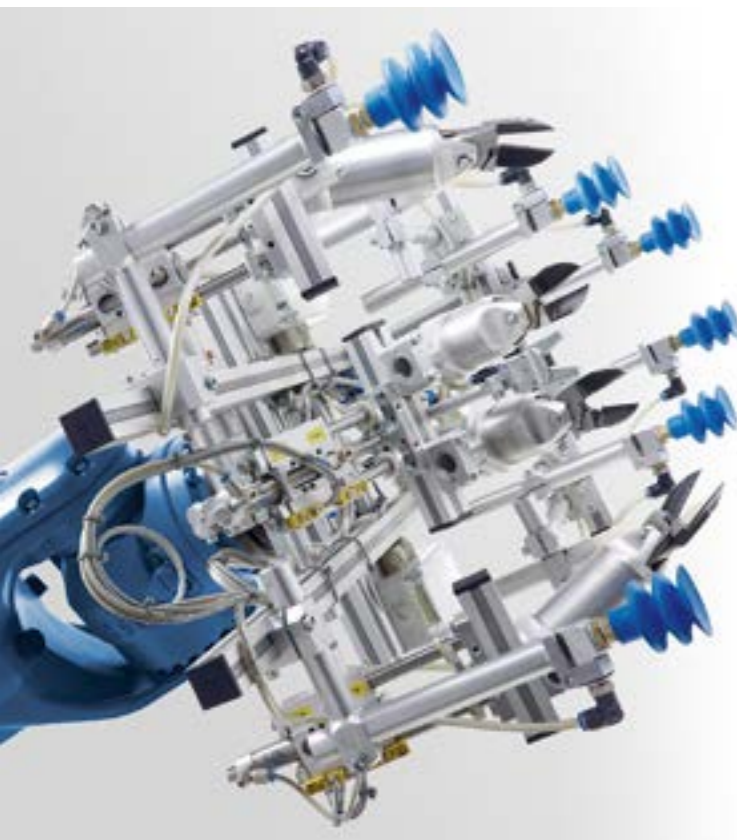


Bertrandt Services Cologne

DESIGN FOR ROBOT ARM

Our design services are in demand in the field of automation and robotics. ASS Maschinenbau GmbH in Overath designs complete robot arms using standard and specially produced gripper mechanisms to meet the individual requirements of customers' automation systems. The focus of the development process is on compliance with the EU machinery directives, maintaining high standards of quality and producing lightweight, standardised structures. Bertrandt Services Cologne provides development support for the company in a range of areas:

- Developing robotic hands and storage stations for automotive components
- Designing special robotic hands
- Producing technical drawings
- Project management (from the project handover and customer support through to production)
- Drawing up documentation in accordance with the manufacturer's regulations
- Creating parts lists



Bertrandt Services Frankfurt

DESIGNING CUSTOMISED GRIPS FOR AN INSULIN PEN

New medicines and innovative medical products help to improve our health and our quality of life. Our customer has the world's largest insulin production facility which is equipped with state-of-the-art biotechnical manufacturing systems. The company also produces the accompanying medical products, known as pens, for administering insulin.

Bertrandt Services Frankfurt was closely involved in developing a new design of insulin pen for different patient groups (children and elderly people). The tasks included:

- Market research
- Preparing the concept and the design
- Selecting materials
- Developing and designing the product with a focus on usability
- Documentation
- Surveys of target user groups
- Constructing a prototype (rapid prototyping)

Bertrandt Services Stuttgart

DEVELOPING A FLEXIBLE CONTROL SYSTEM

Bertrandt Services Stuttgart creates a modern control function

The starting point of this project was an existing demonstrator for driver assistance systems which we developed and implemented in collaboration with Bosch. The demonstrator was operated using a hard-wired control panel with pushbuttons. Bertrandt Services Stuttgart was commissioned to develop a more flexible control system.

Increased flexibility and reduced costs

The existing demonstrator is based on a PLC software package (Beckhoff TwinCat) running on a laptop. After considering a number of approaches, we opted to control the demonstrator via an industrial PC. In the current system, the PC controls the I/O level via EtherCat and also functions as a streaming server for HD videos, so it needs to offer a certain minimum level of performance. We chose a 9.7" tablet as the actual operating device, which has a compact, modern design and is flexible and easy to use. It can also be placed on a conventional tablet stand and used for presentation purposes at industry exhibitions. Using this inexpensive consumer hardware item gives our customer a great deal of flexibility while keeping costs to a minimum.

Short development period

The decision to connect the HTML system and the PLC using an XML interface file also proved to be a highly flexible solution. XML files are used to store data and can be processed by the HTML system and the PLC. There is a clear dividing line between the operating side (HTML) and the control side (PLC). The XML file can function as an independent interface file or as part of an existing database. The data can be processed and evaluated in all common programming languages. Another benefit of the control concept is the distribution of planning tasks across the company, which allows the project team's capacity to be used as efficiently as possible, depending on the availability of resources. Parallel processing also guarantees a very short development period.



Virtual world:
Visualising driver assistance systems.



Exhibition presentation using the control tablet.

FRANKFURT MOTOR SHOW

At this prestigious event, Bertrandt was able to demonstrate its development expertise using a range of different exhibits. The highlight was the full-LED headlight developed by departments across the entire Bertrandt Group. On the days when the show was open to the general public, Bertrandt presented other prototypes produced by the powertrain, design modelling, electronics, vehicle body/interior development and testing departments.

22ND AACHEN COLLOQUIUM AUTOMOBILE AND ENGINE TECHNOLOGY

At the heart of Europe's largest congress on the subject of vehicle and engine technology, our powertrain experts presented a driving dynamics simulator and a scroll-type supercharger.

SUPPLIER SHOW FOR MECHANICAL ENGINEERING (FMB)

At the FMB the focus was on the development of special machines. Bertrandt Services exhibited its automated sample changer.



Frankfurt Motor Show.



22nd Aachen Colloquium.



Vehicle electrical systems congress.

INTERNATIONAL SYMPOSIUM ON AUTOMOTIVE LIGHTING

Specialists from Bertrandt's light and visibility team were much in demand at ISAL, the world's most important symposium for automotive lighting.

VDI - AUTOMOTIVE ELECTRONICS IN FOCUS

The electronics development department put its own exhibits on display, including the e-scooter and the b.on web server, to illustrate the team's development skills.

CEBIT

Bertrandt Services and specialists from the electronics development department presented the b.on exhibit in Hanover. This system performs a central role in enabling a variety of different components to communicate and interact.

SPECIALIST CONGRESS ON VEHICLE ELECTRICAL SYSTEMS

At the congress, Bertrandt's animations of vehicle electrical systems proved to be highly popular and the electronics development experts were in great demand.

VDI - PLASTICS IN AUTOMOTIVE ENGINEERING

Bertrandt presented its development skills at the conference on plastics in automotive engineering in Mannheim. The vehicle body/interior development department put on display the innovative cockpit of the Audi A7 with the in-house gesture control system.

AIRCRAFT INTERIORS EXPO

The central theme of the exhibition in Hamburg was innovations in the field of aircraft interiors. The members of the Bertrandt Hamburg team were available to answer visitors' questions on all aspects of aviation development. The quadcopter exhibit with the inertial sensor system for flight attitude stabilisation developed by Bertrandt was the perfect illustration of Bertrandt's technological expertise. Inertial sensors play a key role in a number of applications including air navigation.



Hanover Fair.



Aircraft Interiors Expo.

HANOVER FAIR

Bertrandt Services and the specialists from the company's electronics team worked together to present an all-purpose software control package which demonstrates long-term load and functional tests using the example of a robot system. Other highlights included the b.on exhibit and our video on connectivity.

ADVANCES IN AUTOMOTIVE ELECTRONICS

Visitors to the ground-breaking congress in Ludwigsburg were keen to discuss a variety of subjects with the specialists from Bertrandt's electronics development team.

DEVELOPING THE CAB SIDE MODULE FOR THE ACTROS, ANTOS AND AROCS

Bertrandt supports the development of the new range of Daimler trucks

From January 2010 to October 2013, our engineers designed and developed complex components for the cab side module of the new range of heavy-duty trucks. The majority of the work was carried out by the vehicle body development department.





Actros: Long-haul truck.

25 years' experience of truck development – Bertrandt and a partner take responsibility for project management

The services that we provided included virtual CAD development of the external components, such as panels, toolbox, wheel arch extensions and top and bottom steps with tread plates, using CATIA 5. Our involvement began during the concept phase and continued through pre-production and production design, tolerance management and the creation of functional models and prototype tools to support the development process. The wide variety of materials used, such as SMC, thermoplastics, PUR-RIM and steel, presented a challenge for our team's design skills. Working together with a partner, our engineers were responsible for managing the project, which included coordinating with all the relevant technical departments in Untertürkheim and at the production site in Wörth.



Arocs: Designed for the construction industry.

Our role also involved project support activities, for example creating presentation documents for decision-making meetings and preparing drawings of individual parts, assemblies and arrangements. The creation of a monitoring function within the team enabled us to ensure that the drawings met the client's high quality standards.

Modular system – the key difference from car development

The design process is different from that of a car body, because the very large number of variants of truck models puts greater demands on the entire project team. In contrast to a car, there is not just one wheel arch, but several different versions as a result of the varying chassis designs, cab variants, body heights and tyres. The challenge lies in using identical parts wherever possible, despite the different models. In consequence, if a com-

IN BRIEF

Mercedes-Benz Actros, Antos, Arocs

Exterior development and design

- Side module
- Door with peripherals
- Validating the installation space (packaging)
- Concept creation
- Variant management
- Producing 3D data

Interior development and design

- Floor and tunnel covering
- Insulation

Documentation

- Presentation documents
- Drawings
- Preparing for approvals

Design modelling and rapid technologies

- Clay models of the interior
- Data control models of the interior
- Mock-up of cab variants and presentation in Ehningen
- Prototype parts and functional models with testing

Electronics development

- HiL testing of the central electronics system
- HiL testing of lighting functions
- Network and electrical system tests
- Integration of the diagnostic tool chain
- Diagnostic data population/validation
- Coding data management

Engineering services

- Project management
- Data management
- Supplier integration



Antos: Ideal for heavy-duty distribution.



Scope of development work for the side module:

- Top step assembly
- Bottom step assembly
- Tread plates
- Wheel arch extensions
- Top panel
- Bottom panel

ponent is improved, for example, by changing a bolted joint on the basis of test results, all the variants of that component also have to be modified. The task of our team was to evaluate the impact of an improvement of this kind on all the different versions of the parts at an early stage and to implement the change efficiently.

Successful cooperation between all the participants

Our engineers took up the challenge and provided Daimler with development support services for this exciting project in close collaboration with our partner. We would like to thank everyone involved for their friendly cooperation.

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ELECTRIC VEHICLES FOR URBAN ROADS



Bertrandt Cologne – a reliable project partner

The “colognE-mobil – electric mobility solutions for North Rhine-Westphalia” project is based on the vision of Cologne as an e-city. It involves all the main local transport companies and public transport networks and aims to launch a pilot electric transport scheme. The central focus of the project is a comparison between battery electric vehicles and plug-in hybrids. Its goals include using locally produced regenerative energy to reduce the amount of CO₂ emissions on transport routes within urban areas and improving the charging infrastructure.



“Electric transport from the runway to Cologne Cathedral” – A pilot electric transport project.

Project management experience needed

Since August 2012, Bertrandt has been responsible for the project management of the colognE-mobil project. This includes planning and coordinating the four different steering and decision-making committees and organising a range of public project events in North Rhine-Westphalia. The project partners are Ford-Werke GmbH, RheinEnergie AG, the City of Cologne, Duisburg-Essen University, Kölner Verkehrs-Betriebe (the Cologne public transport company), Regionalverkehr Köln GmbH (the Cologne regional transport company), Cologne/Bonn airport, TÜV Rheinland (the international certification company), Taxiruf Köln e.G. (Cologne taxi company), DB Rent GmbH (vehicle rental company), the regional photovoltaic firm Energiebau Solarstromsysteme GmbH and TRC Transportation Research & Consulting GmbH. Bertrandt acts as the central point of contact for all the project partners and provides Ford with active project management support across the whole project.

Commercial services throughout the value chain

In addition, Bertrandt is also responsible for managing the project budget and finances. The project receives 7.5 million euros of funding from the German Federal Ministry of Transport, Building and Urban Development (BMVBS). Bertrandt not only manages the internal customer processes, but is also in constant contact with the funding body. Bertrandt Cologne’s project responsibilities cover the entire value chain, including the project application, drawing up and awarding contracts, coordinating the funding calls and the customer’s internal accounting, procurement and logistics processes.

IN BRIEF

colognE-mobil

Engineering services

- Quality management
- Project management
- Coordinating the partners
- Technical/administrative support
- Supporting/representing the consortium head
- Coordinating the four decision-making committees
- Contract management
- PR activities
- Managing communications
- Interface management
- Budget coordination
- Financial analysis
- Creating financing models
- Coordinating with the funding bodies
- Analysing data from the CAN bus
- Data evaluation
- Validating the raw data
- Correcting errors by modifying the algorithms
- Identifying new parameters
- Determining the existing parameters
- Visualising the data
- Creating new algorithms to produce the necessary evaluations
- Supporting the accompanying scientific research

Testing

- Measuring insertion forces
- Measuring connectors



colognE-mobil – City logistics with battery electric vehicles.

Recording and analysing data

Bertrandt also manages another important aspect of the project: recording the data. Each of the 66 project vehicles (Transit BEV, Transit Connect BEV, Focus BEV, C-MAX PHEV and Mondeo PHEV) is equipped with a high-performance data capture system that records all the technical vehicle data. The first step in the process was to define the parameters used for capturing the data, in order to meet the requirements of the planned analysis framework. GPS data is also recorded and transmitted to a central server in real-time via the mobile data network, together with the data from the control units. The Bertrandt Cologne team displays this data using a special software package and evaluates it. The most important figures, alongside the overall consumption of the vehicles, are the consumption of the auxiliary equipment, which has a much greater effect on the overall consumption levels in an electric vehicle

than it does in a conventional car with a combustion engine. More than 150 parameters are recorded every second. The data recording process forms the basis for several other research activities that are part of the overall project. These include assessing the different usage profiles (commercial, taxi, car sharing etc.) and comparing them with the technical aspects, such as energy consumption and range. Using this information, a requirements profile can be drawn up and the suitability of the vehicles for everyday use can be evaluated.

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RENAULT CLIO 4

FROM DESIGN THROUGH TO VOLUME PRODUCTION

The latest Clio sets new standards for style at Renault. It not only offers an impressive range of innovative equipment and features, but also meets the most recent safety and emissions standards. The Bertrandt Paris site was involved in the development of the new model from the initial design phase through to final production.

Bertrandt was commissioned by Renault to work on developing the saloon, estate and RS versions of the new Clio 4. The project began in 2009 and the Clio is now in production. Bertrandt provided Renault with a wide variety of design services. The wider wheel arches of the new Clio give it a more aggressive and sporty appearance. The use of more chrome trim and high-gloss paint creates a fresher, younger feel. In addition, it meets all the requirements for vehicle networking with its new multimedia console. The new city runabout is also slightly larger than its predecessor.



All-round view – the new Renault Clio 4.

Bertrandt – Renault's project partner

Bertrandt's French site made use of its entire spectrum of expertise from the design phase of the project to the start of volume production. In the early concept stage, Bertrandt designed a number of features and produced prototypes of chassis components. Furthermore, the members of the French team were able to make impressive use of their experience of starting up volume production. Specialists travelled to the Bursa plant in Turkey and the Flins plant in France to set up new processes. In addition to remaining within budget, Bertrandt also had to maintain Renault's existing quality levels, which played an essential role in ensuring that the new model was competitive. By providing reliable solutions, our experts proved to be a driving force behind the improvement of the assembly processes. With its cross-disciplinary vehicle development skills, Bertrandt made a valuable contribution to the project and also designed vehicle geometry components. As a result of our long-term coop-

eration with Renault, we were fully aware of the client's technical and financial needs, including working equipment, the requirements specification and adherence to schedules. It was also possible to achieve significant reductions in fuel consumption by introducing lightweight designs and improving the car's aerodynamics.

More comfort, better features

The image of Renault cars has been enhanced both inside and outside. On the exterior of the car Bertrandt was responsible for designing the roof rails and the accompanying production tool. The other design services we provided included improving the windscreen wiper and washer functions and the horn. Another impressive new feature is the reversing camera which is incorporated into the Renault badge. The interior has also been completely redesigned. The arm rests have a more elegant shape and the fully foldable rear seats create a completely flat load deck, which can be enlarged even further by fold-

IN BRIEF

Renault Clio 4

Vehicle development

- Door/closure mechanisms, seals, windows, interior/exterior mirrors and reversing camera, windscreen wiper/washer functions
- Vehicle geometry
- Interior
- Exterior
- Engine
- Engine compartment architecture
- Chassis
- Prototyping

Testing and validation

- Road tests
- Test rig tests

Support for the start of volume production

- Logistics
- Validating the assembly process and technical components
- Project management
- Supplier support



Interior – equipped for comfort.

ing down the passenger seat. During the process of developing these features, the regulations concerning whiplash and clearances were carefully followed. Each new equipment range also comes in a wider range of colours. One striking new feature is the multimedia console with integral GPS and the touch-screen R-link system. In this area, Bertrandt was responsible for creating a harmonious design and coordinating the new components with the centre console.

The new Clio is available with four different engines, one of them a new diesel that meets the Euro 5 emission standard. Bertrandt was commissioned to design the engine installation space in accordance with Renault's design regulations and the engine compartment architecture. During the design phase, the Bertrandt engineers ensured that the new design met vehicle safety and crash testing requirements. We were also involved in working on the chassis from the development phase onwards. In close collaboration with suppliers, our teams produced prototypes and carried out test rig and road tests.

Bertrandt also took responsibility for the start-up of volume production at the Turkish plant in Bursa. Bertrandt employees from the Istanbul site provided on-site support when production began in Turkey. Logistics processes were set up for the chassis production and assembly line in accordance with Renault standards and training was provided for the employees.

Conclusion

Bertrandt once again demonstrated its reliability as an engineering service provider from the design phase to the start of volume production. We were pleased to be able to take part in the development of this new model and would like to thank Renault for the trust they placed in us and for their cooperation.

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TESTING AND VALIDATION



In order to ensure their future viability, companies must constantly develop new solutions. Bertrandt tests and evaluates these ideas and concepts to the limit in real-life situations, to ensure high-quality, promising results for our customers. We also demonstrate our inventiveness by producing new and tougher test procedures and systems. The engineers and technical experts in our testing and validation department specialise in these areas.



Long-term experience of planning and integration

TESTING SERVICES AT BERTRANDT

Mario Cannata, Head of the Testing Competence Centre, discusses current issues in the field of testing and validation

» The testing and validation department at Bertrandt carries out uncompromising functional tests of customers' products and proposes potential improvements. Mario Cannata, you have the right business model to meet every customer's requirements, whether it is testing on the customer's site, at your own facilities, as a tailor-made operational support package or in the form of in-house development combined with test engineering. What milestones have you set for the development of your department? What will the benefits be for your customers?

I think that the essential milestones for the department involve constantly developing and extending our technical services across all the specialist areas. We set high standards of quality and performance and we are always up-to-date with the latest developments. Since it was first established, the testing department has diversified and developed. We not only provide start/stop testing services, we also have many years' experience of planning tests and integrating systems, modules and components

We set high standards of quality and performance.

throughout the product development process. This represents a major advantage for our customers.

» Bertrandt develops state-of-the-art, innovative testing systems and methods to test components and modules. What are the characteristic features of your department?

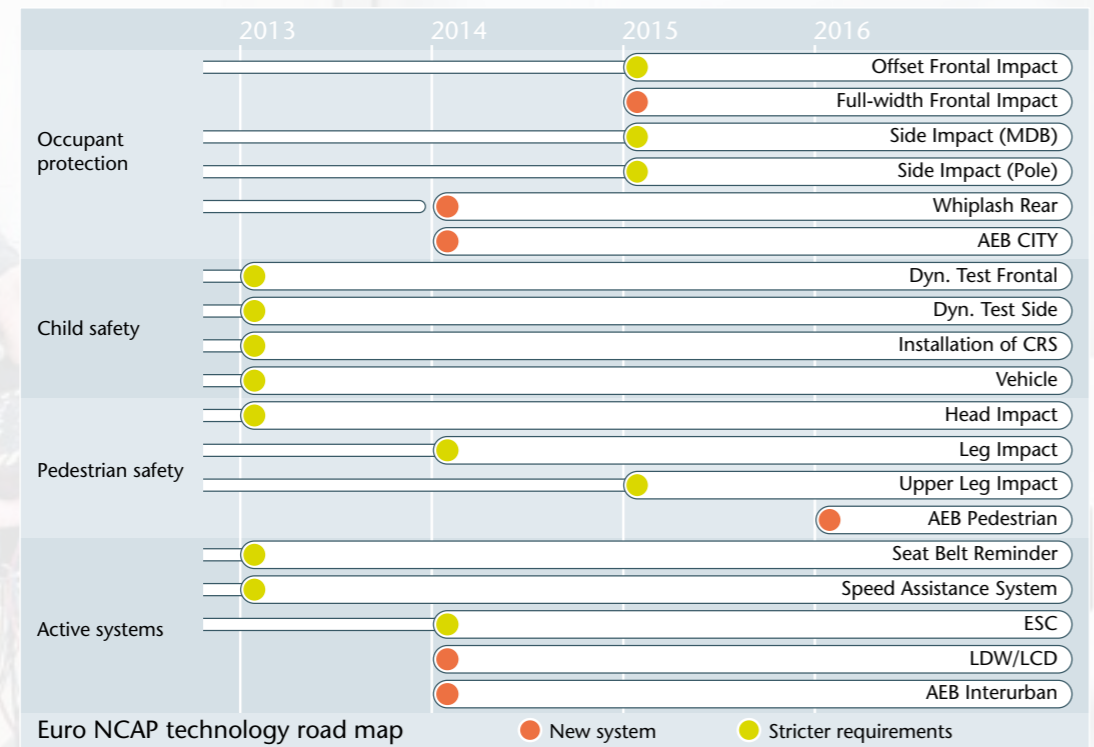
In order to provide an attractive spectrum of services for our customers, we are constantly developing new services and methods for validating components and modules, including robotics.

Our decentralised organisational structure and the resulting proximity to our customers enable us to be flexible and focus closely on our customers. This in turn allows us to extend and enhance our long-term, intensive cooperation with them. In addition, the department uses a range of approaches, such as tech days and competence centres, to investigate and evaluate testing methods and to bring them into line with new technologies and the latest trends. One important factor in this process is to ensure the sustainability of the testing department and to make use of our experience in order to improve efficiency and create new methods for testing and qualification. >

» Active and passive safety are becoming increasingly important and the focus is on preventing accidents. We are all aware of situations such as a child playing in the street who runs out from behind a parked car or another car which suddenly emerges from a side road. What services does Bertrandt offer in the field of active and passive safety?

As crash testing legislation and regulations have become more stringent, so the complexity of safety systems has increased. OEMs and OESs are moving forward in leaps and bounds in this area. It is clear from the Euro NCAP technology road map for 2014

that the focus is on whiplash rear and AEB city systems in the context of occupant protection and on lane departure warning/lane keeping devices and AEB interurban functions when it comes to active safety. Other systems need a new rating or a tightening of the regulations. Alongside quality, safety is the most important purchase criterion for end customers with a score of 96%. It ranks above price, fuel consumption and environmental considerations. More than 25% of all the innovations introduced are in this area. We only need to think of the experts' vision of accident-free driving and of the challenges that demographic change will present us with. >





Ensuring that older people remain safe on our roads, whether they are drivers, passengers, pedestrians or cyclists, will prove to be a major consideration for active and passive safety systems.

We have been overcoming challenges of this kind for years in our department and we are constantly developing new solutions and approaches for our customers and partners.

We cover all areas of classic passive safety and provide a comprehensive range of services from airbag testing and pedestrian safety through to low-speed crash testing and the safety of high-voltage vehicles.

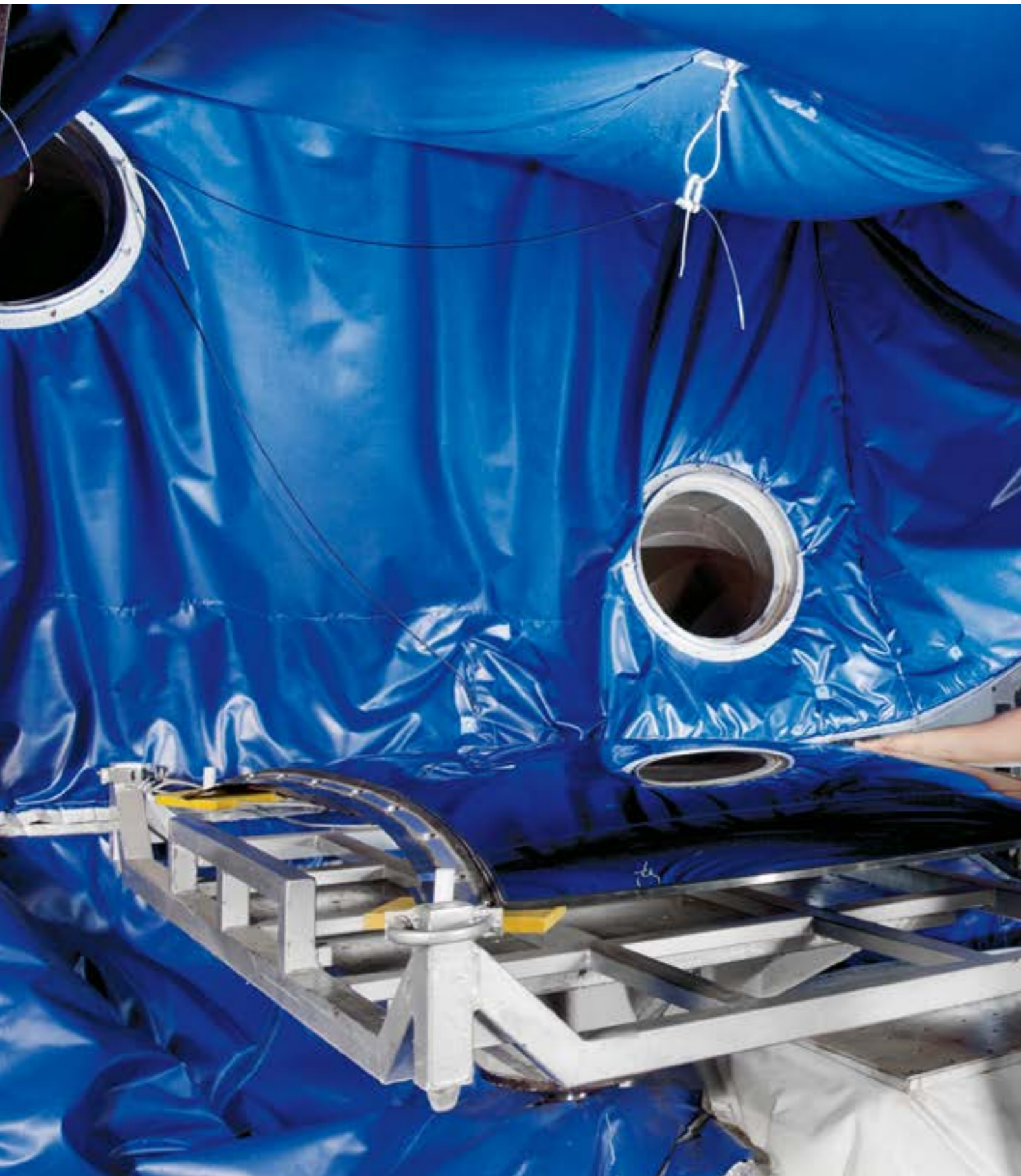
Our test engineers focus primarily on validating active vehicle safety functions in parallel and cross traffic. In this area we work on detailed test solutions using our in-house tools such as b.target, b.rabbit and b.wire. These are mainly used to trig-

ger safety functions and to test the performance of safety systems, such as emergency brakes or emergency steer assist functions. In order to make the measurements more objective, we also develop reference measurement strategies which correspond with the accuracy of the function and the environmental conditions.

Another major area of our work is field testing and designing the necessary monitoring systems which can automatically evaluate possible risks of functions being triggered by faults. Our accompanying endurance testing with the functional evaluation of all the basic conditions for the relevant sensor concept supports this process.

In summary, we test, evaluate and document all the findings, which allows us to make a confident recommendation that the component should be approved. We assess the accompanying risks and confirm the usefulness of the function which we have fully tested. >





» Subjects such as lightweight design, alternative drive systems, comfort and networking are currently under discussion within the industry. What impact does this have on the development services that your department provides?

Weight reduction or lightweight design affects every area of automotive development. Whether it concerns reducing the diameter of a wire, replacing conventional copper wiring with aluminium or using high strength steels for the exterior and interior of a vehicle or fibre composites in the body-in-white, reducing the weight of a car has far-reaching effects and direct links

to comfort and drive systems. Examples include the NVH behaviour and the acoustic requirements ...

Acoustics throughout the car are playing an important role for us. The demand for our testing services is high. This is because the impression of quality that a car conveys depends heavily on the customer's acoustic perception of it. Not only a rich, full engine noise combined with quiet running, but also the noises that people only hear subconsciously, such as the seat adjustment mechanism, warning signals or voice control functions contribute to creating a harmonious acoustic environment. >





Our test engineers ensure that modern vehicles sound good.

Therefore, these noises need to be carefully developed and improved. Our test engineers work to ensure that modern means of transport are not only safe, but also sound pleasant.

Acoustics relates to every part of a vehicle both outside and in: the bodywork, the exhaust system, brakes, wheels, tyres,

gearbox and engine. And another important consideration is the electric car, which presents us with highly complex acoustic challenges.

The growing networking trend is similarly demanding. The complexity here also lies in the detail and the impact on our department and on the industry as a whole is enormous. Alongside the technical challenges and the development of new testing systems and methods, our department also has to offer a wide range of specialist skills. In the past the majority of our employees had traditional backgrounds in mechanical and automotive engineering, but now they come from a variety of disciplines. >



» How do you plan to develop your department in future? Describe your vision for testing and validation. Which areas do you think you will be working in by 2020?

Achieving a successful, long-term position on the market involves being aware of the options open to you and making the most of opportunities as they arise. In order to implement a market development strategy of this kind, we need to understand our customers' requirements and incorporate them individually into our expansion strategy. In addition, the so-called technological mega-trends and

the resulting regulations and legislation will continue to drive technical advances.

The ambitious climate targets we have set ourselves and the accompanying reduction in CO₂ emissions will result in the need for extensive changes, including lightweight design, improved aerodynamics, engine downsizing and sophisticated energy management systems, such as auto start/stop functions and brake energy regeneration. Our aim is to provide the necessary test functions from our in-depth portfolio and to continue to expand our services. ■

The interviewer was Gudrun Remmlinger

Today we need a good mix of skills.

ACOUSTICS/ ELECTRIC CARS

Designing cars that make no irritating noises

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

Engine,
tyre and
wind noise

Irritating noises

Irritating noises
barely audible

Increased use of
electric vehicles



Increased
awareness

← Past

Future →

The challenge of electric cars and noise emissions

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

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

Preventing irritating noises during the development phase

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

Preventing irritating noise is already a well-established part of the vehicle development process. During the early phases of development, specialists detect and evaluate pos-

sible causes of irritating noise and take the necessary measures. As part of this process, it is essential to highlight possible risks and identify solutions to the problems during the creation of the concepts. As development cycles become ever shorter and the pressure to keep costs to a minimum increases, virtual evaluations of irritating noises are often ignored. Expert knowledge, experience and assertiveness are needed in this case. It is the job of the experts to differentiate between the different rattling and creaking noises and to identify the components that cause them.

Developing solutions

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

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

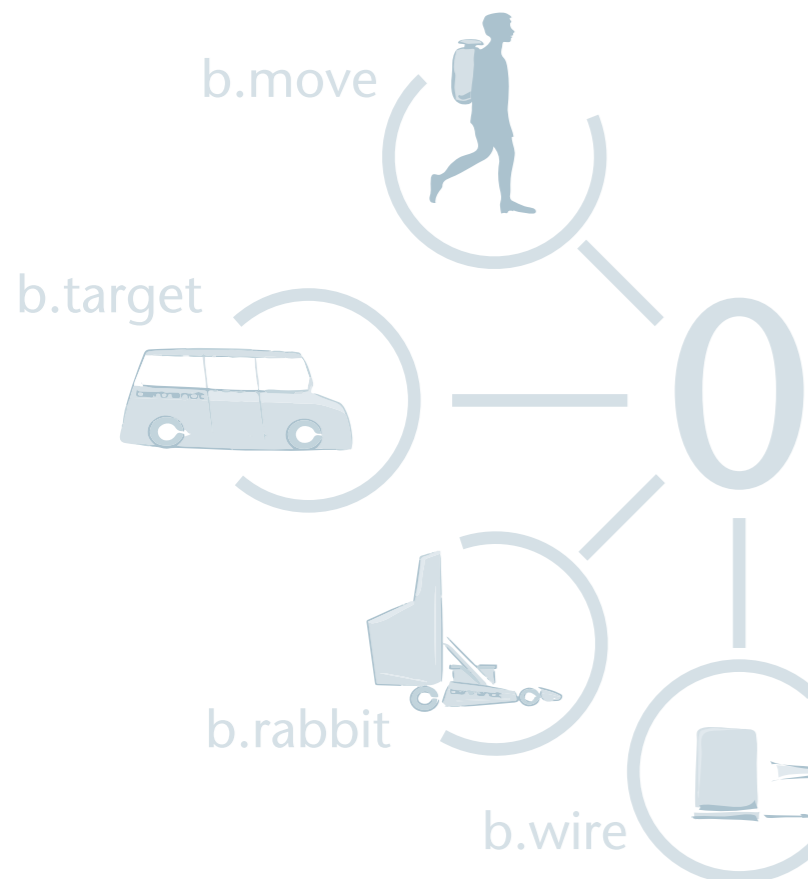
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VEHICLE SAFETY

En route to Vision Zero

Road safety and accident-free driving present a major challenge for all road users. A glance at the statistics shows the progress made as a result of the introduction of new vehicle safety functions. These are milestones on the road towards Vision Zero, which the automotive industry aims to reach by 2050. Our specialists are helping manufacturers and suppliers to resolve issues relating to vehicle safety and our individual development solutions are making the roads even safer.



En route to Vision Zero: Bertrandt test systems for accident prevention.

Adding new active and passive safety services

Vision Zero is an ambitious target. The aim is that by 2050 no one should be seriously injured or lose their life in a road accident. An interim target has been set for Europe's roads which involves halving the number of fatalities by 2020. To achieve this, the latest active and passive safety systems are needed. The road safety figures worldwide show that many countries are following this example. But is this challenging target achievable? At Bertrandt, we believe that it is and, using our sophisticated procedures, we are helping the automotive industry to overcome the obstacles on the road to Vision Zero, in close coordination with our customers. The technical simulation system used more than 20 years ago to design the structure of cars forms the basis of this process. During this period we have enhanced and improved specific areas and methods and invested in the appropriate testing technologies, such as airbag laboratories and pedestrian safety test facilities. Our test engineers work with all aspects of vehicle safety above and beyond legislative and consumer protection requirements with two goals in mind. One is to improve the performance of components in order to reduce the severity of accidents. The other is to develop new technologies and methods which will help to prevent accidents.

Pedestrian safety – an important aspect of Vision Zero

From Bertrandt's perspective both approaches are essential to the achievement of Vision Zero. Using the example of pedestrian safety, we can look in more detail at the different factors involved.

Structural design of vehicle bodies

For more than ten years, Bertrandt has been designing the body-in-white to protect pedestrians as part of its simulation and test

validation processes. We have been able to meet the constantly growing requirements in this area by expanding the range of services on offer at an early stage.

Testing

Bertrandt has extensive expertise in the field of validation. We can provide the appropriate test equipment to meet our customers' requirements and, therefore, generate highly reproducible and representative test results.

Sensors

At the limits of what is physically possible, sensors are used to create valuable space within the vehicle for the absorption of energy. The development of robust trigger mechanisms which are activated in the event of a crash requires a variety of detailed tests using misuse impactors, which represent small animals, birds, balls and stones, for example. Efficiency and precision during this stage ensure that the development process is cost-effective. Methods from areas such as statistics, simulation and testing are combined to minimise the risk of the mechanism being triggered in error.

The evaluation of a vehicle front-end with integrated sensors begins with an assessment of the current status in the testing department. This is followed by simulation processes which allow the design to be improved. The robustness of the solution is then investigated in the field and confirmed by the testing department. This approach keeps costs low and reduces the number of expensive components needed in the development process. Bertrandt can guarantee to meet the necessary requirements, because the methods have been carefully coordinated with one another.



FlexPli, the new impactor, is already in use in our test laboratory.



Using human models, it is possible to identify what actually happens during an accident.

Simulation

In order to minimise the risks involved in development, we create appropriate simulation models for the misuse impactors at an early stage. The aim is to reproduce them realistically in the simulation system and to generate accurate forecasts for the testing process.

Homologation and type approval

As a result of Bertrandt's extensive experience of pedestrian safety and modern testing methods, we are a certified partner of bodies such as the German Federal Motor Transport Authority and provide tests of product characteristics which meet statutory requirements. As a result, Bertrandt is an officially recognised type approval centre for pedestrian safety.

Accident evaluation and the development of new methods

Our development activities focus on what actually happens in accidents, not just to a dummy but to a real person. So-called human models are very helpful in this respect. They can enhance our understanding of the causes of injuries which are the result of a real accident. This allows the individual characteristics of different people to be taken into consideration. The findings of these tests enable our engineers to improve their development and test methods on a regular basis. >

CRASH VEHICLE SET-UP AND ANALYSIS

Full vehicle crash testing is still one of the most exciting types of vehicle safety test. In a fraction of a second, the bodywork deforms and the occupants are held in place by their restraint systems. The requirements of the legislation and the consumer protection regulations that are being investigated may be met and new and important findings may be made concerning the risk of injury to the occupants. But this type of test and the resulting outcome require a long and detailed preparation process with a focus on accuracy, documentation and reproducibility.

New drive concepts

The new drive systems on the market also involve risks that are still underestimated. The increased popularity of hybrid, electric and gas-powered cars has led to the need for new work safety processes and ongoing training for the test set-up team. A suitable infrastructure is essential to ensure that the set-up and analysis processes are safe.

Crash analysis

When the test is completed, the work of our team is by no means over. Crash analyses provide the necessary information for the development of a safe vehicle concept.

One of our most important activities in this area is evaluating the data. A crash produces a wide variety of data, which range from the photos taken, the measurements recorded by the sensors in the vehicle and the dummies and noticeable problems in the bodywork. All these data, together with the video evaluation taken using high-speed cameras, provide a comprehensive picture of the performance of the test vehicle, which can be used to validate the simulation methods or produce the necessary documentation to support an approval recommendation in a pre-defined load case.



Requirements for modern crash set-up processes

The requirements that workshops which prepare vehicles for safety testing need to meet have changed significantly over recent years. Not long ago, their role was to integrate the parts being tested into the test vehicle and to install the necessary sensors in order to produce results relating to acceleration and deformation. But nowadays that is far from sufficient. The growth in the number of driver assistance and active vehicle safety systems in the pre- or post-crash phase require increased attention, otherwise the risks involved in the test are high. In addition, the growing mix of materials used in vehicles, including aluminium and glass-fibre reinforced plastics, present a challenge for the testing processes.

The benefits of Bertrandt's crash vehicle set-up and analysis services

The choice of Bertrandt as a partner in this complex area can bring a number of advantages. One of these is the high level of flexibility which allows bottlenecks in the testing programme to be accommodated. This enables the OEM to focus exclusively on carrying out the tests. The result is an increase in throughput that in turn leads to faster results and shorter development times. The time that is saved can be spent improving the quality of the products and reducing the risk of costly changes to the tools. ■

STATE-OF-THE-ART E-LINER ACCELERATION SLED

The Bertrandt Munich site has installed a new sled test system as a complement to its range of development and testing services. The modern E-Liner system represents an important addition to the development process. Its main purpose is to test components and assemblies such as seats or dashboards, which have to meet specific requirements in the event of a crash and the resulting acceleration or deceleration.



which brings a number of benefits with regard to consumer protection criteria, such as NCAP, and customers' requirement specifications.

As a result of the precision and ease of use of the sled system, a large number of tests can be carried out in a short time with a high level of reproducibility.

The new system has been incorporated seamlessly into the existing testing infrastructure which simplifies processes and enables data to be processed and analysed at a high level. In the area around the system there is equipment for h-point and component measurements and for modification, component and video analyses and climate controlled component testing. Therefore, the new E-Liner sled test system fits perfectly into the Bertrandt Munich site's existing portfolio of services and makes it possible to implement complete development projects at the highest level of quality which involve close cooperation between specialists from our design, simulation and testing departments.

Examples of the use of the sled in vehicle safety tests:

- Whiplash – rear impact
- Acceleration in accordance with FMVSS201 and ECE-R17
- ECE-R44 side impact
- ECE-R44 child seat testing
- Body block tests
- Protection from loads
- Crash substitute tests for a variety of vehicle components

Modern electromagnetic drive system

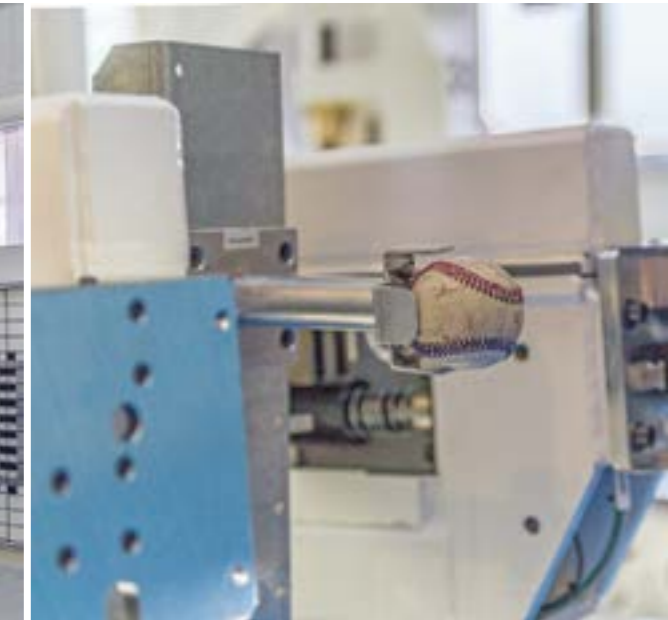
In contrast to conventional sled test systems, this machine has an ultra-modern drive system. In a similar way to a magnetic levitating train, the sled and the test object are accelerated and decelerated by means of a non-contact electromagnetic drive which is largely unaffected by the ambient temperature and humidity level. As a result, the acceleration of the sled over the entire distance of travel can be accurately defined and is fully reproducible at any time. The specially developed control software makes it possible to program in the required acceleration and braking cycles in a very short time on the basis of both the distance travelled and the time.

High level of precision produces rapid results

The interaction between the drive and the control systems not only allows individual sequences of pulses to be specified. It also enables existing acceleration pulses from other test systems to be reproduced at any time,



New test laboratory for evaluating pedestrian safety and misuse requirements for sensor systems.



Test set-up with a misuse impactor to simulate a bird hitting the front of a car.

Accident prevention

Our engineers and technical specialists devote much of their time to accident prevention. In addition to developing functions for preventing accidents from occurring, they also evaluate the necessary sensor concepts based on radar, lasers or camera systems. Furthermore, Bertrandt produces the validation methods and the accompanying tools to allow these functions to be thoroughly tested during the development process. Examples include our in-house test systems b.target and b.move.

Comprehensive road safety services

Our expertise in this area is all-encompassing and includes pedestrian safety and other current issues, such as the influence of electric cars on vehicle safety or the effect of the new small overlap crash test on the structure of vehicles. We focus on the safety objectives and challenges relating to more vulnerable vehicle occupants, such as children or older people. The engineers and technical specialists from our simulation, testing and electronics department pool their knowledge and constantly develop their expertise on behalf of our customers. This is our contribution to Vision Zero. ■

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SYSTEM TEST BENCHES FOR THERMAL MANAGEMENT OF DRIVE SYSTEMS

The challenge of thermal management

Against the background of increasingly stringent emission regulations and the priority given by developers to reducing fuel consumption on the one hand and customers' high expectations of vehicle comfort on the other, over recent years traditional engine cooling circuits have metamorphosed into sophisticated thermal management systems. During this process, the focus has shifted from simply dissipating the heat generated by the engine and using it in part to heat the interior of the vehicle towards the intelligent, condition-based distribution of supply and waste heat to a variety of components at different temperature levels. This results in highly complex thermal systems with a growing number of variables. As the complexity increases, so too do the demands placed on component and system testing.

Flow test benches – an important tool in developing thermal management systems

Bertrandt has taken up the new challenges involved in thermal management and developed a generalised flow test bench strategy. The spectrum ranges from simple standard cooling systems through to thermal systems with several circuits and a large number of variables. The appropriate test bench is set up in the correct position ready for installation with all the coolant-related components. A functioning engine, which is costly to install and requires a great deal of planning, is no longer needed. The mechanical coolant pumps are operated by regulated electric motors and the electric pumps are controlled by PWM or a LIN bus. These cold flow test benches are fitted with sensors to measure the local pressure and volume flow rate. Depending on the customer's requirements, different measurement methods, such as magnetic induction and turbine flow, can be used.

The following tests can be carried out using this type of test bench:

- Filling tests, including the identification of dead volumes
- Degassing investigations using endoscopy and rapid prototyping
- Volume flow distribution

Investigating the load limits of cooling systems

On the basis of these cold test benches, Bertrandt has developed a neutral test bench solution which does not lead to hydronic balancing of the entire system and enables thermal systems to be investigated at different temperatures. In principle, all the temperature ranges which are relevant to the application can be reproduced. In addition to cold measurements, other options are available, such as:

- Volume flow distribution as a function of temperature
- Identifying component pressure losses and the characteristic curve of the system
- Thermostat opening tests
- Quantifying the cavitation range of pumps
- Endurance testing

Hardware and software solutions from one source

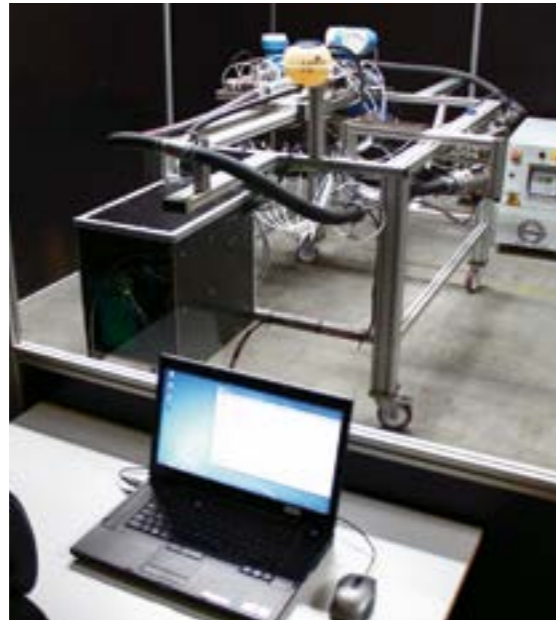
Several software packages have been developed in collaboration with the software development team in the powertrain department on the basis of the technical requirements of the test bench hardware. One particularly important solution is the b.automized program, which allows

for fully automated operation. b.automized runs a predefined test plan while at the same time monitoring the critical operating parameters. In the event of a fault, the program initiates a set of hierarchically structured countermeasures which range from a controlled start-up at a safe operating point through to an emergency shutdown. It has a sophisticated function for real-time monitoring and evaluation of the measurement data, an automated stationary value recognition and test period adaptation system, virtual measurement channels for simulating the physical variables and a comprehensive library of controllers that enables control tasks to be implemented for an almost unlimited number of variables.

b.automized is currently equipped with CAN and LIN bus communication interfaces for >



b.automized allows for fully automated operation.



Flow test bench for basic investigations.

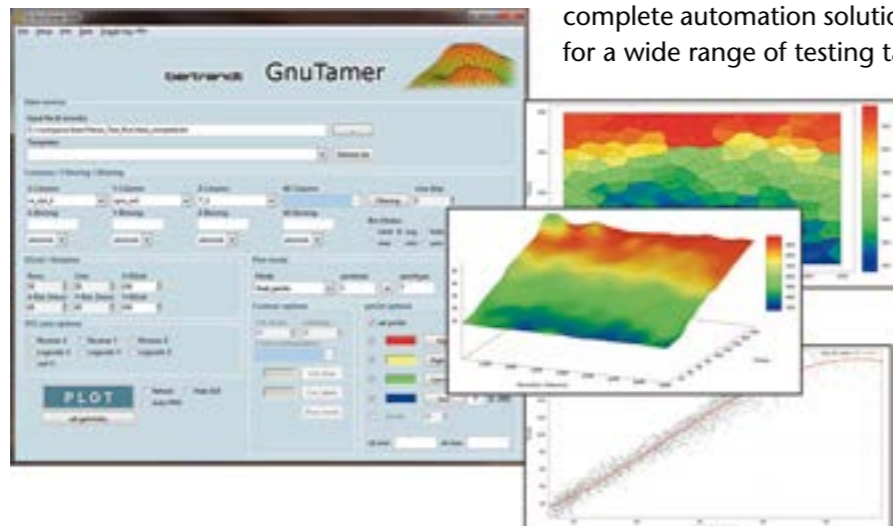


Complete set-up for a thermal management simulator.



Detailed view of a flow test bench.

Complex graphical representation of measurements in real time: b.automized interacting with GnuPlot.



the purpose of activating components. As the next logical step, a configurable hardware interface for b.automized is being developed in cooperation with the electronics development department. This has a 10 kHz real-time system with a variable controller application, a measurement data recording system (for analogue, digital, temperature and counter signals) and a corresponding safety logic function. This system allows a complete automation solution to be created for a wide range of testing tasks.

Pooling thermal management expertise

The accompanying simulation of the entire cooling circuit and the car's driving conditions also plays an important role. A variety of algorithms has been developed for this purpose during the course of parallel projects. This involves the advance simulation of both the hydraulic conditions and the overall thermal situation to guarantee that the car can operate safely. Possible areas for improvement can also be identified and, therefore, can be taken into consideration at a very early stage of development.

Because all the technical aspects of the control and measurement cycle can be fully covered in-house, it is possible to provide customised test bench solutions for customers.

As a result of the cooperation across the different Bertrandt sites, additional applications and customer segments can be opened up and the thermal management service portfolio can be extended. This gives Bertrandt the opportunity to offer customers a complete package consisting of the functional design and development of a thermal management system. It also closes the loop between component development and endurance testing on the one hand and simulation testing and the application on the other.

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CONNECTIVITY

INTEGRATION. COMMUNICATION.
ELECTRONIC INTELLIGENCE.



Bertrandt's comprehensive networking solutions

Our cars are controlled by electronic systems and these are becoming increasingly complex. In this digital age, it is not only individual components that communicate with one another. The cars themselves, their infrastructure and the internet are also connected. Bertrandt has developed a range of intelligent concepts to overcome the challenges that networking presents.



b.on web server opens up communication

One of Bertrandt's latest developments is the b.on web server, which functions as a central hub to allow different components to communicate and to be networked. These include mobile devices, PC applications, home automation systems, the car itself and a variety of services. Web servers like this ensure that we can download our e-mails to our smartphones and have them read out while we are driving. We can find out the lowest fuel prices in the area or use search engines to discover the best local visitor attractions and inside tips. In addition, we can switch our lights at home on and off from our car.

b.tracks records and structures data

Connectivity is a future mega-trend, but many of the functions in this area are still under development. As a result, they need to be tested in realistic conditions. Bertrandt has developed the b.tracks application for this purpose. It helps to record data in a structured and transparent way. The application functions in a range of environments and can easily be configured. It enables navigation systems to be tested, for example, and voice commands and context displays to be evaluated in real-life conditions. With just a few clicks, b.tracks validates and documents functions that can also be allocated GPS coordinates for improved traceability. In addition, photos and voice recordings can be included, if required. This allows innovations to be adapted for everyday use and for volume production quickly and easily.

Providing reliable navigation data

A combination of accurate map information, practical route suggestions and the latest traffic reports will help to make journeys fast and stress-free. Bertrandt has comprehensive knowledge of the processes and interfaces for database and release management, together with configuration, error and test management. This allows us to provide expert system validation and standardisation services and

to incorporate the systems into existing customer solutions.

A networked navigation system with a range assistant and charge level display is particularly important for hybrid and electric cars. The inclusion of topographical features of the landscape helps the driver to drive economically in electric mode, by enabling electrical energy to be regenerated as often as possible or necessary. And if that is not enough, local and long-distance traffic information can be added to make it easier for drivers to reach their destinations. Car sharing and logistics companies will also benefit from reliable navigation data. It will enable companies to monitor and improve the operation of their fleet via interfaces in the cars and in the head office that use a mobile data network.

Software solutions for car-to-car communication

Not only the navigation data, but also the communication between cars and their environment needs to be thoroughly tested. Until now all the systems of this kind in cars have operated largely independently. For example, a car "sees" a road sign and informs or warns the driver or a car "notifies" an unintentional lane change and prevents this from occurring. But what happens when a car has no independent access to information or cannot identify a risk itself? Developers have been working on finding a solution to these problems for years and the keywords in this context are car-to-car and car-to-X communication, where X stands for all the possible communication partners, such as traffic management centres, traffic light systems and functional nodes by the roadside. As a result, road users and their surroundings become part of an overall network.

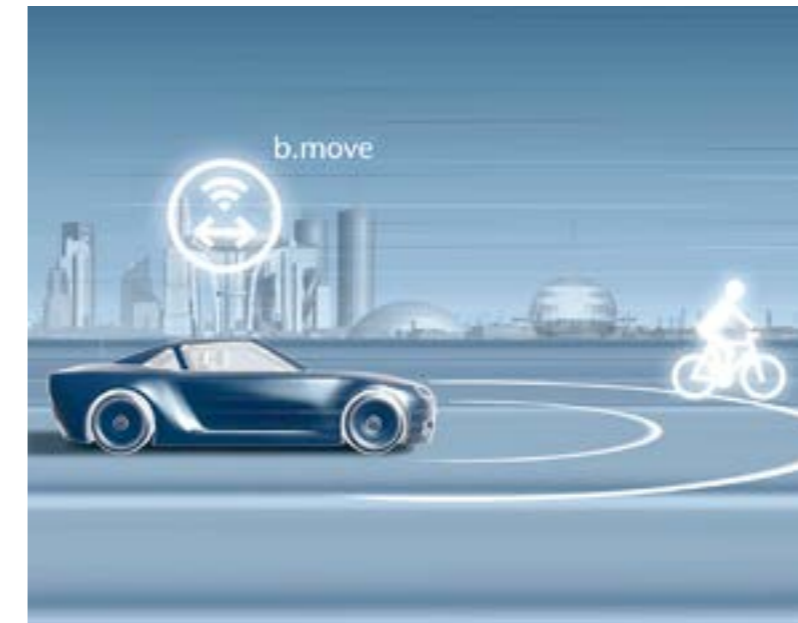
It is essential that communication functions smoothly. This is why the Bertrandt engineers are developing interfaces between different manufacturers' vehicles. We are working on software solutions in areas such as driver information, risk analysis and identifying traffic situations at an early stage. Bertrandt is monitoring and improving the entire infor- >



A networked navigation system with a range assistant and charge level display is particularly important for hybrid and electric vehicles.



Driving as a complete experience: restaurant recommendations, sports news or switching on the lights at home.



The b.move mobile referencing system allows the exact position of objects in the vehicle's environment, such as cyclists, to be recorded.



Speech recognition is an important aspect of networking.

mation path from reception of the data via a wireless system through to final processing by the user software.

Developing driver assistance functions with b.move

Bertrandt has produced a mobile referencing system, known as b.move, for developing, validating and approving driver assistance functions and environmental sensors. b.move makes it possible to carry out reproducible tests that can be evaluated objectively. The mobile referencing system enables the precise position of objects in the vehicle's environment, such as pedestrians or cyclists, to be recorded and because of its compact design is highly flexible.

Apps and b.speech enhance comfort on the move

Bertrandt sees driving as a complete experience and, therefore, focuses not only on safety but also on comfort. In this area, Bertrandt has developed car-related smartphone apps which enable the driver, for example, to switch on the pre-heater without being in sight of the car, to open and close the sunroof or to check the fuel level. In the near future, cars will be able to do much more than this. When we leave the office, our car will have already moved out of its parking space and be waiting outside the office door. It will inform us about the safest and fastest route home, let us hear the latest news and recommend a restaurant where we

can eat that evening. Our cars will become more than just a means of transport. They will be part of a wider network.

Speech recognition is an important aspect of networking and the system needs to be able to recognise not just one language, but many. To ensure that different languages can be recognised, managed and reproduced perfectly, Bertrandt has developed b.speech. This app allows us to expand our language database and to use it to create reproducible test scenarios, so that in future language barriers will no longer be a problem.

Bertrandt develops networked mobility solutions

Our engineers and technical specialists are creating intelligent data management systems which they encrypt and validate. They are developing new applications and smartphone apps which make life simpler. They are producing the right ideas and solutions for the increasingly networked world of transport. They are creating connections: between components, vehicles and people. ■

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DEVELOPING ALTERNATIVE ENGINE CONCEPTS

Bertrandt's low-cost engine – a technological concept study

Developing and implementing unconventional engine concepts has been high on car manufacturers' agendas for several years. The technical requirements for engines are changing significantly, in particular with regard to powertrain configurations where the combustion engine has no mechanical connection to the drive system, but functions only as a range extender. For this reason, Bertrandt decided to develop its low-cost engine as a technological experiment in the light of the growing level of hybridisation in powertrains.

Technical features

We opted for a two-stroke diesel engine process as the basis for the low-cost motor. The decisive factors were abandoning the development objective of an engine design for highly dynamic, transient operation and the greater power density of the two-stroke process when compared with the four-stroke. The choice of the diesel process, which is successfully used in stationary, military and marine two-stroke engines, was crucial. The two-cylinder engine has a capacity of 900 cm³, a maximum power output of 45 kW at 4000 rpm, maximum torque of 150 Nm at 1400 rpm and a maximum cylinder pressure of 120 bar. Special design features include the division of the engine into a bed plate (lower part of the crankcase), crankcase, barrels and liners. A parallel flow arrangement is used for scavenging the combustion chamber. The inlet system consists of conventional inlet ports on both sides of the barrels. The air throughput can be adjusted via variable openings using two shafts. The outlet system is made up of three valves in each cylinder head.

As the low-cost engine does not have a pre-compression system for the intake air, a forced air circulation system is needed to give a positive scavenging gradient. A scroll-type supercharger manufactured by Handtmann Systemtechnik GmbH & Co. KG is used for this purpose. The mixture is injected directly into the cylinders by two pump-nozzle units. The piston skirt forms the seal between the combustion chamber and the crankcase. This is made possible by the fact that the low-cost engine has forced feed lubrication rather than a petroil system. In addition to lubricating the bearings, the engine oil is also used to cool the crankcase and the lower half of the barrels. The upper half of the barrels and the cylinder head are connected to the

coolant circuit. In order to minimise blow-by of intake air into the crankcase, the pistons have an additional piston ring at the bottom of the skirt. The engine also has an externally cooled and regulated EGR system to exploit the benefits of exhaust gas recirculation.

Pioneering engine control system

The highly flexible engine control unit is based on a rapid control prototyping platform in the form of the PROtronic development control unit. The starting point for the software architecture is a diesel functional model specially adapted to the low-cost engine, which has a new fuel path for activating the injectors. To simulate the start of the activation process and the duration of the feed to the solenoid injectors, we added parameters to the fuel paths. Also the synchronisation of the crankshaft drive and timing assembly was modified to allow for the functional release of the injection system. In order to guarantee a reproducible injection sequence, we defined a suitable feed sequence which was spread over the different activation phases. In addition, the functional model for the air path was adapted and the control of the centre of combustion was adjusted and modelled on the basis of the charging pressure and cylinder pressure.

Further potential for weight reduction

The low-cost motor is a preliminary study which will lead to a fundamental investigation of the combustion process. The modest size of the engine offers considerable potential for weight reduction in the next stage of development. During the subsequent stage, a suitable exhaust system will be designed on the basis of the results of the test bench measurements. ■

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DESIGNING PROTOTYPES AND PRODUCTION FACILITIES FOR THE MACK RIDES MEGACOASTER

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a comfortable ride**

Specialists in breathtaking experiences

In addition to its traditional fairground rides, MACK Rides is famous for manufacturing roller coasters and water rides. Its Young-STAR coaster product is the first of its kind to combine a children's roller coaster and a family ride. The focus of development at the company, which is based in the German town of Waldkirch, is on its top-class Megacoaster range. These machines have been produced by MACK Rides since 2009. Its "Blue Fire" launch coaster has a breathtaking looping track, but is also highly comfortable. Alongside its classic steel roller coasters, MACK Rides also holds a number of patents for water rides. The company offers interactive water rides, traditional peaceful boat rides and also watery attractions for thrill-seekers. The water coaster, which is a water ride and a roller coaster combined, is enjoyed by visitors to many theme parks throughout the world. Over the last few decades, the company's main sales market has shifted from classic fairground companies to international theme park chains. Customers such as Sea-World Parks & Entertainment, Universal Studios, Disney and Parques Reunidos are familiar faces in Waldkirch and they value the specialist skills of the MACK Rides engineers, who are also responsible for special orders and prototypes.

How the cooperation began...

Bertrandt began working with MACK Rides because of the company's need for design services for its new production facilities. In addition, the company established a prototype manufacturing department alongside its existing design and development offices, which is where Bertrandt Services Freiburg came in.



Project scope: Simplifying and accelerating the production process

The first challenge involved redesigning an existing machine to give it six axes and to enable it to move fully automatically (under CNC control) to any position, in order to cut workpieces to size which would otherwise have to undergo a costly milling process. As a result, the production process was automated and made significantly faster.

The second project consisted of designing a special crane to handle the workpieces used in the manufacturing of roller coasters. Curved and corkscrew-shaped rails presented a particular challenge. The aim was to calculate the forces to which the building would be subjected and to design the components accordingly.

The overall goal involved simplifying and speeding up the company's production processes. A number of different innovative concepts were used to achieve the best possible solution and a highly satisfied customer. The success factors included the joint expertise of the two companies and the positive cooperation between them. We learnt a great deal and experienced the unlimited potential of the world of fairground rides. ■



Bertrand Technikum, Ehningen

NEW LOCATION IN STUTTGART

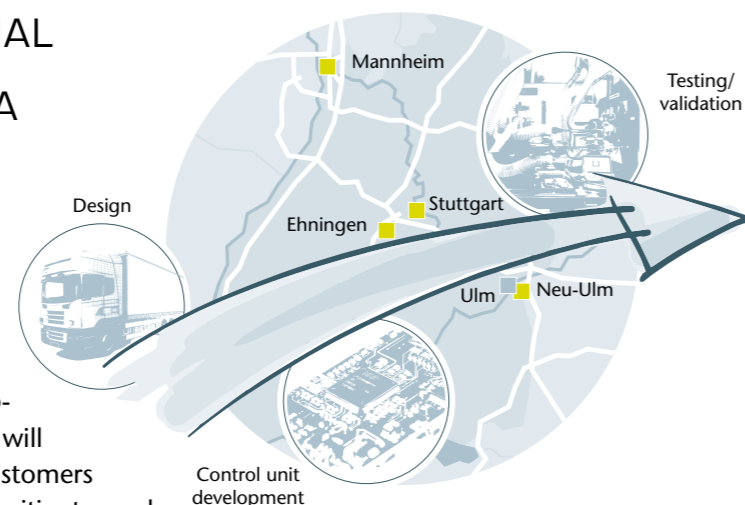
Geographical proximity and industry knowledge are important aspects of a successful customer relationship. At its new location in Stuttgart-Wangen, which opened on 1 April 2014, the Bertrand Technikum will be offering a wide range of engineering services from its portfolio, such as:

- Design modelling and rapid technologies
- Classic bodywork development, including body-in-white, exterior and interior
- Electronics
- Powertrain and chassis development
- Simulation
- Testing and validation
- Development and production support services

Bertrand Technikum, Ehningen

MEMBER OF THE COMMERCIAL VEHICLE CLUSTER IN SWABIA

In order to attract more attention to its new commercial vehicle development services, Bertrand Technikum GmbH decided to join the commercial vehicle cluster in Swabia (CNS). The location of the CNS and its business area around the city of Ulm make it the ideal networking platform. This region has the highest concentration of commercial vehicle development activities in Germany. Membership of the CNS will enable Bertrandt to develop its relationships with customers and business partners and to make the most of opportunities to work with the local chamber of industry and commerce and with universities in the area.



Bertrandt Ingolstadt

NEW PREMISES IN HUNGARY

Bertrandt Ingolstadt has been working with customers in Hungary for several years, primarily in the field of quality assurance. Following an increase in the amount of project work for a major customer, Bertrandt opened new premises in 2013. The new site offers the complete portfolio of services with a focus on quality assurance, complete vehicle development and all production-related activities. ■



Bertrandt Munich

AWARD FROM THE CITY OF MUNICH FOR "BUSINESS MOBILITY MANAGEMENT"

On 24 October 2013, the city of Munich department of work and business presented Bertrandt with an award for the company's successful participation in the "Business Mobility Management" programme, which was supported by the city. Other well-known Munich companies also took part. The background to the programme is the growing population of the Munich region, which is resulting in an increasing volume of traffic in the city. The purpose of the funding programme is to enable the city to help businesses in Munich to make more effective use of the infrastructure in order to prevent the increase in energy consumption, noise, air pollution and wasted time caused by growing congestion. Bertrandt Munich put in place its own measures, including an organised mobility day, and introduced the business mobility management programme, which was given a very positive reception by the employees. ■

The Bertrandt roadshow in Sèvres – an opportunity for discussions on technical subjects.

Bertrandt France

IMPRESSIVE ROADSHOW HELD BY BERTRANDT PARIS

How will cars communicate with one another in future? What role will smartphones play in future vehicles? How can we achieve the dream of autonomous driving? These were questions considered by a panel of automotive experts at the roadshow in Sèvres. It was the first roadshow of its kind staged by Bertrandt's Paris site and, given the positive feedback from customers, it will certainly not be the last.

The goal of the roadshow was to demonstrate the Bertrandt Group's expertise to a selected group of customers by means of technical discussions and eye-catching exhibits. The exhibits included the in-house Ergositz development, a hand-made Bertrandt steering wheel and the innovative LIBERTÉ e-scooter. In addition, Renault made available the robot arm with the X52 cockpit. A driving simulator gave the guests the opportunity to experience the driving conditions of the future.

This was also the theme of the German-French panel discussion moderated by journalist Laurent Meillaud. The panel, which discussed the current issues in the international automotive industry, consisted of

Bertrandt's Heads of Competence Centres Matthias Rühl, Klaus Härtl and Michael Hage, together with Marc Tison, former head of the electric vehicles department at PSA, Eric La Fay from Continental and Franck Cazenave from Robert Bosch France. ■





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CALENDAR

23-24/09/2014	VDI – Focus on Vehicle Electronics, Baden-Baden
06-08/10/2014	Aachen Colloquium Automobile and Engine Technology, Aachen
11/12/2014	Annual report press conference, Stuttgart
18/02/2015	Annual general meeting, Sindelfingen
13-17/04/2015	Hannover Messe (Hanover Fair)
14-16/04/2015	Aircraft Interiors, Hamburg
April 2015	Plastics in Automotive Engineering, Mannheim
May 2015	Conference for Body Engineering, Hamburg
June 2015	Advances in Automotive Electronics, Ludwigsburg

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