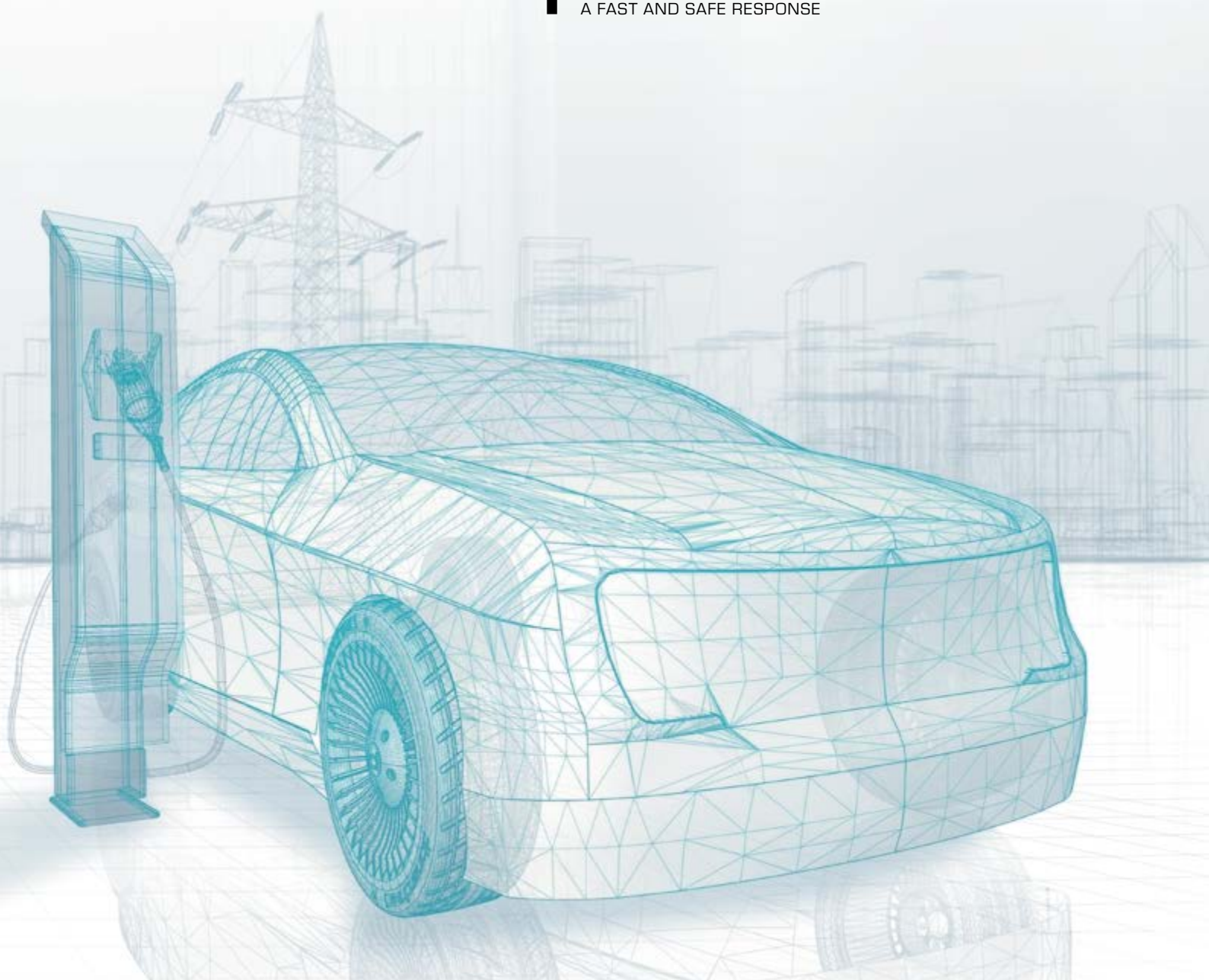
Bertrandt*magazine*

The Customer Magazine of the Bertrandt Group
No. 18 | September 2018

AUTONOMOUS DRIVING FROM BERTRANDT: "PARK AND CHARGE" PROJECT

PORSCHE CAYENNE:
BERTRANDT PROVIDES FULL SUPPORT FOR BODY DEVELOPMENT

BMW EMERGENCY AND OFFICIAL VEHICLES:
A FAST AND SAFE RESPONSE



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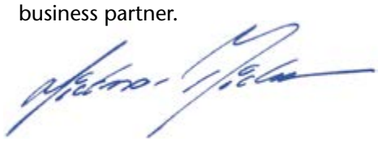
EDITORIAL

Dear readers, Environmentally friendly individual mobility and autonomous and connected driving are important market trends for Bertrandt. The dynamic developments in these areas and the resulting transformation processes are currently causing major upheaval within the automotive industry, which is having an impact on all the players in the sector. In addition, these trends are continuing to grow in both breadth and depth. We are therefore taking greater responsibility for development processes in areas such as interface management and project management, for example during the development of the body for the Porsche Cayenne.
Because of the growing interaction between mobility and data, we are becoming involved in new fields and services, alongside our established business areas, with the aim of providing the best solutions for you, our customers. We are entering into new collaborative agreements, for example with Microsoft. At the Frankfurt Motor Show we announced the start of our cooperation and since then we have been working with Microsoft even more closely. We have been certified Microsoft partners for Azure and the HoloLens for some months and are in the process of setting up our first cross-site projects.

This issue of our customer magazine can only show you a small cross-section of our wide variety of day-to-day activities. We are adapting to changes that range from autonomous driving and electric mobility to virtual reality and other new technologies. As a solution-focused service provider, we are ready now to meet the future requirements of the market and of our customers. As a consequence, Bertrandt continues to be a reliable business partner.



Dietmar Bichler

> These trends are continuing to grow in both breadth and depth.

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More references online:

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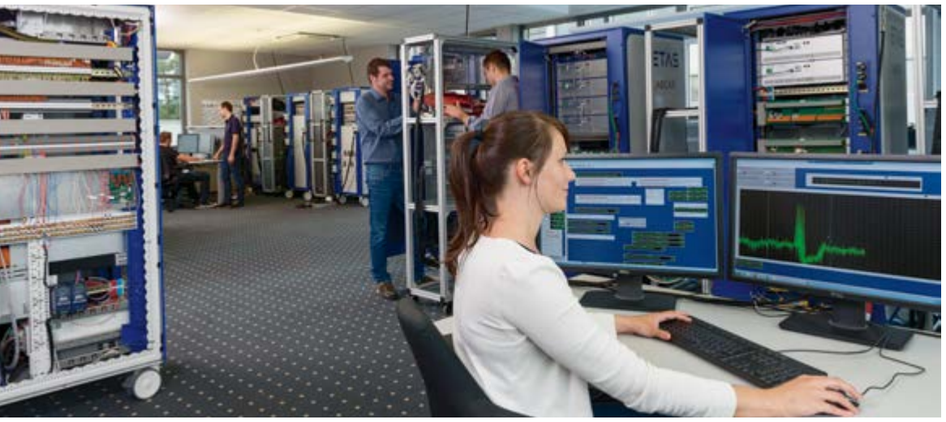
Electronics development

NEW TEST FACILITY FOR COMPLEX ELECTRONICS ARCHITECTURES



Bertrandt can now offer its customers comprehensive testing services for complete vehicle electronic systems from the test specification through to the approval process in a new test facility with high-performance HiL (hardware-in-the-loop) test benches. This allows electrical and electronics tests to be fully automated, provides modular and scalable solutions for wide-ranging, in-depth testing and results in highly efficient services. The Bertrandt specialists, who have many years' experience and extensive expertise in this field, can carry out complete tests of all types of electronic control units, including those from premium models with highly complex architectures. They cover the entire testing process from the planning phase and the preparation of the specification through to the creation of audit-compliant documentation of the results, together with project management. The customer's specifications for the electrical and electronics functionalities form the basis for this process.

Intelligent electronic control units make a major contribution in areas such as safety, performance, ride comfort and the individual character of modern cars. As a result, the control units in the powertrain, steering, brakes, chassis, passive safety systems, lights and body and interior components of new models need careful testing during the development process to ensure that they function safely and reliably. Software simulations of the environment and real and substitute loads are used in a closed loop in the HiL test rigs to evaluate whether the systems function correctly on an individual basis and in combination with others. Bertrandt's expertise lies in thorough and in-depth testing of individual system components, integrated systems and the interaction of all the systems in the car on all levels.

The biggest challenge involved in electrical and electronics validation is the large number of test cases that have to be implemented and analysed in a very short time for each software release. The new test facility enables Bertrandt to cover the entire bandwidth of HiL testing from an individual component to the complete range of electrical and electronics systems in a car. Using the HiL test rigs based on ETAS LABCAR it is possible to carry out efficient tests of the full sequence of complex, electronically controlled, embedded systems in a car without interruptions. ■

Powertrain

INTELLIGENT THERMAL MANAGEMENT

As the variety and complexity of powertrains increase, so too do the requirements placed on thermal management systems. Vehicles with alternative drives in particular, such as PHEVs, BEVs and fuel cell cars, require a carefully controlled cooling system which guarantees that individual components are kept at the ideal temperature. A central water pump driven by the crankshaft is no longer adequate for effective energy management. As a result, the developers of cooling systems in vehicles are faced with considerable challenges.

Bertrandt has been working in the field of thermal management for more than ten years. In addition to CAD systems, areas such as functional design, CFD simulation, testing, validation and application are becoming increasingly important. The objective of intelligent thermal management is to bring all these areas together to allow a complete engine cooling system to be developed.

The basis for this process was a compact car with a turbocharged 1.4 l petrol engine. The existing components were measured in a wind tunnel and the resulting data formed the foundation for the creation of a simulation model in GT-Suite, which was able to produce a transient simulation of the high-temperature and the low-temperature circuit including heat transfer. The one-dimensional model was used to develop alternative variants with controllable electric pumps and a continuously adjustable mixing valve to improve energy management. A method was then developed to bring the individual components to the optimum temperature at each operating point independently of the engine speed. On the basis of this method, cooling circuits can be designed for any type of powertrain and, most importantly, for alternative drives. The cooling systems for the battery and the peripherals are the main beneficiaries of this method, because it allows very specific temperature requirements to be accurately met.

Each individual concept is designed using a CAD system and tested on a test rig. It is then integrated into the car and specific function routines in the ECU are developed. Finally the vehicle with a modified cooling circuit is tested in the wind tunnel and on the road.

The entire development process for thermal management systems is covered and the result is a vehicle that is ready for testing with a basic system that has improved cold start properties and is more robust. In addition, entire control unit systems can also be optimised. This process paves the way for a more energy-efficient, low-emission future. ■

SPOTLIGHT

Body development / Simulation

VIRTUAL REALITY USED FOR A-PILLAR DEVELOPMENT

Using innovative VR technology, Bertrandt is able to develop A-pillars with a cross-section designed for the specific body while taking into account all the static loads. This means that the A-pillar can be assessed at an early stage of the development process with the aim of improving the passengers' viewing angle. Our development solution accommodates all the requirements to create the ideal balance between performance and function and to give the driver and passengers the best possible all-round visibility. At the same time, the A-pillar with a smaller cross-section is designed to withstand all the loads required by vehicle manufacturing regulations, including front crash, side crash and roof drop tests. In addition, the A-pillar needs to provide sufficient space for components such as wires, hoses, airbags, seals and trim.

In conclusion, the VR system presents the effects of different variants in visual form early in the development process which speeds up decision-making. The static loads can also be visualised as part of the virtual presentation. ■

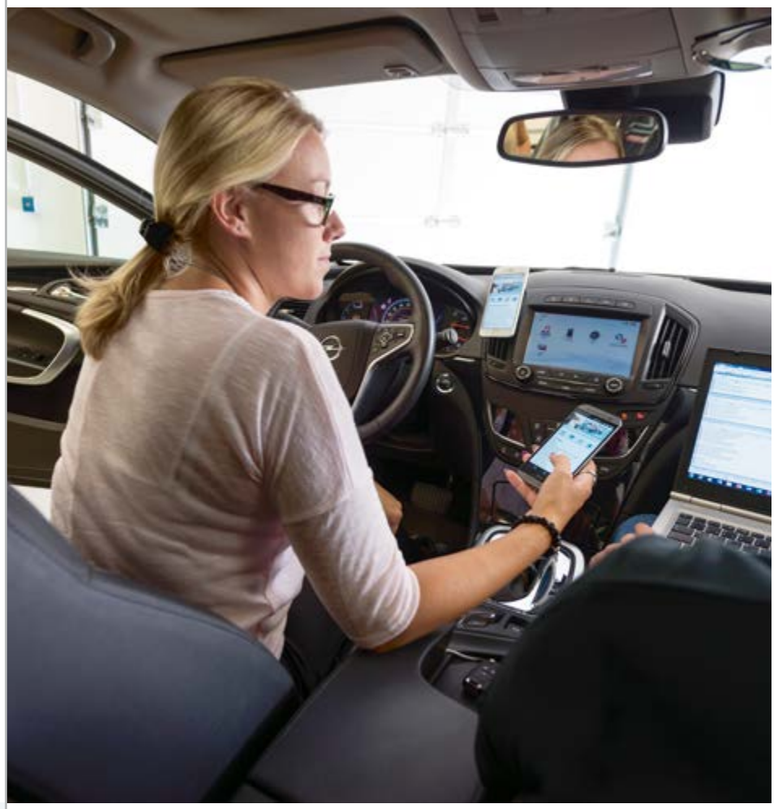
Electronics development

DEVELOPING HIGH-VOLTAGE BATTERIES FOR ELECTRIC CARS

Bertrandt has been involved in the development of high-voltage batteries for many years. To ensure that electric cars are as attractive to consumers as conventional vehicles with combustion engines, two key challenges have to be overcome: range and performance. A number of highly complex requirements need to be taken into consideration in the development of batteries. The problems involved in battery development across a number of industries, which include cost, service life and energy content, are accompanied in the automotive sector by specific requirements such as weight, resistance to high temperatures and vibration and a robust design. In order to meet these needs in the most effective way, Bertrandt provides services covering the entire process from the initial concept and the development and testing of components through to integration into the vehicle. ■

Electronics development

DESIGNING AUTONOMOUS DRIVING FUNCTIONS



Bertrandt has expertise in every area of the development of autonomous systems. We work with our customers to define the requirements for autonomous driving functions, starting with the sensors. Our developers cooperate closely with the specialists from our test labs to evaluate the resistance of sensors and other components to environmental influences and incorrect voltages and to certify them. This is followed by comprehensive hardware and software tests in accordance with the requirements specification to ensure that the components are of the required quality. Bertrandt has also been involved in the design of an emergency stop assistant, the first highly automated driving function to be used in production models. Our experts develop highly complex algorithms, run them in prototype environments, prepare them for use in production systems and test them in accordance with ISO 26262. From SAE level 3 onwards, liability is transferred from the driver to the manufacturer. Against this background, the quality standards for software in autonomous systems have risen significantly. As a result, quality assurance is Bertrandt's top priority. Our team members regularly take part in training courses and certification procedures for process, development and testing skills. In addition, our internal development processes and methods are audited by our project management office (PMO). With its extensive network of experts, Bertrandt is able to take full responsibility for innovative projects from the research phase through to volume production. ■

Electronics development

INTELLIGENT ENERGY MANAGEMENT FOR ELECTRIC CARS

As part of the hyPowerRange project funded by the German Federal Ministry for Economic Affairs and Energy (BMWi), a new battery concept is being developed and tested that represents an inexpensive, modular and flexible solution for improving the performance and capacity of electric vehicle batteries.
The goal of the hyPowerRange research project is to increase the range and performance and reduce the cost and cooling requirements of electric vehicles. The project aims to achieve this by developing and building a modular hybrid energy storage unit. A variety of high-energy and high-output cells will be combined to create a single battery for a specific application. In contrast to previous projects, the hybrid battery will have a direct connection, which means that it will operate without an intermediate electronic transformer.

In addition to the direct coupling, the project will also introduce other measures to extend the range of electric vehicles. The hybrid storage unit will be integrated into the vehicle's overall energy and thermal management system. The system also uses heat pumps in the vehicle and a battery and vehicle temperature control system with thermal preconditioning from the electrical system which is designed to produce the longest possible range.
Bertrandt's engineering team is responsible for developing an intelligent energy management system to increase the range of the vehicle and to enable the battery to operate more efficiently. The fundamental energy management functions include independent control of the available power for electronic components and the powertrain depending on the battery charge status. The development of predictive energy management functions will involve determining the energy requirements and the range for the route being travelled in relation to the driver. The functions will also provide recommendations for the driver. The modular, flexible battery concept will be integrated into an electric vehicle and will be tested and demonstrated in both driving and charging mode from 2019 onwards. ■

Electronics development

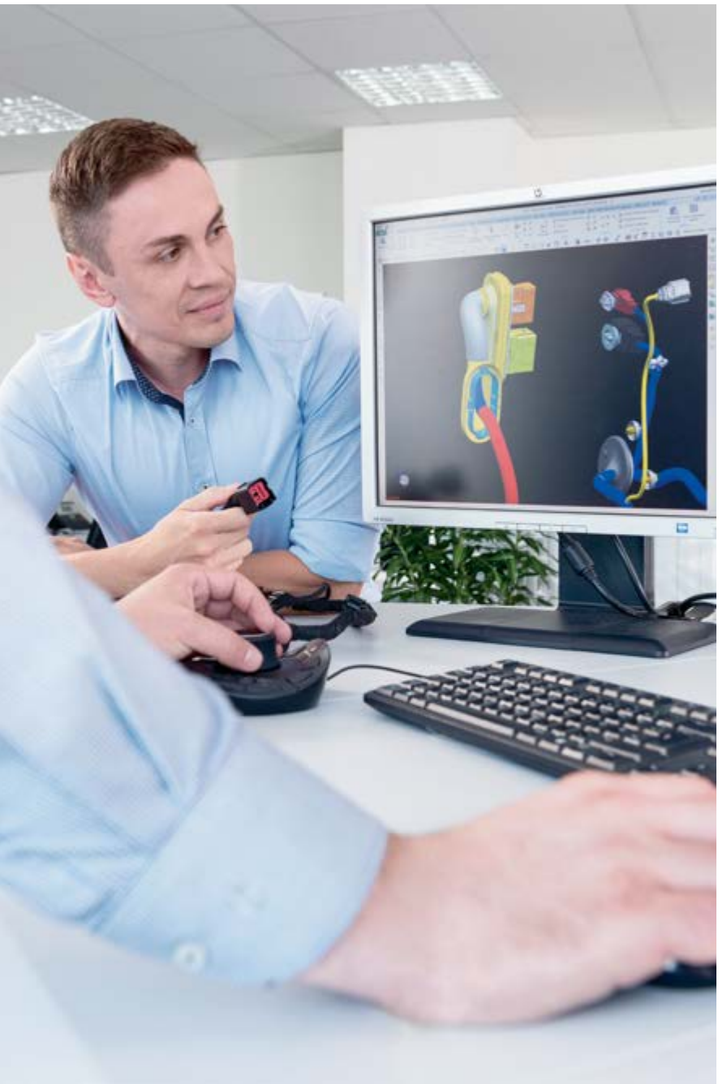
CAR IT, IOT AND INDUSTRY 4.0 COMPETENCE PROJECT

One important factor in the move towards autonomous driving is the acceptance of driver assistance systems by car drivers. The control response of the systems is a key factor in gaining drivers' trust. The ability of the systems to adapt to the driver also plays an important role. The driving style of the driver and the environmental conditions must be analysed and the dynamics of the intelligent cruise control system adapted accordingly. However, it is only possible to acquire an in-depth understanding of the driving behaviour by analysing data over long periods. A back-end and database structure developed by Bertrandt in-house can be used as a car IT infrastructure for this purpose. It is not only the car as a "sensor on wheels" that is an important part of the Internet of Things (IoT). A decisive consideration for future developments is also the integration of other objects. Bertrandt has developed new technologies for use in this area including embedded software, car IT and back-end analyses, together with inside- and outside-car functions. Other new developments include AUTOSAR-compliant software components, driving style and environment detection systems, mirror mode for diagnostic purposes and in-house machine-to-machine gateways, analysis algorithms and machine learning systems. These are used for developing and training neural networks, in the heartbeat function for data loggers to allow data to be recorded and transmitted on the move without errors, for detecting objects and road signs and in the bi-directional connection to a charging station for intelligent energy management as a part of smart charging systems and smart grids. It is clear that our customers can reap the benefits of our in-depth expertise in the fields of car IT, IoT and Industry 4.0. ■

Electronics development

STATE-OF-THE-ART ELECTRICAL SYSTEMS

Many people forget that the electrical system of a modern car is often its biggest and most expensive component. This is the result of the large number of electrical and electronic parts throughout the car. Because they have to be supplied with power and data, the wiring loom extends into all areas of the vehicle. Today's cars would not be able to move without electrical and electronic assemblies. The weight of the electrical system in a medium-sized car has increased significantly over recent years and can be as much as 70 kg. In the past cars had very few control units and very little electric wiring, but because of the wide range of variants available today there are many possibilities for individual configuration, accompanied by several kilometres of wires. Bertrandt has provided development services in this area to manufacturers and system suppliers for decades and is increasingly taking full responsibility for the interdisciplinary development of electrical systems covering the entire product creation process. In the early stages of development there are many questions to be answered. What size should the opening between the engine compartment and the passenger cell be, because any gap can have an impact on the acoustics inside the car? Will the components be affected by condensation or spray? What loads are expected and what should the diameter of the cables be? What are the fuse and earthing concepts? What type of information or signals are needed in the car and how quickly must they be transmitted (Ethernet, fibre, CAN etc.)? How will the wiring loom be routed in the interior and what bend radius is possible? The Bertrandt developers can provide answers to these and many other questions during all the phases of the development process from the creation of the wiring loom and wiring diagrams and the production of the first prototypes through to the testing and validation of components in our own material and test labs. At Bertrandt we carry out these tests not only in our own facilities but also at customers' sites throughout the world. In addition to the automotive industry, these electrical and electronics services are also important to the aviation and rail transport sectors and to other areas of industry.



Testing

TEST RIG DEVELOPED FOR PARKING LOCK MECHANISMS

HIGH-PRECISION TESTING AT AN EARLY STAGE OF DEVELOPMENT

Bertrandt has developed a test rig for testing the function and robustness of lock mechanisms in the gearboxes of all types of cars. The new test rig provides a realistic representation of road conditions and cars. The test system incorporates the gearbox and its lock mechanism together with all the other components in the torque path right through to the tyre contact patch. It is also able to represent all the relevant load points accurately in terms of their position and elasticity. The direct forces and the resulting inertia can be adjusted for different test procedures depending on the configuration of the car and the driving situation. The simulated load scenarios and accompanying vibration of the entire powertrain are equivalent to real-life situations in vehicles. The tests give an insight into the dynamic behaviour of lock mechanisms when exposed to a wide range of different stimuli, which allows the function of the locks to be accurately tested and the long-term strength of individual components to be assessed in the early stages of development.

PORSCHE CAYENNE:

BERTRANDT PROVIDES FULL SUPPORT FOR BODY DEVELOPMENT

THE OFFICIAL LAUNCH OF THE THIRD GENERATION CAYENNE TOOK PLACE AT THE FRANKFURT MOTOR SHOW 2017.

Bertrandt played a significant role in the development of the body of the new premium SUV, providing services for the body-in-white, interior and exterior and fulfilling a range of cross-disciplinary functions. »

Unmistakable – the new generation of the Porsche Cayenne.

The impressive design of the new cockpit.

The Porsche Cayenne has an eye-catching exterior.

Eye-catching and unmistakable

The Porsche Cayenne is instantly recognisable and this unmistakable identity has been developed and enhanced in the new generation models. Its completely new, yet still familiar, exterior design clearly reflects the Porsche brand identity and reinforces the aim of the Cayenne to be the sportiest car in its class. The front of the new Cayenne is synonymous with performance. The pronounced bonnet with the distinctive “power dome” emphasises the wings, which lead into the redesigned headlight contours. The lateral trim strips on the central air intake now point outwards, enhancing the width of the vehicle and highlighting its athletic appearance. The front end is dominated by Porsche’s trademark large air intakes.

From the first drawing to the start of production

Bertrandt had already worked closely with Porsche before the start of this major project. The company was then awarded a contract to work on the development of the body for the Cayenne, which included aspects of the body-in-white, doors and closures, interior, cockpit, centre console, seats, insulation and trim. Other areas of the project included designing the connecting elements / cross-sections, evaluating drawings, organising the approvals process, FMEA and tolerance management.

Bertrandt also had to manage the integration of common parts from elsewhere in the Porsche Group.

For each work package, Bertrandt was given responsibility for function development. The engineers designed, simulated and tested components and ensured that they functioned correctly in the context of the complete car. In addition, they were responsible for producing the accompanying documentation. They evaluated drawings, coordinated the approvals process, planned and procured prototype components and provided support for the assembly process at Porsche’s plant in Zuffenhausen. The Bertrandt specialists’ responsibilities also included testing the prototypes in the complete car and in the components, together with the subsequent integration of the results into the development process, the independent analysis of test results and the identification and implementation of the necessary measures during two development phases. Following the prototype and construction phase, the components were developed further until they were approved for volume production. Bertrandt was also responsible for supporting activities, such as weight management, eliminating rattles and squeaks in the bodywork and change management with regular reporting.

The scope of Bertrandt’s responsibilities was a new challenge for the company – from the first drawing to the start of production.

Different working models were used within the process. For example, Bertrandt developed and designed the body-in-white, while Porsche prepared and produced the high-quality tools in Zuffenhausen and Bratislava. The cooperation with the suppliers of various modules, including interior components, involved a different working model. During the production development phase, Bertrandt managed the activities of this supplier together with Porsche. »

The car was tested all over the world.

A project with many highlights

A project of this volume and scope is naturally more complex. The extent of Bertrandt's responsibility for the body led to a different way of working with new roles and concepts. The integration of the platform components from the Porsche Group (air conditioning, fuel) also presented a challenge for the Bertrandt specialists. During the course of the project, the customer's and the suppliers' acceptance of Bertrandt increased. One particularly rewarding part of the project involved planning the tests of the bodywork on the car in extremely hot and cold climates throughout the world. Another interesting aspect was the interface with the production function. Bertrandt provided support for audits, quality meetings and body assembly processes during the start of production at the Bratislava plant. The comprehensive reports submitted to the customer's committees also played a key role in the development of the car. The result was a highly successful start to production.

In conclusion, this was a very interesting and wide-ranging project. Bertrandt was able to provide the customer with significant support and an efficient service, because the body components were developed to a large extent by one service provider. ■

Raimund Busse, Mönsheim

IN BRIEF

PORSCHE CAYENNE: BERTRANDT DEVELOPED THE BODY

Design

- Data control model / grey zone
- Design check model

Body-in-white

- Body shell
- Incorporating the platform requirements
- Developing, designing and simulating the differentiating features
- Developing two different joining concepts for the wings / bonnet
- Support for tool development, assembly and joining, body, quality and logistics processes
- Validating all the necessary, legally required and Porsche-specific functions

Doors and closures

- Doors: development, design and simulation
- Glazing: development and coordination with the supplier
- Seals: development in coordination with the interfaces to the interior, exterior and Porsche Group components
- Tailgate / spoiler: development and functional validation in cooperation with the supplier and in the context of the complete car

Interior

- Trim for doors, tailgate and luggage compartment
- Trim for the greenhouse
- Trim for the sills, integrating Porsche Group components
- Carpets / insulation
- Integration of the cockpit variants – independent management of the cockpit module developer
- Basic instrument panel and all the different variants / supporting frame
- Basic centre console and all the different variants

Exterior and add-on parts

- Front-end / rear-end and subassemblies: integration and management of design, simulation and testing
- Panoramic roof system and roof racks: integration and management of design, simulation and testing

Cross-disciplinary functions

- Simulation
- Production start-up quality
- Cross-disciplinary areas of body engineering
- Coordinating coloured parts

BMW EMERGENCY AND OFFICIAL VEHICLES:

A FAST AND SAFE RESPONSE

The police, the fire service and emergency doctors and paramedics have to respond quickly in difficult situations, which means that they need to be able to rely on their vehicles. The overall design and the special equipment of BMW emergency vehicles ensure that they are perfectly suited to the challenges of day-to-day work in the emergency services. The same applies to other official vehicles, which can be unmarked, armoured or designed for civilian use. Bertrandt Munich is responsible for developing and building these cars. »

Fully equipped for the everyday challenges of emergency service work.

Special features of the emergency vehicles.

More than 15 years ago BMW commissioned Bertrandt to develop emergency vehicles on the basis of the 3 Series saloon and estate models. This was the first time that BMW had assigned responsibility for designing and integrating all the special fittings, including the electrical and electronics systems, to an external partner. After the successful start of production of these cars, Bertrandt was commissioned to develop additional features and to supply special components to the BMW Group. This was followed by further orders to produce official vehicles. Since then Bertrandt has been constantly adding to its range of services and today it is responsible for developing components, manufacturing emergency vehicles both individually and on a production scale and supplying larger volumes of specialist parts.

From development to parts production

The project is divided into three areas: development, vehicle production and the supply of mass-produced components to the BMW Group plants.
Bertrandt acts as the general development service provider for all the factory and add-on solutions for BMW emergency vehicles. This includes all the models and derivatives from the MINI to the BMW 7 Series and covers the design and integration of all the special components. Bertrandt's cross-site network plays an important role with regard to validation, the use of the shaker and the salt spray test, simulation and VR.

The production of the vehicles involves special requirements, regardless of whether this relates to orders for marked and unmarked vehicles from the BMW Group or from end customers. Each type of vehicle needs specific items of equipment which can include a radio, roof signalling unit, horn loudspeakers, front and rear signalling units, an additional power supply with a backup function, the installation of special luggage compartment features and volume production or special bodies to meet customers' requirements. Bertrandt has all the necessary expertise. The services it provides include creating vehicle-specific production orders in the work preparation team, ordering equipment from external suppliers or Bertrandt departments, commissioning installation work, manufacturing the vehicles on the basis of the production order and the installation documents, interim and final testing by department specialists and the quality management team and regular internal and external vehicle audits to monitor and improve the quality of the production vehicles.
Another aspect of Bertrandt's activities is the small-scale production of parts. This is based on call-off orders from the BMW Group plants or the Bertrandt vehicle manufacturing department and on the creation of internal production orders. It also involves the assembly of specific components such as roof rails with angle brackets and wiring looms, B pillar trim with loudspeakers, tailgate trim with flashing lights and special emergency vehicle wiring looms. Bertrandt's quality assurance department also carries out the final inspection before the parts are delivered to the relevant BMW Group plants. »

A variety of models are used for emergency vehicles. Each of them has to be specially modified.

Tight production schedules

The project requirements are challenging. For example, in the case of the project for the police in the German state of North-Rhine Westphalia only three months elapsed between the order being placed and the project starting. During this time demonstrator cars had to be built and the production team set up. In the start-up phase around 300 vehicles were produced in seven weeks. While this phase was underway, technical changes were made to the equipment at short notice and a quality management process designed for the project was put in place. Before this the suppliers had to be identified and the entire logistics chain established. Bertrandt's experience and expertise ensured that the project was a success. Other internal success factors were the short-term interdisciplinary, cross-site cooperation on the basis of "strength through networking" and clear objectives in terms of deadlines and delivery quality.

Clearly defined structures ensure success

The Bertrandt specialists were able to meet the project requirements very quickly. Fast decision-making and permanent contact people made the process considerably easier. The close and constructive cooperation with the BMW development department throughout the course of the project proved to be very helpful in allowing the technical changes to be implemented quickly. Even customer requirements that were received at short notice could be fulfilled and the cars were delivered to the North-Rhine Westphalia police force on schedule and to the required BMW quality standards. Bertrandt also provided training at the customer's site on the use of the special equipment. ■

Jochen Hölzel, Matthias Fritsch, Munich

At Bertrandt in Munich the vehicles are prepared for deployment.

On top: conversion of special emergency vehicles.

Bertrandt now converts around 300 fire service, paramedic, police and survey vehicles each year to meet customers' individual requirements. The challenge lies in customising the cars and in manufacturing special brackets, wiring looms and equipment and developing specific operating concepts.
Other manufacturers are also making use of Bertrandt's specialist expertise. One particular example is the service car for the rescue helicopter operated by the ADAC (the main German motoring organisation).

IN BRIEF

BMW EMERGENCY AND OFFICIAL VEHICLES

Development

- Design and integration of all the special components
- Development of electrical and electronics components and software (including the virtual wiring loom)
- Creation of prototype components, such as brackets, wiring loom, electronics etc.
- Construction of demonstrator vehicles through to the approval process
- Validation of mechanical and electronic components
- Software modifications in control units
- Production support and ongoing development

Vehicle production

- Volume production of emergency vehicles (police, emergency doctor, fire service)
- Production capacity for up to 2000 vehicles per year, depending on the complexity of the manufacturing process
- Special bodies to meet customers' individual requirements worldwide
- Building survey vehicles
- Process-controlled production workflows
- End-to-end quality management

Supply of production parts

- Supply of special components for emergency vehicles to BMW plants
- Small-scale or individual production of wiring looms
- End-to-end quality management

„AUTONOMOUS DRIVING FROM BERTRANDT“

AUTONOMOUS DRIVING FROM BERTRANDT

AN INTERVIEW WITH PETER SCHIEKOFER ABOUT THE PARK AND CHARGE PROJECT

Experts agree that autonomous driving is the future of car travel and we are already seeing the rapid growth of this revolution in automotive engineering. Imagine that you are on the A8 motorway in Germany a few kilometres from the town of Ulm heading south. You are in the inside lane and the cruise control in your car is keeping it purring along at 130 km/h. You have taken your hands off the steering wheel and handed responsibility for driving to the car's computer. A truck is around 200 metres ahead of you in the same lane. Your car puts its indicator on independently. The steering wheel starts to move and rather hesitantly but steadily the car pulls out into the outside lane and overtakes the truck. Shortly afterwards a 100 km/h speed limit begins, followed by an 80 km/h limit. There is a speed camera at the side of the hard shoulder. Before you can brake, the car has done it for you. Then it indicates and returns to the inside lane. The speed limit ends and the car accelerates to the recommended speed that has been selected.

In the near future, this will be the reality of partially automated driving on our motorways using driver assistance systems. The latest production models have been equipped with the necessary sensors and cameras for some time and are already performing a number of tasks on our behalf. The debate is now centred not on whether the technology can do what it promises but on whether we want what the technology can do.

Bertrandt has been involved in this area for some years and has already developed its own innovative solutions. The Park and Charge project demonstrates the company's expertise in the field of electronics development for autonomous driving.

Peter Schiekofer, head project manager for driver assistance systems, autonomous driving and electric mobility, describes the project. »

The electric car will be sent the command to find a free space for charging and parking by an app.

// **The Park and Charge project is intended to be a showcase for autonomous driving. What exactly does it involve?**

Imagine that you are in your new electric car with friends on your way to have a pleasant meal in a restaurant. You arrive completely relaxed, because your car has automatically avoided all the traffic jams. The car stops right outside the restaurant. You get out and walk over to the entrance, but before you go into the building, you have to send your car to a parking space. The car battery is almost flat, so you need to charge it too. You get out your smartphone, open an app and tell your car to find an empty parking space where it can charge itself. Your car sets off without you and finds an empty space with a charging station. Once the battery is charged, the car moves to another space to free up the limited charging facilities for other cars to use. When you and your friends are ready to go home, you contact your car via your smartphone. It drives itself to the pick-up area and transports you safely home. This is exactly the scenario that we are working on.

// **Developing the human-machine interface (HMI) is a subproject in your scenario.**

That's right. Displays and machines are become increasingly complex and intelligent. The quality of the human-machine interface determines whether and how effectively we can use them. We are in the process of developing new methods of improving the understanding between people and machines which go far beyond switches, knobs and touch screens. Our primary goal is to create an innovative display for our own technology demonstrator. One aspect of this is the technical design of the displays, but it also involves user-related issues such as the evaluation of the interfaces. One area that we are focusing on is the development of a display and operating concept for our technology demonstrator. We are also setting up an interior design model, which is a sort of driving simulator, as a development and test environment where we can run user studies. This will allow us to evaluate displays at a very early stage and we can then feed back the evaluation into the ongoing development process. Another important area is app development. This makes it possible to interact with the vehicle remotely rather than directly. For example, you may want to check your car's charging status or tell it to pick you up at a specific time and place. »

We are developing new methods of improving the understanding between people and machines.

Our connectivity experts are helping us to integrate devices such as smartphones that can function as the HMI and safely initiate the autonomous procedure in the car after receiving confirmation from the user.

// Where do connectivity and back-end services come into your application?

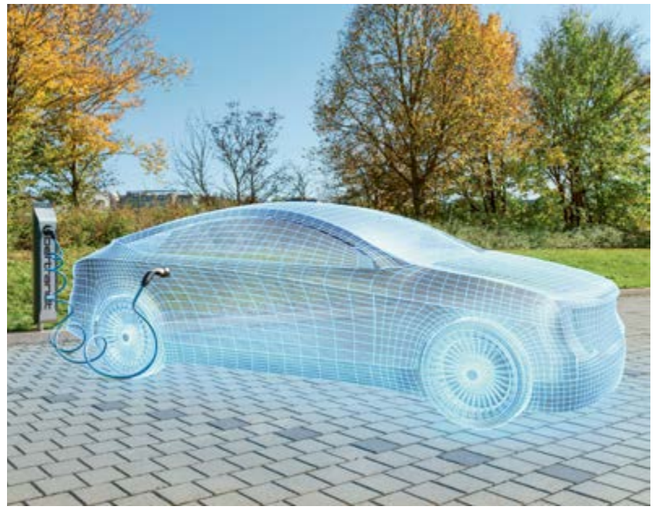
This is all about developing the architecture for autonomous driving, creating secure data transmission paths and designing a cloud-based platform. This platform will enable us, for example, to record vehicle data using sensors and store and evaluate it in the Microsoft Azure cloud. We are working on the communication between the vehicle and the back-end where the data needed for autonomous driving is processed, but we are also developing a solution-based platform. Our connectivity experts are helping us to connect several cars and, in future, fleets of vehicles to the Bertrandt cloud, together with other devices such as smartphones that can function as the HMI and safely initiate the autonomous procedure in the car after receiving confirmation from the user. The Automotive Analytics and Development Platform that we have developed is a solution for analysing sensor data and developing algorithms using artificial intelligence.

There are interfaces in all areas of autonomous driving. The software and the functions need data from the back-end for the purposes of localisation and environment recognition. The HMI uses data which is processed in the back-end and status messages about the technology demonstrator's current or subsequent actions for the display in the vehicle. For the charging system and infrastructure there need to be open communication channels that provide information about the car and its charging status. Our modular tool and engineering kit gives us a scalable end-to-end solution that can be adapted to the requirements of individual customers.

// One of the objectives of your project is to carry out autonomous manoeuvres safely. Which factors do you need to take into consideration?

Planning and implementing autonomous movements is a key issue. We are developing an intelligent, autonomous driving system that can react and make decisions independently using information from the car's environment. One very important aspect of this is software development. The goal of our project is to move the car autonomously and safely to a predefined parking space and to bring it back again on command. This means that we have to overcome many of the difficulties that we would encounter on public roads, such as high-precision localisation, obstacle recognition and planning the problem strategies. In addition to localisation, other important issues include environment recognition, trajectory planning, longitudinal and lateral control and further high-level functions. We need to know where we are at all times and what position the car is in. This is managed by the localisation function. The environment recognition system uses a wide range of sensors to identify and classify objects in the car's surroundings. These sensors also play an important role in the highly accurate localisation process. Using high-level functions we can bring together areas such as communication with the vehicle bus and the diagnostics system. If the owner of the car sends a remote command, we use all the information available to us about the environment in the trajectory planning process, which prepares a driving strategy to send the car safely to the parking space. The longitudinal and lateral control function is responsible for following the trajectory or route. This requires very high-level control algorithms for the steering, powertrain and brakes. »

We have to overcome many of the problems that we would encounter on public roads.



The battery can be charged from a normal mains socket using an integrated AC charging device or at an external fast-charging station.

// **Electric mobility is another area that your project is focusing on and you are involved in battery development. What have the results of your work been so far?**

We want to use the expertise that we have gained from developing a battery for the technology demonstrator to offer our customers a complete solution for the development of battery derivatives. We are using the latest lithium ion cells with a high volumetric and gravimetric energy density. As a result, our battery system is around 60% lighter and more compact than existing products. It consists of several battery modules, an efficient battery management system (BMS) and a battery junction box. Each module is made up of several cells and has sensors to monitor the temperature and voltage. This data is transferred to the BMS from the cell controllers. Software algorithms in the BMS use the data to ensure that the cells are operating within a very narrow temperature and voltage range. The BMS data is subsequently sent to the car via the CAN.

// **What is the connection with autonomous driving?**

Autonomous driving requires energy, services and availability, for example, from the vehicle's high voltage system. This consists of an electric battery and power electronics. The battery provides the power for the drive system and the vehicle's electrical network. The power electronics system converts this power into the form of energy that is required. The battery can be charged from a normal mains socket using an integrated AC charging device or at an external fast-charging station. The battery data is sent via the BMS over the CAN system to the technology demonstrator's domain controller and presented on interactive displays by the HMI. The connectivity system and the backend ensure that the data is also sent to the Bertrandt automotive cloud where it can be accessed using smartphone apps, for example. Our development process helps to ensure that our battery system meets the functional safety requirements of ISO 26262 and the quality standards of Automotive SPICE.

// **Finally I'd like to ask you a personal question about autonomous driving. What do you think the future will look like?**

I am already looking forward to the day when I no longer have to drive and can make better use of my time. Autonomous driving is definitely on its way. All the main car manufacturers agree on this. The question is simply when it will be supplied in production models and what the first application will be. It is likely to be on the motorway where there will be a motorway chauffeur as a driving function. We expect this to be available on a wide scale between 2025 and 2030. Autonomous driving will change the way we travel. We will become more mobile, but the mobility systems will be very different. It is not yet possible to predict what autonomous driving will be like in cities. One challenge still to be overcome is the combination of manually driven and autonomous cars on the roads. ■

The interviewer was Gudrun Remmlinger.

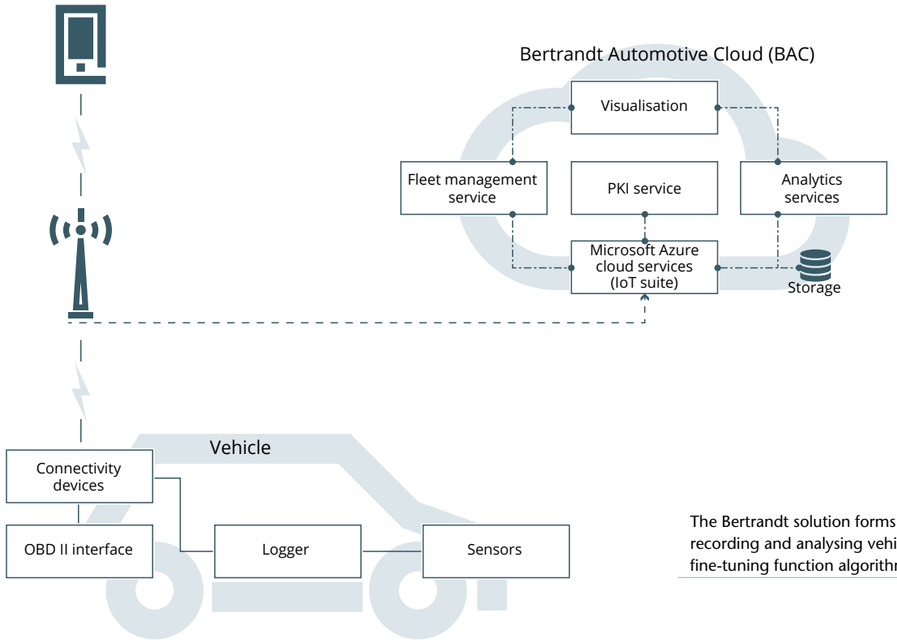
> We will become more mobile, but the mobility systems will be very different.

CERTIFIED FOR AZURE AND THE HOLOLENS

COOPERATION AND PARTNERSHIP WITH MICROSOFT

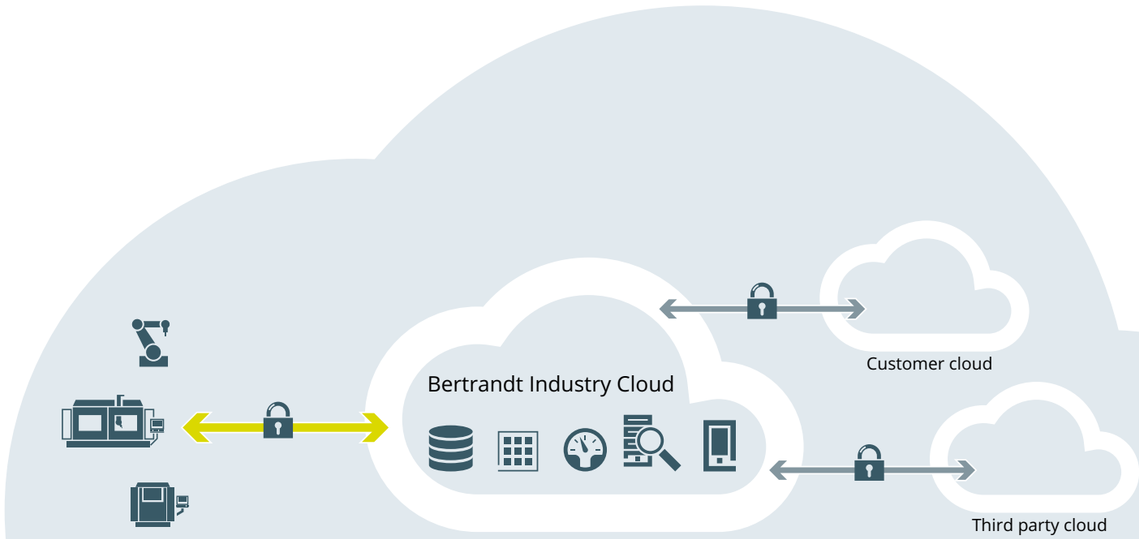
Bertrandt and Microsoft Germany presented a joint project in the field of cloud computing at the Frankfurt International Motor Show. The aim is to make driving more comfortable and safer in future. The Automotive Analytics and Development Solution uses sensors to capture vehicle data and to store and analyse it on the Microsoft Azure cloud platform. In addition, for some time Bertrandt has been using mixed reality technology in the form of the Microsoft HoloLens headset for application development, which makes it possible to add digital content to the real world. The certification process for the HoloLens with the Holographic Academy has already been completed.

The Automotive Analytics and Development Solution is a platform that Bertrandt's customers can use to access vehicle data. It allows Bertrandt to provide customers with a complete sensor data analysis service. In addition, Azure makes it possible to store huge volumes of data. The Automotive Analytics and Development Solution is used for analysing vehicle and sensor data and for developing algorithms using artificial intelligence. The platform is designed to manage a large volume of data and complex algorithms. The Bertrandt solution forms the ideal foundation for the following use cases: capturing and analysing vehicle data, developing and fine-tuning function algorithms and evaluating the functional properties and usability of sensors. Bertrandt made its first public appearance as a Microsoft partner in April 2018 at the annual conference of the Microsoft Business User Forum in Stuttgart and gave presentations about the HoloLens and the Azure cloud platform, as well as putting its show car on display. »



The Bertrandt solution forms the ideal basis for recording and analysing vehicle data, developing and fine-tuning function algorithms and evaluating sensors.

The Bertrandt Industry Cloud offers new opportunities for taking developments forward in the field of the IoT. Among the many possibilities are the use of data analytics in testing, automated design (artificial intelligence), collecting machine data (predictive maintenance), fully automated supply management (logistics) and interpreting via Skype on the HoloLens.



Azure

Using the Automotive Analytics and Development Solution it is possible to record vehicle data supplied by sensors, to store it on the Microsoft Azure cloud platform and then to evaluate it. Developments of this kind are based on cars that are already equipped with sensors or have had additional sensors retrofitted. This allows any type of data to be saved and evaluated. The data is also sent to the Microsoft cloud via the mobile network and is then available for further processing.

This is an important step towards autonomous driving, which requires vehicles to be connected to one another. Algorithms developed using the new solution will allow traffic congestion and speed limits to be detected, for example, and the location of damage to the road surface, such as pot holes, to be identified. Using this information, following vehicles will be able to adjust their speed and their chassis and suspension settings automatically. This will give the occupants a more comfortable ride and at the same time reduce wear on the cars. Another important consideration for autonomous driving is safety and this new solution also results in an increase in safety levels. For example, if there is heavy rain or ice on a particular stretch of road, this information can also be passed on to other vehicles in the form of swarm data. These cars can then adapt their speed to suit the conditions or choose a different route.

The sensor data is managed centrally by the Microsoft Azure cloud platform and stored in an Azure data lake or database cluster. Azure stream analytics are then used to analyse the data and produce forecasts. Bertrandt will make available its automotive expertise and also services such as stream analytics for analysing the necessary statistical algorithms. The results will be presented in the form of interactive graphics which will help developers to make cars more comfortable and safer in future.

In addition, by evaluating the swarm data it will be possible to make predictions, for example about how the road surface will wear. This will enable public authorities to plan road repairs more accurately and to gain a better understanding of the condition of the roads. The cloud solution has one further benefit. The process involves collecting large volumes of data and developing complex algorithms, which requires a huge data storage and evaluation capacity. Microsoft Azure provides this in a scalable and secure form.

THE MICROSOFT HOLOLENS IN USE

THE LATEST TECHNOLOGY AT BERTRANDT

Yesterday it was science fiction and today it is reality: virtual items that you can interact with in space in the form of holograms which add information, colours, shapes and even noises to real objects. The HoloLens, a mixed reality headset from Microsoft, can be used in an industrial environment, as well as its more obvious applications in gamification.

Increasingly intelligent subsystems are being developed as part of the moves towards Industry 4.0. As the intelligence levels of the systems increase, so too does their complexity. Extensive expertise is needed to carry out repairs and maintenance to components of this kind and a long familiarisation period is also required. The increase in the number of variants, for example in the aviation industry and in automotive development, brings new challenges for repair work. The use of the HoloLens will make it possible to carry out a variety of repair and maintenance activities on the components of a machine or a device without having detailed knowledge of the system, because holograms can be displayed to explain the individual steps that need to be taken.

Over the next few years augmented reality will play a key technological role in the field of B2B services. Deutsche Bank Research is forecasting growth in the global market for AR from the current level of 500 million euros to 7 billion euros by 2020. In a survey carried out by the Gesellschaft für Informatik, a specialist IT association in the German-speaking countries, around 60% of the companies questioned had definite plans to use AR with mobile end devices and / or headsets by 2022 at the latest. Bertrandt is demonstrating its skills in this new technology at an early stage. ■

GUIDED MAINTENANCE APP

VISUALISING SERVICE AND MAINTENANCE ACTIVITIES

The HoloLens Guided Maintenance app developed by Bertrandt enables the service and maintenance work on an electric aircraft to be visualised, documented and made simpler in the long-term. Holograms are used to show the stages involved and to display safety information in a detailed and easily understandable form, which allows technicians to work safely even if they only have a general knowledge of repairing and maintaining aircraft. The app also has a positive impact on the training of technicians, because practical sessions can easily be held using a digital twin of the aircraft motor. The holograms are as realistic as the actual object and there is no risk of damaging sensitive components of the aircraft.

Rapid implementation in reality

After the virtual training course, the work on the real aircraft begins with the help of virtual elements. The app is divided into three areas: information, service and repairs. The information area gives an insight into the current status of individual components. The service and repair areas provide detailed, step-by-step instructions on servicing and repairing the electric aircraft which are complemented by holographic animations. In both these areas there is also an emphasis on logging and documenting the entire process. This allows the work and the decisions made to be easily tracked. Confidentiality also plays an important role. Password-protected profiles, which require the technician to log in before the work or the documentation process starts, prevent unauthorised use of the system.

Unlimited use of the HoloLens

The Bertrandt use case is an impressive demonstration of the almost unlimited possibilities of augmented reality. It is not only being used on AR headsets and head-mounted displays. For example, Bertrandt has an AR app for specialist areas that runs on ordinary mobile devices such as smartphones and tablets. Even the smallest objects can be virtually augmented with impressive results. The flexible choice of hardware makes the app ideal for B2B and B2C applications, for example for the joint monitoring of production facilities with operating data displayed via a live stream or for use by museum visitors.

The HoloLens Guided Maintenance App is designed to meet future requirements and can be scaled up at any time, for example by adding interfaces to other systems, databases and smart tools. This makes ongoing industrial networking a reality and removes the obstacles in the way of future developments. ■

Leonard Kaup, Axel Unger, Ingolstadt

NEW INTERIOR STRUCTURE MADE OF CARBON

FIBRE-REINFORCED INSTRUMENT PANEL FRAME FOR ELECTRIC CARS

The Carbon Carrier, an innovative instrument panel frame made from carbon fibre composites, is the product of a cooperation between Bertrandt and SGL Carbon. The lightweight structure is designed to accommodate the different force and load paths in electric cars. At the same time, it improves function integration by linking together assemblies made from carbon fibre-reinforced composite sheets.

The complete system for the instrument panel frame, which is made primarily from carbon fibre, represents a new concept that integrates a number of different functions. The new frame performs the tasks of the current instrument panel, instrument panel frame and centre console. A unique feature of the new component is its integration into the overall concept of a stiffness-related tunnel load path.

The Carbon Carrier demonstrates the potential of new structural components for vehicles such as convertibles and coupés and in particular for models with electric powertrains. This is based on the principle that the convertible and coupé body variants need to compensate for the lower levels of stiffness that result from the level floor required for the battery package. In order for the Carbon Carrier to provide support in this area, its structures and its connections to the vehicle body need to be newly designed. Its bending stiffness has been improved by means of a brace on the bulkhead that can extend as far as the heelboard. The Carbon Carrier can support all the other instrument panel components and takes into account the latest requirements for vehicle bodies and interiors. It replaces the conventional modular cross beam in the body-in-white, the instrument panel frame and the tunnel, including all the relevant functions. »

The right technology for every fibre composite component: Radius-Pultrusion with an extrusion coating for the bulkhead brace.

The key side rail component is manufactured from braided towpreg.

The side rail console: BMC / SMC with a towpreg surround.

Large-scale production of the Carbon Carrier

During the process of developing the Carbon Carrier, the engineers focused on ensuring that the materials, technologies and assembly concepts would be suitable for volume production either now or in the near future. In addition, the latest results of research and pre-development activities at Bertrandt, SGL Carbon and other research institutions were included in the process.

Innovative exhibit made from fibre-reinforced plastic

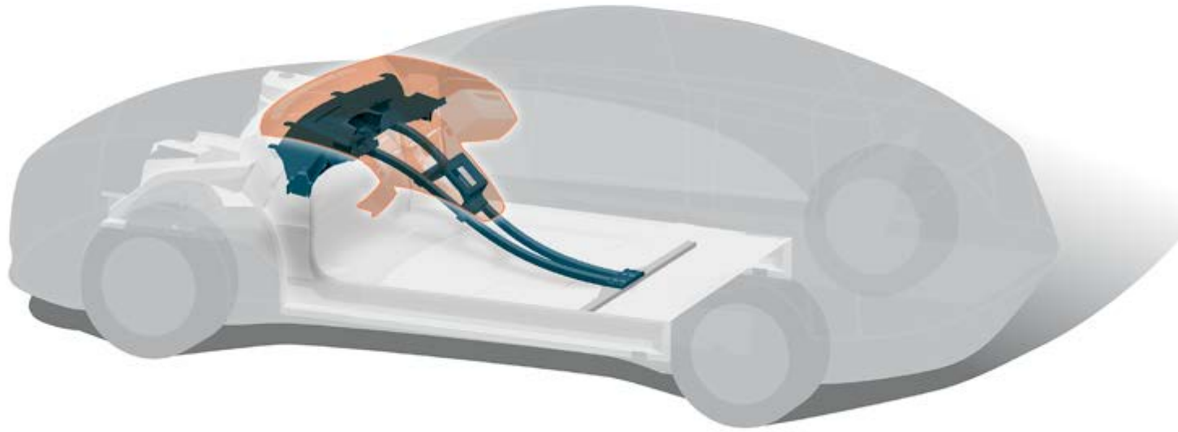
This highly innovative component with the potential for volume production demonstrates how new structures can be incorporated into modern vehicle concepts. Both companies have increased their knowledge of the mass production process for new types of structural concepts in today's vehicle bodies, starting with the initial idea and the pre-development activities and also including the design and the close interaction between CAD, CAE and production.

This knowledge has been put into practice in an exhibit that can be used by both companies to illustrate the different challenges and solutions involved in the increased use of fibre composites in the structure of vehicles. The newly developed component has excellent structural properties and a pleasing aesthetic appearance. It also forms the basis for the use of other combinations of materials and technologies.

The Carbon Carrier is an innovative, integrated concept for use in interior structures that can be made available to large-scale vehicle manufacturers and producers of niche models and incorporated into their vehicle designs.

Bertrandt and SGL Carbon regard the new structural component as an opportunity for working with users and end customers to increase their understanding of the use and behaviour of fibre-reinforced plastics and, in particular, CFRP. It will also allow more sophisticated components and systems to be designed specifically for these materials. ■

Michael Hage, BPG



PROJECT X-TRACK

A MOBILE LAB FOR TESTING ACTIVE SAFETY, DRIVING DYNAMICS AND BRAKE SYSTEMS

Bertrandt has a long and successful history of function validation for the automotive industry. An extensive range of test facilities is available within the Bertrandt Group, which makes it possible to offer customers a comprehensive portfolio of services. When we look at the future of the automotive industry, in particular with regard to highly automated driving, it becomes clear that there is already a huge demand for validation services, which is likely to increase. This is precisely where project x-track comes in. It provides testing facilities for automated driving functions and driving dynamics and braking systems.

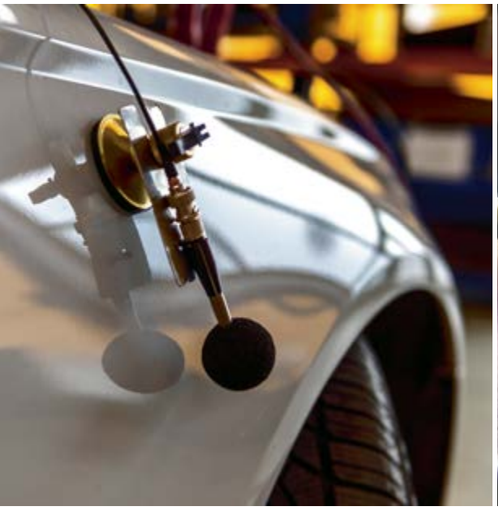
The special feature of the project is that it makes available all the test equipment needed by the Bertrandt Group in mobile form. How does this work? The answer is that Bertrandt has its first mobile testing lab. It is based at the company's Gaimersheim site and is ready travel from there at any time to other Bertrandt sites or to test tracks throughout Europe.

Measurement data on the display in the bus.

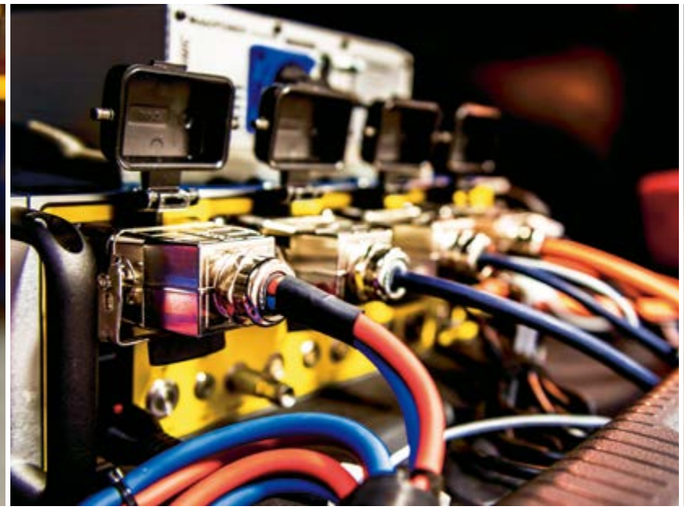
Equipped with innovative systems

The MAN bus is fitted with a complete set of inertial measurement equipment, a dGPS base station, driving robots, test facilities for predictive pedestrian protection and emergency braking scenarios, brake measuring systems and measurement steering wheels for driving dynamics tests. It also has a mobile workshop, its own power generating facilities and systems for documenting the test results and the weather and light conditions, which allows it to operate independently on any test track. It uses cutting-edge technology that meets the testing requirements of the 2018 Euro NCAP protocol. Bertrandt is already fully prepared for the new protocol, in particular with the newly introduced Global Vehicle Target (GVT) and a mobile platform. This allows the emergency lane keeping systems planned for 2020 to be tested now, together with traditional emergency braking functions such as City AEB. The platform's speed range of up to 80 km/h and the GVT attached to it allow all possible scenarios to be tested with any trajectories, including a vehicle turning off a road.

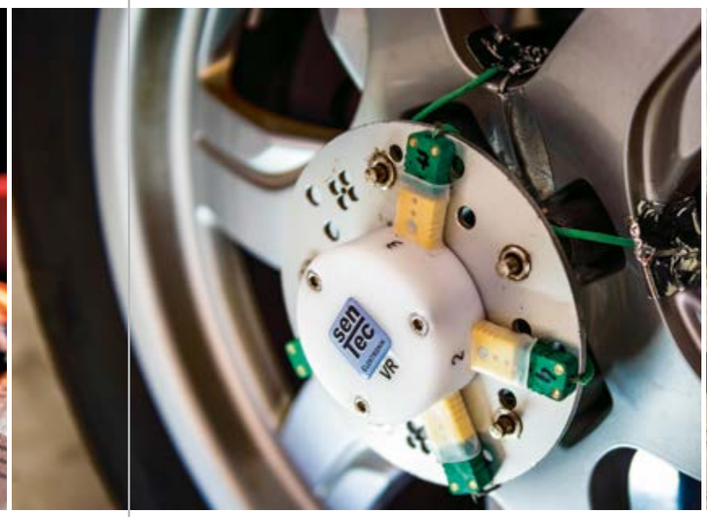
In order to be able to test the function of different brake systems directly, the bus also has a special measuring unit which can record the temperature of the brake discs, the braking pressure in the hydraulic hoses, the force that is being applied to the brake pedal and the acoustic influences that result from squeaking brakes. »



Investigating brake noises.



Controlling the driving robots.



Measuring the temperature of the brake discs.

GVT and VRU dummy in use.

As all of these things have to be assessed in relation to the vehicle's surroundings, the mobile lab is equipped with a highly accurate weather station that can monitor and document the environmental conditions on a minute-by-minute basis. These include factors such as temperature, ambient humidity and brightness.

Emergency braking at night

It is not only the intensity of the daylight that is of interest, but also conditions at night. Since 2018 this has been one of the conditions in the scenarios defined for emergency braking systems by EuroNCAP. A special light set-up is added to the test with a cable winch system and pedestrian dummies. Special mobile lamp posts are used for the purpose. Accurate measurements must be made in advance to ensure that the light cones are fully reproducible. This represents a major challenge for current emergency braking systems.

Making complex driving manoeuvres reproducible

When the basic conditions are right, the test system has been set up and the measuring equipment is ready for use, the important consideration is that the car hits the dummies in exactly the right place or performs a reproducible movement, such as the fish hook manoeuvre in the field of driving dynamics. This is when Bertrandt's robotic driving system is used, which consists of steering, acceleration and braking robots. The robotic system makes it possible to create accurately reproducible trajectories. The system can orient itself using the dGPS units in the targets or other vehicles and the corrective data from the base station, which results in an accuracy level of just a few centimetres.

The x-track mobile lab is equipped to meet a wide range of testing requirements on test tracks. It represents another milestone in the story of testing at Bertrandt – a flexible solution with a variety of applications. ■

Kai Golowko, Ingolstadt

Measuring the braking force being applied.

LASER-BASED SCANNING PIXEL LIGHT

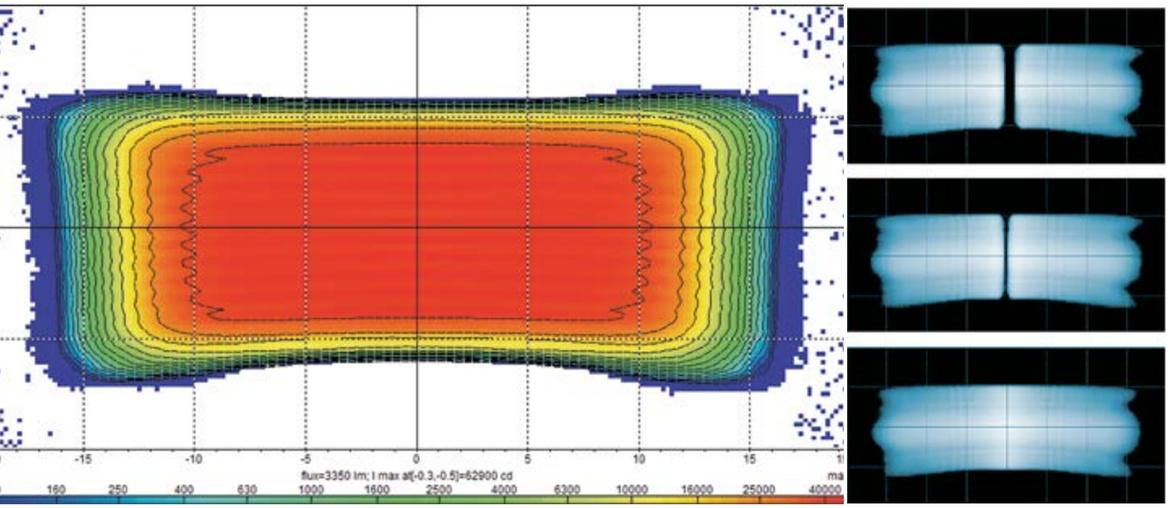
A LOOK AT THE LIGHTS OF THE FUTURE

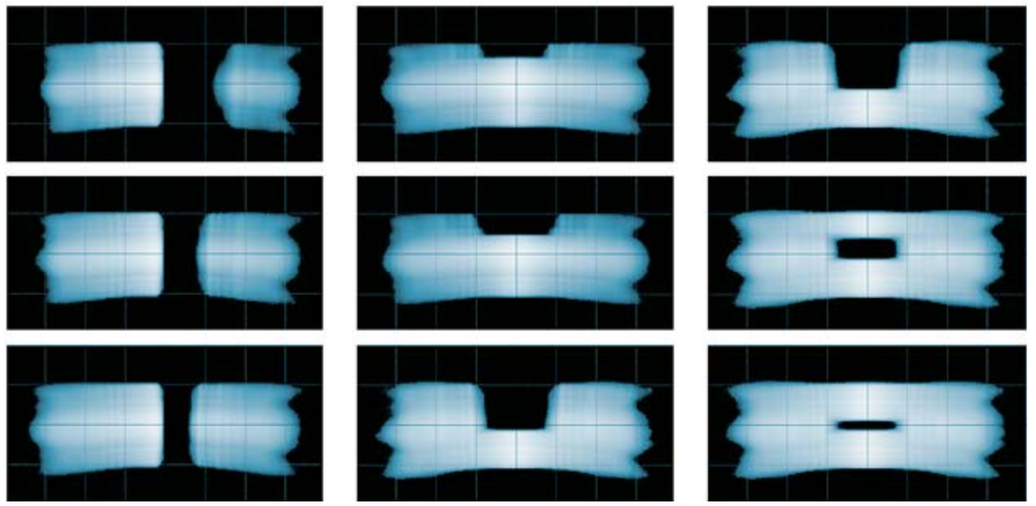
Halogen, xenon and LED headlights are already standard features in a wide range of models, but some interesting changes can be expected in the near future in this area, including the introduction of laser technology into vehicle lighting. Bertrandt has designed a high-resolution projection module based on this technology: the laser-based scanning pixel light.

The lighting department at Bertrandt's Cologne site has been in existence since 1995 and there have been a number of new developments in this field in recent years. The headlights of the future will be able to do more than just light up the road. Modern lighting systems provide the best possible distribution of light and also display information for drivers and pedestrians. The result is a significant improvement in safety. Bertrandt's engineers are working with this functionality to develop systems that will be used in the cars of the future. »

THE LIGHTING REQUIREMENTS FOR THE HEADLIGHTS OF THE FUTURE:

- High resolution
- Fading individual pixels in and out
- Variable light distribution





Simulation results:
fading pixels out horizontally.

Introducing a new technology

The goal is to provide users with the best possible light distribution in any given situation. The main features of the light systems that the engineers are working on include maximum depth and breadth of lighting, a design that prevents oncoming traffic and pedestrians from being dazzled, the ability to highlight obstacles that have been identified and functions that illuminate road signs and project information on the road. High-resolution lighting systems are needed to meet these requirements. The automotive industry is currently exploring three technologies: MEMS, DMD and LCD. The specialists in Cologne are taking a fourth approach: the laser-based scanning pixel light which was presented at the conference of the Association of German Engineers (VDI) in Karlsruhe. The technology received a very positive response and Bertrandt was immediately commissioned to develop a prototype system.

Increasing skill levels

The project began with the initial idea and ran through to the construction of the first prototype. As the system was being developed on the basis of a completely new technology, there were no reference projects available with findings or other information that could be used. The project enabled Bertrandt to expand its skills in basic research, system requirements, customers' needs, regulations, vehicle integration and mechanical, optical and electronic system development.

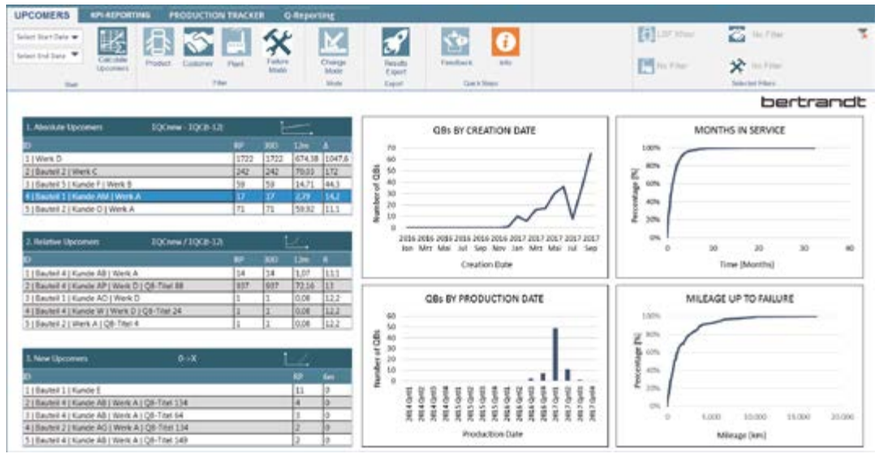
In a strong position for the future

The USP of this project is that Bertrandt's Cologne site can provide all the disciplines needed for the development of lighting systems and has expertise covering all the phases of the process right through to the start of volume production. This includes the design of headlights and rear lights, simulation and visualisation of lighting, thermal simulation and electronics development. This combination of skills will continue to be a factor in the success of the Cologne site in future. Light is becoming an increasingly important feature of cars, not only as a design element, but also as an intelligent function. For Bertrandt it was essential to move one step ahead and to help to shape the future by designing the pixel light. No one currently knows how lighting systems will develop in autonomous vehicles. The Bertrandt specialists are working on the assumption that light will continue to play a key role even if there is no driver.

Sensor systems need light and are sometimes even based on lighting functions. In addition, "being seen" will continue to be crucial and it is likely that lights will also be used to communicate with other road users. ■

Mario Dotzek, Christopher Klein, Marcel Schlesier, Ulf Stiegen, Cologne

ALWAYS ONE STEP AHEAD WITH B.ALERT



By combining our expertise in quality management and software development, we can help our customers to manage the digital transformation.

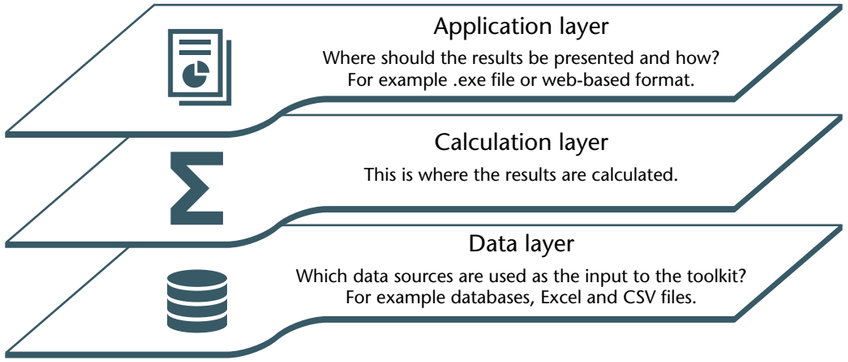
THE BERTRANDT TECHNIKUM HAS DEVELOPED A TOOLKIT FOR THE EFFICIENT ANALYSIS AND EVALUATION OF COMPLEX QUALITY DATA

The starting point – the digital transformation in the automotive industry

Across almost every field of business people are talking about the digital transformation. This subject is of particular importance to the automotive industry in the light of developments such as autonomous driving, electric vehicles, connectivity and networking. In addition to the vehicle functions and systems, it also affects the business processes of vehicle manufacturers and automotive industry suppliers. Development and production processes and also administrative processes, such as procurement, controlling and quality management, can be networked and fine-tuned using intelligent digital systems. Bertrandt has developed the b.alert quality management toolkit to support its customers during the digital transformation of quality management activities.

Challenges in quality management

Quality management consists of a variety of tasks that range from quality planning during product development to managing production quality and failures in the field. The challenges faced on a day-to-day basis by quality engineers include increasingly complex products with a large number of variants, complicated fault patterns, global production networks, customers' growing requirements, interpreting large volumes of complex quality data and complying with automotive industry standards.
The objective of b.alert is to provide algorithms to help quality engineers to analyse and evaluate large amounts of complicated quality data, identify and assess risks, carry out process analyses and produce reports. »



Three-layer architecture:

The database and the user interface can be customised to meet individual customers' needs.

b.alert – the quality management toolkit from Bertrandt

b.alert is a modular software package that functions as a kind of construction kit. It currently consists of four units which can be used independently. Each of these four tools is based on a three-layer architecture. The benefit of this architecture is that the database and the user interface can both be customised to meet individual customers' needs. Different interfaces to databases and other data sources and different types of evaluation in the user interface have no impact on the calculations and algorithms, which allows b.alert to be set up quickly on customers' systems. The programmers who developed b.alert focused on making the system as user friendly as possible. Its intuitive user interface enables results to be accessed quickly and easily which means that effective use can be made of the existing database.

Agile product development with Scrum

b.alert was developed as an in-house project with agile structures based on Scrum. The product owner continuously recorded and prioritised the complex requirements in a product backlog (requirements specification). Specific work packages, known as product increments, were developed in ongoing iterations called sprints. The Scrum team came together for a daily Scrum meeting to discuss the results of the work and agree on the current tasks and challenges. This ensured that the results were functional and compatible, the project objectives were achieved and the team remained as agile as possible with regard to external influences and new requirements.

Cooperative models

Using tailor-made cooperative models, Bertrandt can adapt b.alert to its customers' individual requirements. The targeted combination of consultancy services and the four units in the b.alert toolkit brings the greatest possible benefits for customers. The team of consultants uses the software to run data analyses and to produce evaluations. The results are presented to the customer at regular review meetings. The analyses can be reproduced at any time and more detailed assessments can also be created. The export functions of b.alert allow individual data records to be exported and complete sets of presentation slides to be produced in common file formats. This makes it easy to process the results of the analyses quickly. All Bertrandt's customers will, of course, benefit from the ongoing technical and methodological development of b.alert and the regular updates. ■

Martin Endres, Alexandros Velikis, Ehningen

B.ALERT – THE TOOLS

EARLY WARNING SYSTEM (EWS)

How can potential quality risks be identified at an early stage and their progress be analysed?

An algorithm in the EWS identifies possible risks. It checks all the combinations of predefined attributes and their elements using mathematical criteria and key figures. Depending on the number of attributes and elements, millions of combinations can rapidly be calculated and evaluated. Critical combinations are prioritised in the tool and subjected to an in-depth analysis.

PRODUCTION TRACKER

How can quality defects in production be identified using field data where there is a large number of products or plants?

In a similar way to the early warning system, an algorithm checks all the combinations of predefined attributes and their elements. Each production period (day, week, month or quarter) in the combinations is evaluated and prioritised using mathematical criteria and key figures. The most important production periods and the accompanying combinations are displayed in the tool and analysed in detail.

PROCESS KPI SYSTEM

How can complex processes be made transparent and performance be measured during the individual stages of the process?

The models of the workflows in specific customer processes are stored in the tool. Incoming and outgoing goods and the start and end dates of the workflow are evaluated on the basis of the raw data. Using jointly defined evaluation methods (for example throughput times, Pareto principles etc.), the calculated results are analysed and displayed.

QUALITY REPORTING

How can the high cost of producing (quality) reports be reduced by automating the process?

In the quality reporting tool, a configurator can be used to design complete reports. A series of evaluation methods are stored in the tool for this purpose. New evaluations can also be created and added to the tool. The reports can be produced in common presentation formats at the click of a mouse. Different variants of configured reports can also be saved and accessed at any time by users. This makes it possible to create new versions of reports with updated data quickly and easily.

Attributes are defined by their **elements**. **Combinations** are groups of elements.

Examples of attributes:
- Products, plants, production lines, fault patterns / codes, customers, suppliers

Examples of elements:
- Product attribute: headlight, ECU, steering gear
- Plant attribute: Ehningen, Munich, Tappenbeck

Examples of combinations:
- Headlights from Ehningen
- Steering gear from Munich for customer X

BERTRANDT WORLD

Ehningen, Technikum

INNOVATIVE VIBRATION TESTS

A PROJECT WITH
EBERSPÄCHER CLIMATE CONTROL
SYSTEMS GMBH & CO. KG

The air conditioning systems manufactured by the Eberspächer Bus & Coach business unit must undergo thorough testing before being delivered to customers. A new profile for the shaker test bench enables the systems to be tested to the limit. It simulates the poor road conditions sometimes found in Mexico, including potholes and bumpy surfaces.

Some of the roads in Mexico are not exactly smooth, which can turn a bus journey into an exciting experience. With all the bumps and potholes, a bus ride can sometimes seem like an off-road trip and some buses do travel on unsurfaced roads. This not only puts the vehicle itself to the test, but also the air conditioning system on its roof. The goal of the project was to develop a new standard for vibration tests that comes as close as possible to the real-life conditions in countries like Mexico.

The Bertrandt specialists visited Mexico together with Eberspächer to gain an idea of what the country's roads are like. There were three buses, three cities and three scenarios and the test drives produced quite different results. Surprisingly, the worst-case scenario was not the unsurfaced road near La Paz, but a relatively wide main road in Monterrey. The combination of high speeds and large numbers of potholes led to the highest level of stresses and therefore to the toughest conditions for the air conditioning system.

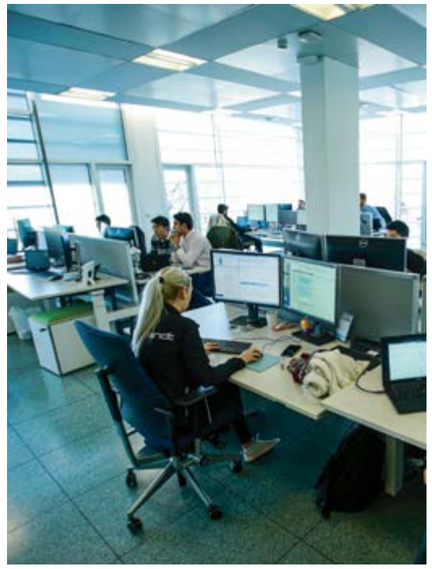
Back in Germany, the team used the results to develop a new profile for the vibration test. The test bench simulates overlapping movements in several axes and reproduces the real-life conditions very closely. The test will be used early in the process of developing new products and new generations of products. It will involve shaking the air conditioning system over a period of several days to discover where the greatest vibration occurs, what possible damage can be caused and what changes are needed in the design, such as different mounts or connectors. The results of the hexapod test will allow the air conditioning systems to be designed in future to withstand potentially challenging conditions as efficiently as possible. ■

Rüsselsheim

INCREASING ADAS EXPERTISE

Bertrandt has opened a new site in Koblenz to develop its expertise in the field of driver assistance systems and brakes even further. The new premises will enable Bertrandt to offer its customers in the region individual development solutions. In addition, Bertrandt will be able to expand its services relating to the main trends in the automotive industry and strengthen its company network. The site will focus on driver assistance and braking systems. The range of services available includes electronics, validation, process management, bodywork and road testing. The engineers and technicians in the Koblenz team will have an area of around 1000 m² at their disposal. ■

BERTRANDT WORLD



Spain / Castellví de Rosanes

EXPANDING CAPACITY

At the start of the new financial year 2017 / 2018, the team at Bertrandt's site in Spain moved into their new building in Castellví de Rosanes near Martorell. This was an important step towards consolidating the company's position in Spain. The new building in Castellví de Rosanes has modern, well-equipped workplaces and, in particular, plenty of space for laboratories and workshops. This makes Bertrandt Spain an attractive and strategic partner for its customers and puts it in a strong position to provide production-related services in the fields of electronics development, design, powertrains and quality management. ■

Neckarsulm

NEW SITE IN SANT'AGATA BOLOGNESE

Because of its close cooperation with a customer in Italy, the Neckarsulm site has opened a new office in Modena. Following a collaboration that has already lasted for five years, it will now be able to provide its customer in Sant'Agata with comprehensive local support. ■

Cologne

ELECTRONICS DEVELOPMENT IN ESSEN

The new building in Essen will allow Bertrandt's Cologne site to expand its electronics development expertise, which is needed because of the growing number of projects in this field. In March 2018 around 40 employees began working in the new building, which has a floor area of around 400 m². In the medium term the workforce is expected to grow to around 100. The new site will support new and existing customers in the automotive industry. Its proximity to the universities in the Duisburg and Essen area is also a benefit. The team in Essen is expected to work closely with the academic institutions in areas such as autonomous driving, electric vehicles, software development and the Internet of Things in order to develop its expertise even further. ■

CORPORATE SOCIAL RESPONSIBILITY

HELPING TO FUND EVERYDAY MOBILITY

Bertrandt supports the Paravan Foundation which aims to improve the quality of life of disabled and disadvantaged people by providing them with mobility solutions. This could include converting a car for a disabled person, adapting a wheelchair, supplying learning aids for disabled children and offering expert advice on all aspects of restricted mobility. Our donation will help to bring some happiness to these people's lives and to improve their day-to-day mobility.

AFB – SOCIAL AND GREEN IT

In order to ensure that its employees can work as efficiently as possible, Bertrandt regularly replaces its IT equipment, including laptops, monitors and smartphones. A partnership with AfB (a charity that provides employment for people with disabilities) proved to be the ideal socially and environmentally responsible solution to the problem of Bertrandt's redundant equipment. Europe's first non-profit IT service provider reconditions unwanted hardware to reduce the harm caused to the environment and, at the same time, to create jobs for people with disabilities. Usable equipment is reconditioned, has new software installed and is sold with a warranty. Devices that can no longer be used are expertly dismantled, recycled and returned to the raw materials market. This reduces the amount of electrical waste produced and the number of new items being manufactured. Other consequences include lower levels of v emissions and a reduction in the amount of natural resources being mined. In addition, the cooperation helps to provide secure jobs for disabled people.

ADVENTURE IN A GOOD CAUSE

The Baltic Sea Circle Rally is a 7500 kilometre adventure all around the Baltic Sea which involves breathtaking scenery, the unique natural spectacle of "white nights" and the polar days at the summer solstice, together with bumpy roads, long empty beaches, isolated archipelagos and deep fjords. Bertrandt supported a team on its journey to the North Cape. This was a charitable event and the money raised by the teams went to a cancer charity and a Moebius syndrome charity in Germany.

BLOOD DONATION WITH THE GERMAN RED CROSS

Several Bertrandt sites organised local blood donation events with the German Red Cross. The company's Wolfsburg site was among them for the first time. The idea came from the health management team and the response from employees was very positive, with around 130 taking part. Every day 15,000 units of blood are needed in Germany and the Bertrandt employees' aim in donating blood was to help other people.

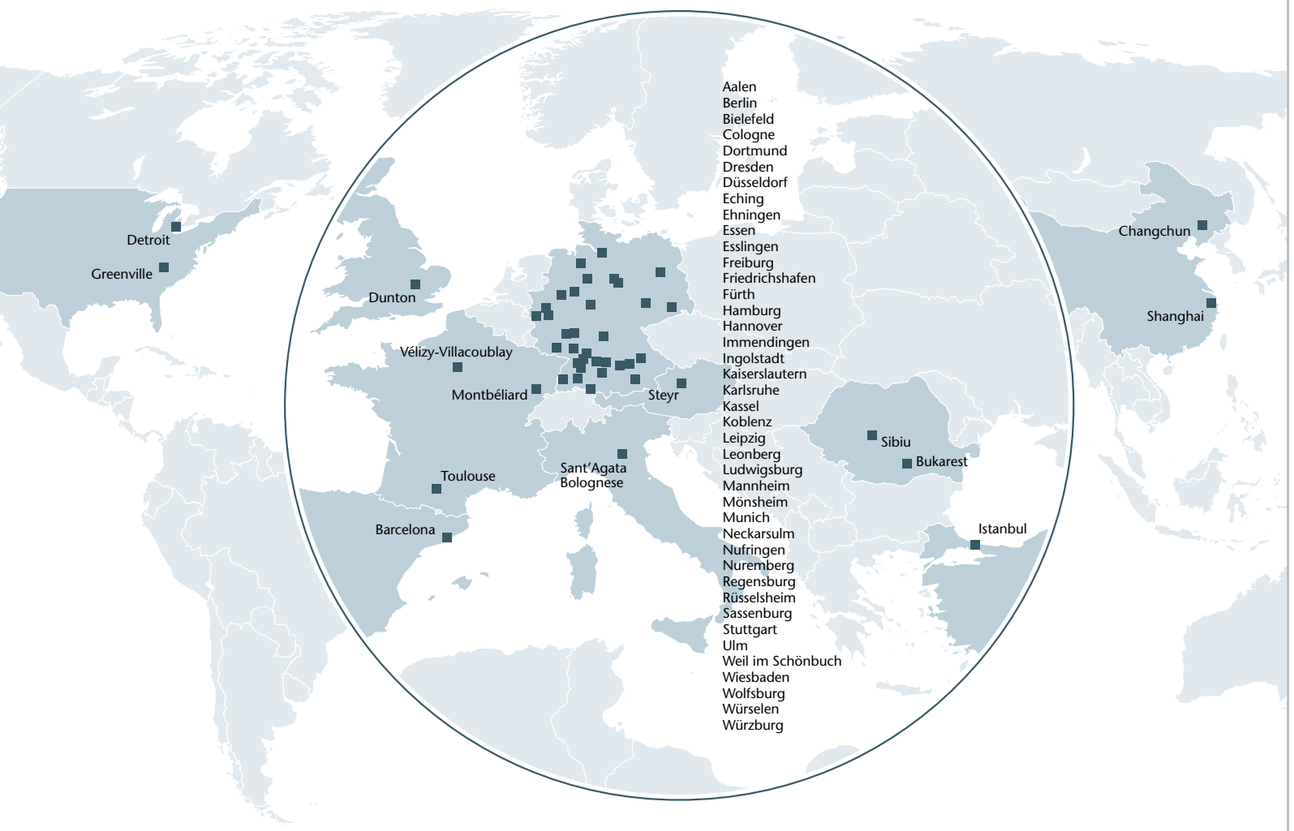
SHAPING CHANGE. DEVELOPING SOLUTIONS.

The Bertrandt sustainability report provides information about our financial, environmental and social development, as well as our values and objectives. It gives a detailed insight into our activities in the field of corporate social responsibility, our employees and business partners and our approach to the environment and to society as a whole.

KARTING FOR A GOOD CAUSE

The "DKMS 24 h Race for Life" took place at the Ralf Schumacher Kartcenter in Bispingen in Germany. The aim of the race was to raise money for the DKMS, the German Bone Marrow Donor Centre, a charity which helps people suffering from leukaemia.
A proportion of each team's entry fees went to the good cause. Bertrandt subsidised the team that included one of its trainee technical product designers. The teams competing on the indoor and outdoor track, which is 2.2 km in length, included semi-professionals, together with GT3 drivers and professionals who can otherwise be found on the world's most famous racing circuits. ■

BERTRANDT IS NEAR YOU – WORLDWIDE



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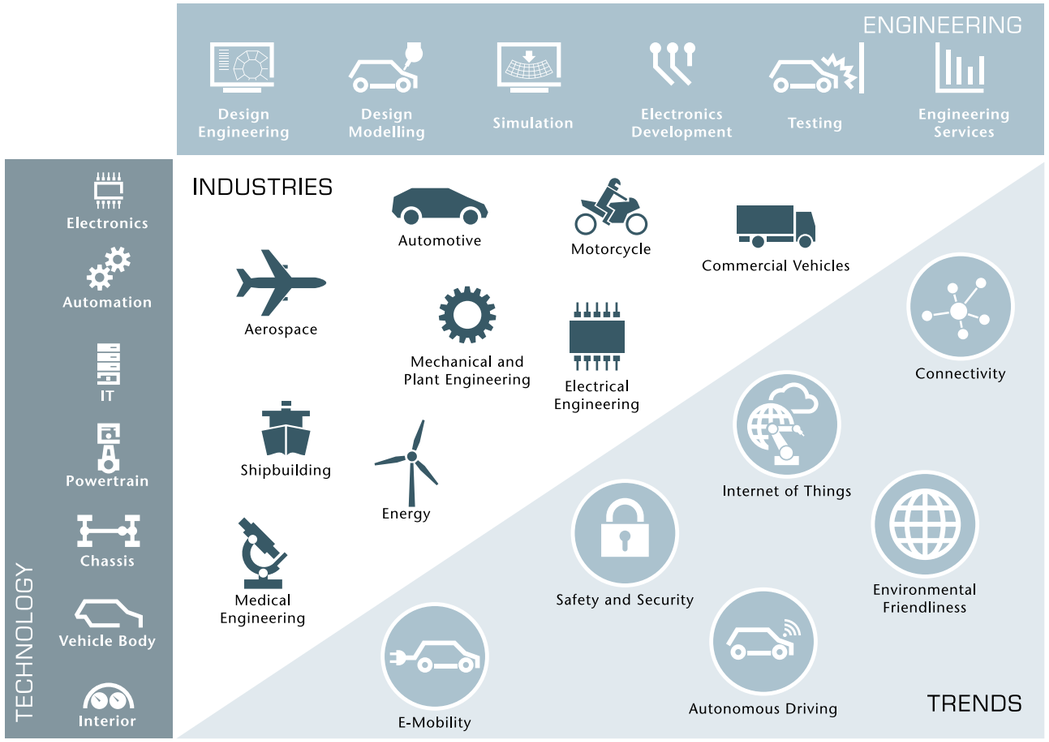
You can find more information about our locations at:

http://www.bertrandt.com/en/company/locations.html

BERTRANDT'S RANGE OF SERVICES



You can find details of Bertrandt's entire range of services on our website at:

http://www.bertrandt.com/en/range-of-services.html

Discover more about the events that Bertrandt will be attending on our website at:

http://www.bertrandt.com/en/company/events.html

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