bertrandt

Bertrandt*magazine*

No. 2 • October 2003

IAA 2003 – Bertrandt Engineering Network

smart crossblade – Derivative development

Audi A3 – Development and project management

VW T5 – Floor unit development

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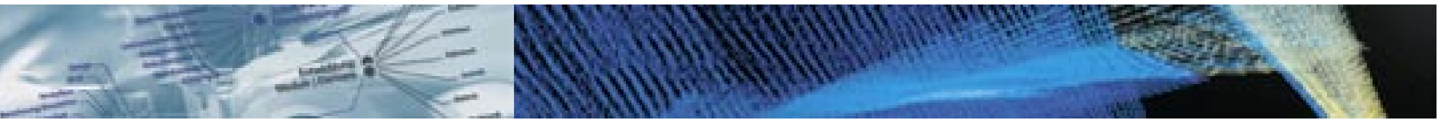
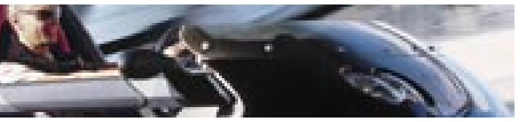
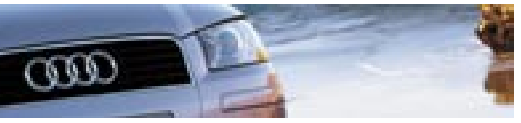
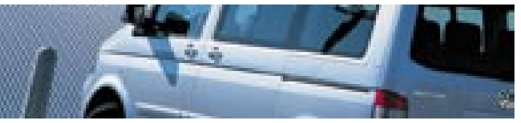


A glimpse behind the scenes is fascinating – even if we do not give away any of your secrets.





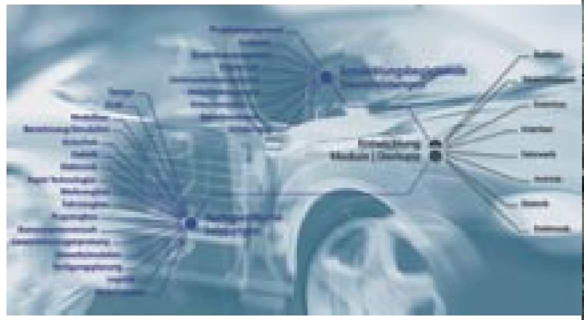


Editorial

With this Edition of Bertrandt*magazine* I would like to invite you to take a look behind the scenes at our company. The first thing you notice is that Bertrandt is in the process of reorganisation. We have established four Divisions: Supporting Services, Specialized Services, Engineering Modules and Derivatives. Enabling us to adapt our structures to the demands of the market and as a means of interlinking our know-how and therefore using it more efficiently. Through the intelligent linking of all the sectors in the added value chain, we want to guarantee optimum project management in the Bertrandt Engineering Network. Three thousand members of staff are available for mobility solutions along with all additional services in the Bertrandt Network. We have already given you an insight into the Bertrandt Engineering Network at the Frankfurt International Motor Show. If you would like to know more about the network, now that the IAA is over, please feel free to visit us at one of our branches for a personal discussion. Contact us on the Internet at www.bertrandt.com or ask for your personal B.Box under info@bertrandt.com for details of our entire range of services – as specialised or as all-encompassing as you want.

Naturally, the Bertrandt*magazine* also includes interesting information. We trust you will join us on our way forward.
We hope you will find this edition interesting reading and we would like to illustrate the concept of the Bertrandt Engineering Network with a quotation by the author Marie von Ebner-Eschenbach: "Pursuing the nearest goal with enthusiasm and effort is the only way to achieve the one furthest away."

Dietmar Bichler



The Bertrandt Engineering Network at IAA 2003

The services of the Bertrandt Engineering Network are divided into four areas, which are networked – as specialised or as all-encompassing as the customer wants.

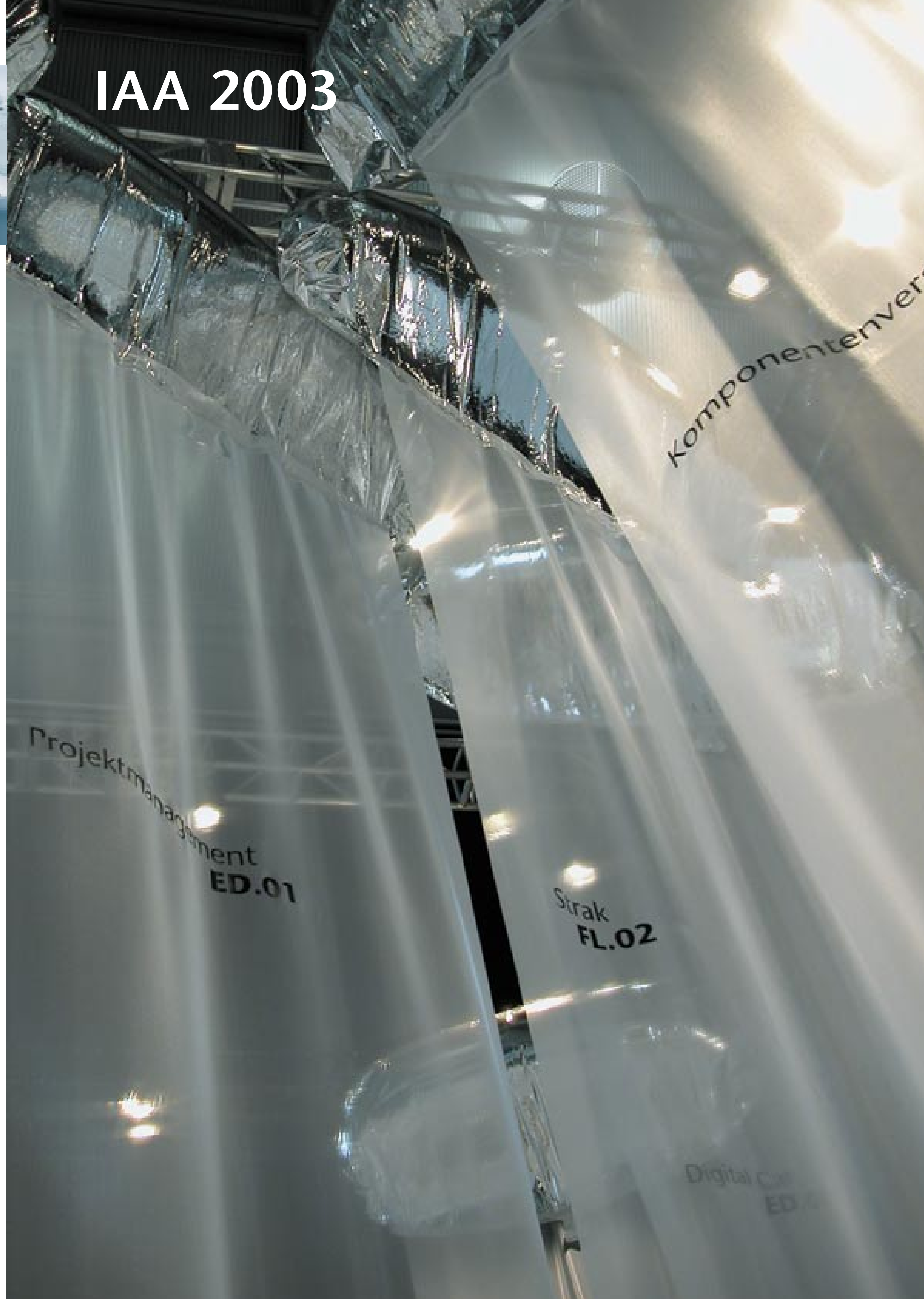
smart crossblade
Complete derivative development in the shortest possible time

Ergoseat
Joint module development of different departments

Bertrandt Competence Electronic Project
Interdisciplinary development in the electronics sector

Bertrandt Composite Car
Creativity, passion and ready for action

IAA 2003



Bertrandt's two UK offices along with the Bertrandt Technikum where heavily involved in the programme. Bertrandt UK undertook all the "A" Class surfacing in ICEM Surf for the vehicle in less than eigth weeks. This involved a UK based project team and a liaison engineer working with the Technikum. This co-ordinated approach enabled Bertrandt to realize the vehicle in a radically reduced timeframe.

smart crossblade

Bertrandt implements uncompromising vehicle concept

Initially it was only a vision, then an idea and just six months later, a real car – the smart crossblade. A limited number of series vehicles will be made on the basis of the smart design study that was presented at the Geneva Motor Show in 2001, and received with considerable praise and enthusiasm. Bertrandt's first offer contained a feasibility study which defined the further process. It convinced the decision-makers at smart. Bertrandt was taken on board as the prime contractor for this project.

Feasibility study

To achieve maximum planning guarantees for the subsequent processes – and therefore to get one step closer to implementation, Bertrandt first of all prepared a feasibility study. It was possible to clarify a large number of questions at an early stage. As the vehicle would have no roof, doors or windscreen would it be rigid, safe and watertight? Was this project feasible in the short time-scale? Which parts, which manufacturing process should be used to build it? And which suppliers should be involved?

Bertrandt answered these questions at the beginning of this demanding project: 2D and 3D concepts were prepared to specify the parts needed, the manufacturing process and also the suppliers' panel. The schedule, the departments involved and the partners at the companies taking part were also selected at this early stage in the project. This process enabled Bertrandt to achieve a very short time-frame – a whole six months lay between the project decision and the SOP – and also to guarantee economic feasibility. Now there was nothing more to prevent a successful completion of the project.

Clay model and Exterior Surface

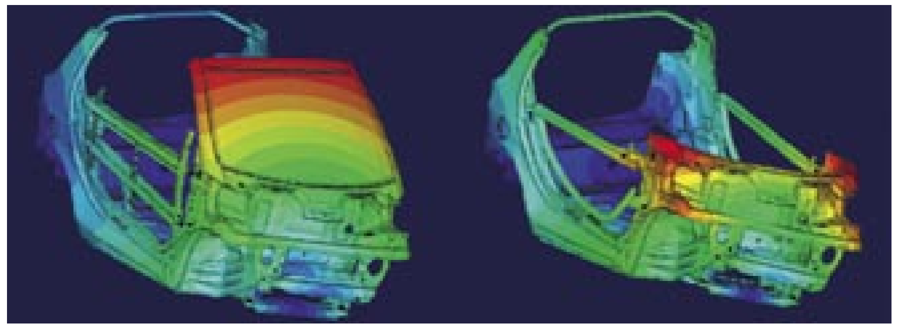
The smart designers constructed a clay model in parallel with the feasibility study. During this work, rough surfaces were constructed at Bertrandt from the first data. These were then used as the basis for the first technical models of the exterior surface.

smart designers involved in the construction of the clay model at the Bertrandt Technikum.

This time, i.e. immediately after the feasibility study and at the beginning of the development work, the smart designers moved into Bertrandt's Technikum in Ehningen to complete the clay model. Having the engineers and designers on the same site simplified communication. Suggested improvements, which the engineers made on the basis of the sections through the "C" class surfaces, were immediately incorporated into the clay model. This resulted in an exterior surface which took into account all production aspects, such as the t-lines and the position of component splits. The procedure demanded fewer compromises in terms of manufacturability in later development phases. Because of the many years of experience of UK Straker, the surfaces obtained from the final data of the completed clay model were first class. The component data, with all fastening points, wall thicknesses and flanges, were developed in a further stage.

Digital mock-up, rigidity and calculation

Virtual test runs, like collision tests and the simulation of production tolerances, for example, were performed on a digital mock-up (DMU) of the crossblade in parallel with the development work in order to be able to incorporate improvements at an early stage. The digital car has served as the central interface for all the departments involved in the development, component weights and parts lists were input. The bending and torsional rigidity of the crossblade was to be the same level as the base vehicle, the smart cabrio. The existing structure of the smart cabrio has been adopted, but because of the extraordinary vehicle concept, which was to give a feeling of unbounded freedom, important components of the structure, like doors and windscreen surround, for example, were not included. Bertrandt then calculated and compared the torsion and bending strength of several alternatives in order to be able to choose the best solution. The crash behaviour was also established mathematically for the crossblade in



smart cabrio with door compared with the smart crossblade with door bar: To compare the torsion strength, a rigid connection of the Body-in-White door structure and of the door bar was incorporated in each Body-in-White as a monocoque system.

close co-operation with the customer. As a result, reinforcements along the door openings and also highly rigid struts guarantee the strength and rigidity of the body structure and therefore also the safety of the occupants.

Approval

With regard to the regulations that had to be satisfied for approval, some components were new territory for the companies involved. For example, what were the TÜV's (Technical Supervisory Association) requirements with regard to a door that is not there?
Together with smart, the Federal Motor Vehicle Office, the TÜV and people at Bertrandt clarified which regulations had to be met and were also practical.
The windshield and the door members required some detective work to identify the relevant regulations, orders and approval conditions.
Lively discussions also revolved around approval of the outside mirror, a component requiring type approval, which was solved in joint detail work. Today, Bertrandt manufactures the mirror system.

Interior

The freedom of motorcycling is reflected in the open structure of the smart crossblade. However, this means at the same time that the vehicle has to be absolutely waterproof despite the lack of a roof. This presented all project members with a major challenge. Waterproof upholstery material was specially made for the crossblade and the seats have their own drain holes and intelligent measures had to ensure that all the electrics and electronics could function reliably in all kinds of weather. The engineering solution speaks for itself. In the test phase, the crossblade shook off the monsoon like deluges to which it was exposed during several test runs.

Tests and trials

A tight test programme with the crossblade was carried out and documented in detail during the development work by Bertrandt. Testing all the newly developed components and systems was particularly important. At the end of the day, everything had to work reliably throughout the life of the vehicle.
Based on the customer's specifications, and also the legal requirements, the crossblade underwent all the functional and endurance tests that occur during the development of a complete vehicle. These include component and function tests, endurance tests, operating strength and environmental simulation and climate change tests, head impact and airbag tests and also stationary and skid tests. A special test rig was developed and built for the door bar endurance test. The new parts developed for the crossblade had to prove their reliability in the various environmental simulation tests. Door bars had to

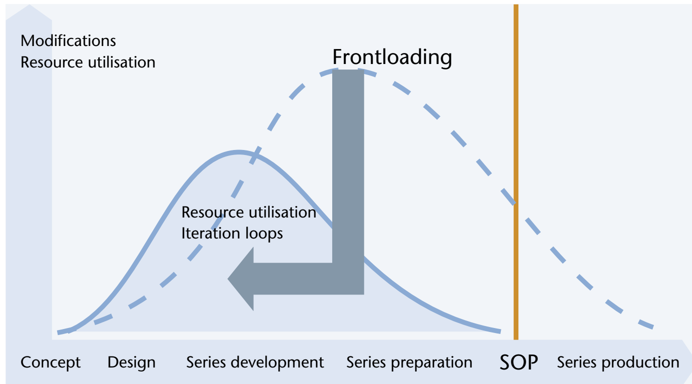
> The Bertrandt Engineering Network proved to be very constructive in the development of the smart crossblade.

open and close at all times without any problem, plastic parts were not deform, seat coverings were not fade even in strong sunlight. In order to determine the driving resistance parameters, the important exhaust and consumption values for licensing, Bertrandt carried out rolling tests. Smart and Bertrandt carried out crash tests together with the TÜV in order to check the results simulated previously and meet the approval requirements.
Finally, the crossblade had to prove in a summer trial in Laredo, USA that it still worked perfectly after thousands of kilometres and had not damaged its looks. Two Bertrandt employees also attended the trial to help smart with the final modifications to the vehicle.

Prototype build and vehicle build

A total of twelve vehicles, known as trial vehicles, were made at Bertrandt before the actual start of the series. Through specific front loading, the Bertrandt team pulled out all the stops to avoid additional correction loops during subsequent toolmaking. The increased use of laser sintered parts (SLS), like 1:1 viewing models for smaller components and 1:4 models for larger components, established the form, function and therefore also the costs at an early stage. This process meant that iteration loops were possible within a few days. Consequently, the approval-related test for checking the outside mirror developed and made by Bertrandt was carried out on the basis of an SLS outside mirror base attached to the crossblade. Toolmaking for the injection moulding process only started at that point. Larger parts, like the floor pan, were sintered in SLS as a 1:4 model, milled 1:1 after the test and a pouring resin tool was made on the basis of this milled model.
Bertrandt chose the methods suitable for the manufacture of the components from among various rapid prototyping and rapid tooling methods. For example, the front mud flap was made as an RRIM plastic part in an aluminium tool. This method was the best for

Floor compartment in SLS as a 1:4 model and as a trimmed moulding on installation.



Specific front loading guarantees efficient product creation in terms of time and cost.

Outside mirror test: Does the mirror fold in on impact in accordance with the regulations?

Green light for the intermediate diagnosis in the electrics/electronics area.

Water off a duck's back – even the heftiest downpour does not bother the crossblade at all.

Door bar endurance test on a special test rig developed and built for this purpose.

1st March 2002, 23.00 hours. We've done it! Exuberant team colleagues from smart and Bertrandt at the assembly and christening of the prototype for the 2002 Geneva Motor Show.

smart crossblade

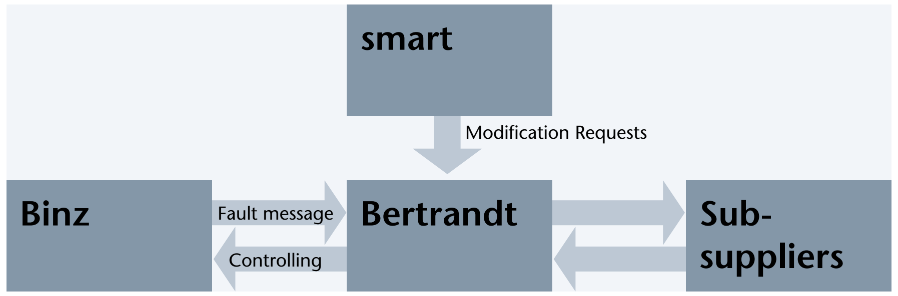
Production and assembly of the side wall.

the very high surface quality required. Vehicle build, which assembled the trial vehicles, was responsible for putting together a car from all the parts. In view of the approaching start of the show in Geneva, and also the looming SOP date, the schedule for this work was extremely tight. In vehicle build, colleagues in the three areas, Body-in-White/Assembly, Raw Materials and Products and also Automation stepped on the gas once more. They made auxiliary fixtures for assembly and also for an assembly test on a first vehicle. Since these were prototype components, the last adjustments were made at this point. Joining techniques such as bonding, riveting and bolting allowed easy removal and improvement of the parts during the modification work. At the same time, colleagues built the show vehicle, which incorporated the changes from the assembly test of the first trial vehicle.

Due to the motivation and performance of all the employees involved, the first milestone was achieved with an excellent result – the perfect vehicle for the Geneva Motor Show.

Production planning, logistics and production

Before final manufacture of the crossblade was started, employees of Bertrandt and Binz prepared an assembly plan. They established which arrangement of the individual stations was practical for an efficient production cycle. In the logistics area, Bertrandt was responsible for ensuring that the several hundred components made by different suppliers matched and were delivered on time. This process also included tool controlling, monitoring the toolmaking process, acquiring the part components required and also the co-ordination of the assembly of complete units – including guaranteeing small series production at Binz. A limited number of 2,000 smart crossblades is being assembled here.



Supplier management as an important module of the overall vehicle development process. In the product creation network, all streams have to converge at, and be co-ordinated by, the prime contractor.

The crossblade was made on time by vehicle maker Binz in close co-operation with Bertrandt.

Bertrandt showed off its derivative capability at the IAA-2003 in Frankfurt using the smart crossblade as an example. The vehicle exhibited is unique and was made specially for the Bertrandt stand.

Conclusion

The smart crossblade was an exciting and extraordinary project that inspired all those involved. Many aspects outside the normal course of development gave Bertrandt insights into new areas, such as obtaining approval from the Federal Vehicle Office. Bertrandt acted as a general contractor for the first time and took responsibility for the development and production of a vehicle. Bertrandt would like to thank the employees of smart and all the partners involved for their excellent co-operation, and is looking forward to future joint projects. ■

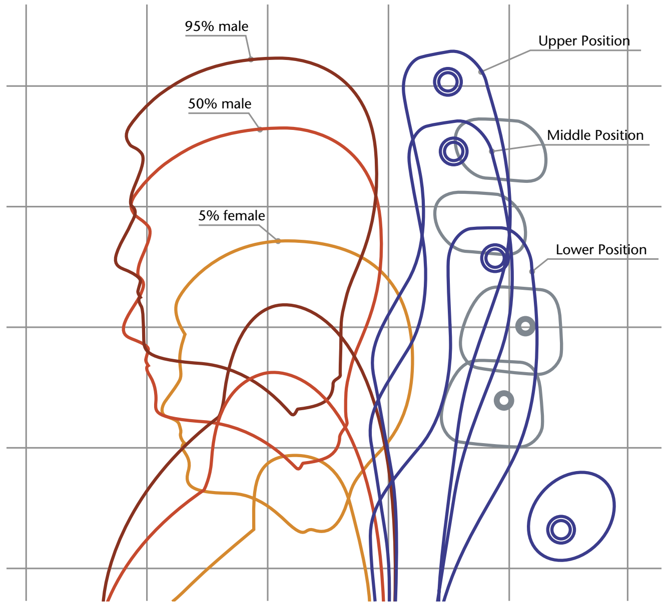
Tailor-made seat solutions for driver and passenger

Improving comfort and passive safety was the basis for new ideas in seat development.

The Bertrandt network proved very successful and constructive in the development of the Ergoseat. Three of the 20 branches contributed their special know-how to the innovative product. Project management, design, development, surfacing and electrics/electronics were located at Cologne, the initiator of the Ergoseat project. Tappenbeck in North Germany was responsible for foam and covering and the research centre in Ehningen in the South-West of the country, for static and dynamic calculations and the prototype build.
Bertrandt took this solution in hand together with the product development laboratory at Aachen University, Jülich Department, and also the French Group Arcelor, which involved itself in particular with innovative steel solutions as part of a strategic partnership.

Current situation: Largely static seats

As you know, the car seat cannot be adjusted to the length of the driver's back. As things stand at the moment, there are no flexible backrest concepts that are adaptable to the individual occupants. The solution is the "Ergoseat". The initial aim of the development was to devise a backrest concept that can be adjusted variably and intelligently to the person's back. Everyone has a different body length, occupants are taller or smaller. The fact that a suitable adjustment cannot be made to present seats has a negative effect on comfort and also passive safety. However, in the case of a critical rear crash, it is particularly important that the head restraint is as near as possible to the head and neck in order to prevent whiplash trauma.



Optimum positioning of the head restraint in relation to the head.

The Ergoseat: amenable travel-companion in the car

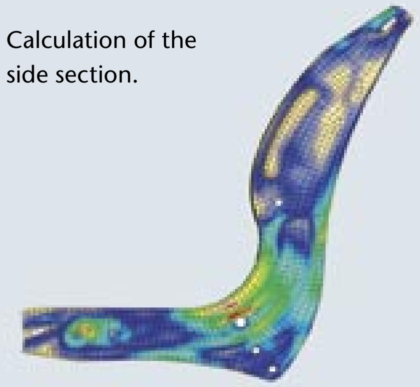
In the case of the Ergoseat presented at the IAA, the backrest concept based on the traditional seat understructure was upgraded to an integrated seat system in order to achieve a height-optimised sitting position for the vehicle occupant. The result is a seat that adapts to the different dimensions of the human back. With the Ergoseat, the pan moves 50 mm down and the upper backrest

part, 100 mm up and forward together, relative to the bottom backrest part (lumbar section). Through the combined movement of the upper backrest, the optimum distance of the head restraint in relation to the head and neck is taken into account. The Ergoseat integrated seat system therefore allows an optimum seat position, irrespective of the size of the occupants. As a result, comfort and passive safety are improved considerably compared with a normal car seat.

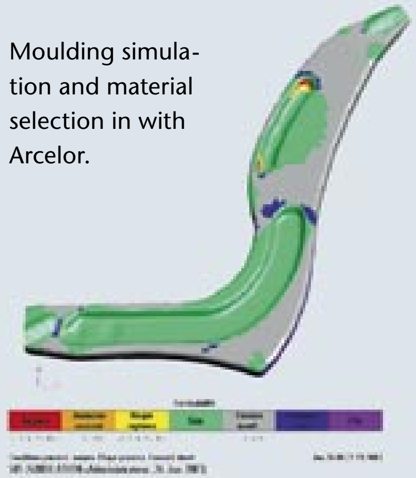
Interdisciplinary development co-operation

The innovative concept, devised on the basis of degree work, in co-operation with the Cologne office and the product development laboratory of Aachen university, Jülich Department, was put into practice and its feasibility proved. With a complex product like the Ergoseat, considerable co-ordination was required between the departments involved, such as Design, Development, Calculation, Electrics/Electronics and Production.

Calculation of the side section.



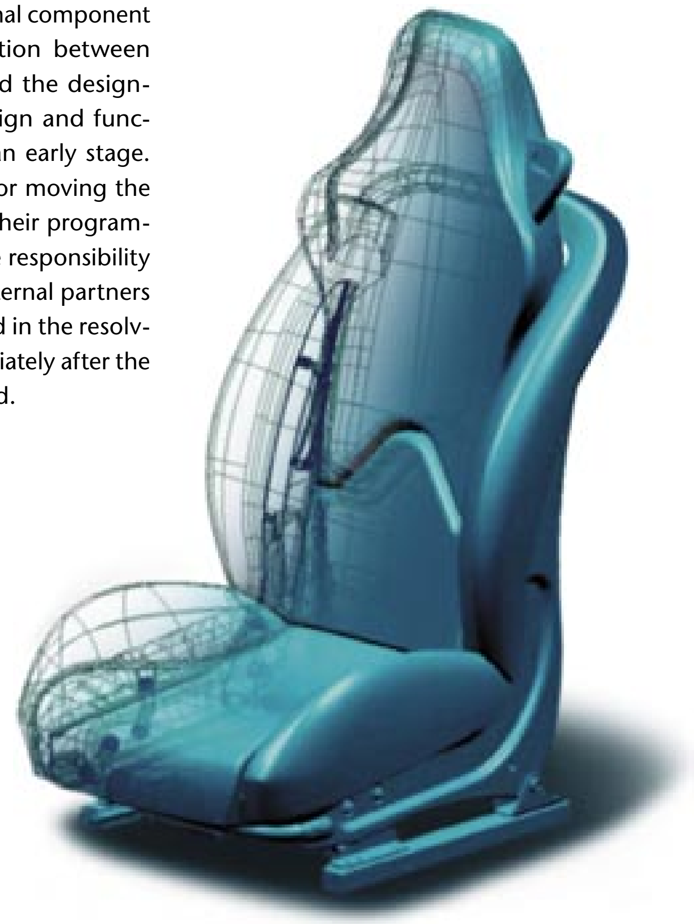
Moulding simulation and material selection in with Arcelor.



Ergoseat in the vehicle.

In Cologne, the engineers established the bases for the "Ergoseat" project, creating both the design and the services up to and including the final component data. In close co-operation between the design engineers and the designers, the harmony of design and function was guaranteed at an early stage. The electronics needed for moving the backrest parts, and also their programming and wiring, was the responsibility of the Cologne office. External partners had already been involved in the resolving of detail issues immediately after the concept had been devised.

Co-ordination of function and design.



In this way, it was possible to minimise Design loops at any early stage and shorten the development time. On the basis of the data supplied by Cologne, the staff in Bertrandt's Technikum in Ehningen produced laser-sintered models for all the plastic components needed, like the trim and sensor plate, for example. The metal and mechanical parts for the seat were then made in vehicle build and completed with the foam and covering by Bertrandt Tappenbeck. The lumbar support was made by Alfmeier Präzision AG.

Conclusion

In spite of the large number of interfaces, internal synergies were achieved and the b.Xcellent Project which defines processes and procedures in the Bertrandt Engineering Network guaranteed intercomunications and a good result. The Ergoseat concept was designed for flexibility right from the outset. It can be used in the widest range of vehicle models. Consequently, occupants of very small cars, sports cars and even van cans benefit from this tailor-made seat solution. ■

Bertrandt Competence Electronic Project

Universal control equipment platform for consistent solutions

Are you looking for an intelligent, consistent solution for the development of your control unit?
Do you intend consistently to design and optimise your development process?
Would you like your costs significantly reduced?

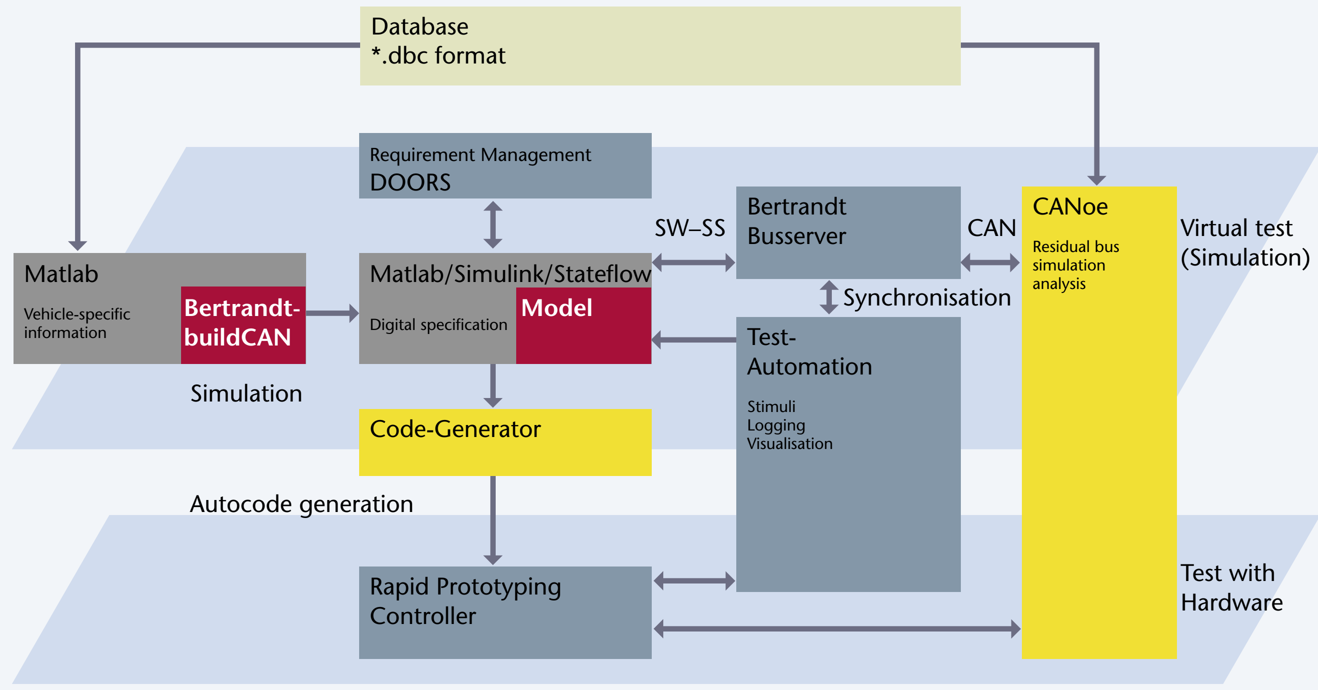
These questions represent the current status of many developments of control units. A large number of heterogeneous, uncoordinated software and hardware development environments exist on the market for this purpose. Because of the many different and, to some extent, very complex control units, and also the development and solution processes used in the past, consistency within the tool chain and the workflow is not guaranteed.
In view of this situation, Bertrandt found a basic standard solution for all its branches, which was successfully implemented in the last few months in the "BCE: Bertrandt Competence Electronic Project".

Virtual development of control unit software

The BCE represents a control unit platform, which can be provided with individual software on a flexible basis. The corresponding software development process is based on the virtual principle according to the V model. The tool chain extends from Requirement Management with DOORS up to and including modelling and simulation of the functions with Matlab/Simulink/Stateflow. The structuring of the models includes an abstraction layer ("HAL") in which all the hardware and system-related reference and functions are encapsulated.

The connection of other tools established in the vehicle test already allows the validation and verification of all the functions in the simulation, including CAN communications in real time. The "frontloading" allows faults to be remedied at a much earlier stage, saving considerable time and money and the test environment created can be used further in the development chain. Software is generated from the models by autocode generation, which can run on the BCE Hardware.

Tool chain for virtual control unit development



Requirement management

The requirements of the specification are defined with DOORS. The requirements can be linked with the simulation models via a connection to Matlab/Simulink.

Modelling

The algorithms and requirements defined in DOORS are modelled with the standard modelling tool Matlab/Simulink/Stateflow.

Model structure

Within the models, structuring is done according to functional software and system-related software.
The connection of the system software (e.g. OSEK operating system HW drivers) of the control unit is made exclusively within an encapsulated abstraction layer. This layer allows the software to be adapted in the development process to different hardware or systems (e.g. from rapid prototyping hardware to the final target hardware) simply and quickly.
Vehicle-specific information, such as the content of the CAN database, for example, is extracted automatically via the Bertrandt "build-CAN" tool and supplied to the models in the form of Matlab libraries. Changes can be introduced into the simulation models by updating the corresponding libraries quickly.

Advantages through simulation

As many complex correlations of the software as possible should be tested at an early stage in the context of "frontloading".
Therefore, the Bertrandt BCE tool chain includes test automation based on established automation tools like, for example, Labview from National Instruments. The test automation gives the control unit models external signals in predetermined reproducible cycles. This allows a continuous data display and recording of the output variables.

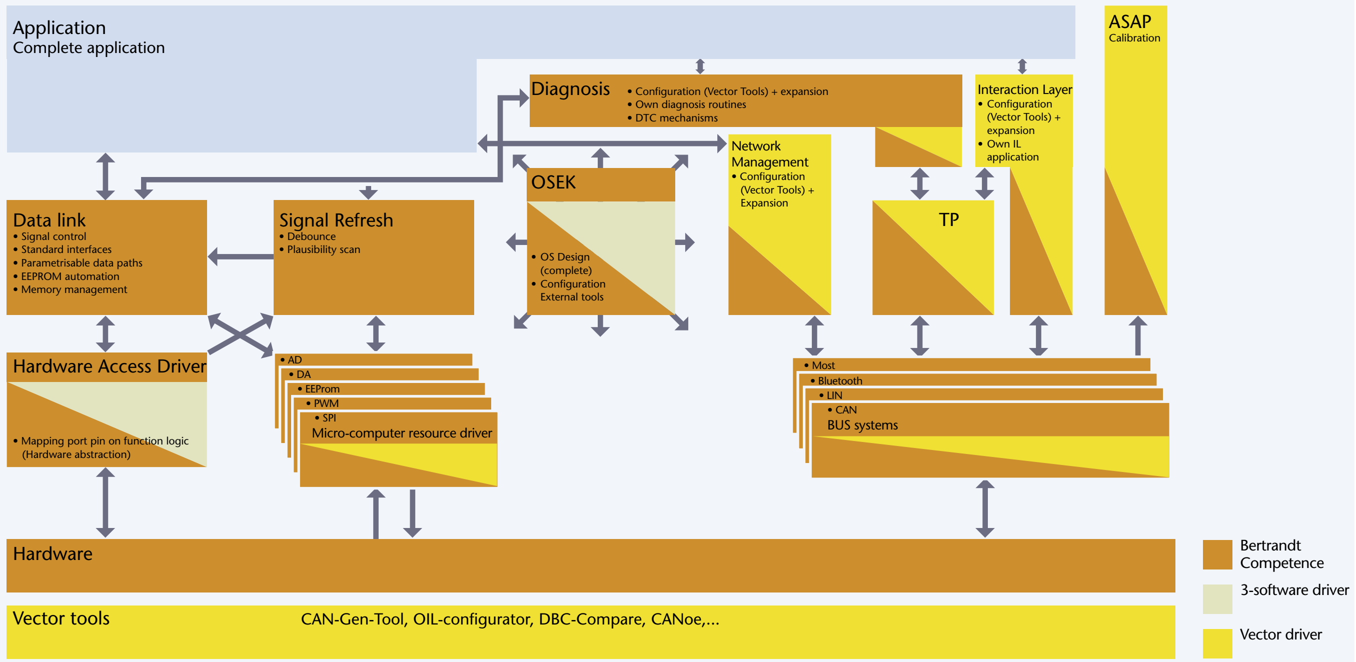
Bertrandt bus simulation server

CAN networking of the models in real time and with the use of standard software components, like OEM-specific software layers, is possible via the Bertrandt bus simulation server. This means that established test tools, like CANoe from Vector Informatik, are available for the residual bus simulation or for analysing the CAN communications before the first control unit hardware exists.
The tests created at analogue, digital and bus level can continue to be used consistently in the development process.

Autocode generation

The models are made with an autocode generation capability so that a target code can be generated for the control unit with normal code generators. In this way, software changes can be introduced into the development process very quickly.

Interfacing details of individual system software components



System software modules

The source code is used to enable development of present control units at a reasonable price, allowing maximum re-use. The objective is achieved through the use of system software modules, which monitor the standard components used, like SPI, Digital IO, ADC, WD and EEPROM. The application is allowed to access the basic functionality of the individual electronic components via the system software modules. The increased deployment time of the individual software components, also through the extended time over and beyond a project, has a positive effect on the degree of development of the software.

Software interfaces

The interface (API) between the application and the actual system and peripheral drivers forms the HIS standard.

Operating system

The parameters of the OSEK operating system of the BCE used can be set with the aid of the PRO-OSEK configurator. The software components of the system and peripheral drivers in the individual application software components are divided over the tasks of the operating system to guarantee optimum task utilisation. The CAN driver is generated by the CANGen software generator, which can be characterised and then integrated into the remaining source code.

Communications concept

The results from all the necessary CAN calculations ensure maximum system performance and are incorporated in the controller parameters. A CANdb database can be extracted in the dbc file format from a system communications matrix created for the BCE project. The database is the basis of the CANoe simulation, which has also been made especially for the BCE project with the formation of the entire capability of the analysis tool. The simulation supports the development stage and is also used as an integration aid and residual bus simulator.

Bertrandt Competence Electronic Project

System software

The software of the BCE system drivers can be re-used to a maximum degree. To achieve this level of further use, system tasks have been distributed for defined interfaces, both at hardware level and application modules. The individual system software modules are encapsulated, highly specialised in their task, and small in size. Because of the portability of the standard components from project to project, the development time has been shortened and the use of structured editors defines the module concept clearly and precisely. To provide the control unit with a "residual" vehicle environment, all the necessary parameters have been calculated and all the tools have been prepared for CAN Bus analysis. The diagnosis of the control unit via transport protocol is also possible. All the development stages are based on process models.

Hardware

The BCE hardware is not a standard Bertrandt product. It is a platform for the virtual development process, which can represent specific functions for series developments very quickly, and cost-effectively without rapid prototyping hardware. Applications of this platform must be seen as niche areas, like special vehicles, additions to the model series or retrofit solutions, mainly in the body electronics area. The basic hardware has an ST10 controller (16 bit), a large number of analogue and digital I/Os, high speed and low speed CAN and also LIN interface. Approximately 20 percent of the hardware has to be revised slightly for specific projects and customers. Bertrandt has a prototype which can be used in many ways during the development period for evaluating the software. Because of the near series level, the series hardware solutions can be developed and built in parallel with the software development.

BCE control unit.

Control panel supports and boards.

Presentation of the BCE on the IAA stand

The electrics/electronics shop on the Bertrandt stand offers an opportunity to see the virtual software development and trial and test phase via screens, computers and BCE hardware. The control unit functionality is displayed on the model and can be changed. It is also possible to simulate these functions. To do this, an idealised residual bus simulation and simulation of the actuators and sensors via the Bertrandt bus server, its own development, are linked with the model. The software modelling generation process is demonstrated with BCE hardware. At the shop, the code generated from the model can be tested with the aid of a test environment. This demonstrates the second development phase – rapid prototyping – of the laboratory rig. Two seat actuator motors belonging to the Ergoseat are used for the test rig. The complete rig is shown, which includes the power packs for the voltage supply and the oscilloscope for measuring the motor signals. The practical application of the BCE project is demonstrated based on a cockpit and a centre console including the Ergoseat. This is controlled with BCE hardware and software created with the aid of the entire development process.

Bertrandt, as an engineering service provider, showed off its extensive electronics capability at the IAA 2003 based on the BCE concept. With the BCE project, Bertrandt has put together a development chain which will allow, in future, for customers to develop complete control units that are both modern and cost-effective. The BCE project also provides future options for Bertrandt to take responsibility for the production and supply of series control units. ■

Shoulder sensors on the Ergoseat, fitted and wired – the electronics department is actively involved here, too.

The Goodwood Festival of Speed

The vehicle developed by Bertrandt UK came 6th

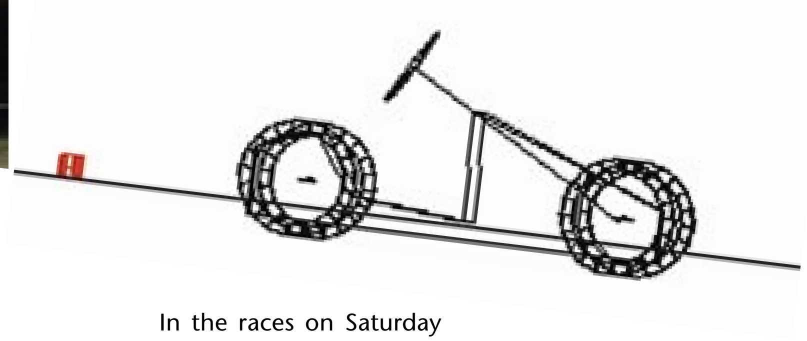
The event which The Times called the “Garden Party of the Gods” is one of the most impressive in the world. At the Goodwood Festival of Speed, which is held once a year near Chichester in the South of England, you will see the best cars, motorcycles and drivers from all the leading countries. Bertrandt was at the tenth festival from 11th to 13th July 2003 with its own vehicle and did well in the Soapbox Challenge. David Roche, responsible for the Bertrandt Composite Car 2 project (BCC2) lived and breathed the soapbox challenge in the truest sense of the word. The Bertrandt soapbox ended up with a respectable 6th in the overall placing. This is David’s report on three days at the Festival of Speed in Goodwood.

It is not a case of simply buying tickets for the Goodwood Festival of Speed, you have to be invited – and getting an invitation is no easy matter. We received ours nine weeks before the first qualification date. Naturally, this meant just nine weeks to develop and build a vehicle. But we managed it, together with our sponsors, who worked and sweated with us on this project.

The Race

The Festival of Speed is held on the estate of its initiator, Lord March, at Goodwood House. It lasts for a total period of three days. Friday is training day for the Soapbox Challenge. The first race takes place on Saturday and the final one on Sunday. Naturally, there are many other attractions at this festival – everything that interests car and motorcycle enthusiasts. This is evident from the competitor list for the various events – this year several Formula 1 teams were present, including Ferrari. The McLaren Team presented the new McLaren Mercedes SLR for the first time at Goodwood. One special event is the “Hill Climb” where cars drive up a very steep hill as quickly as possible. But the highlight of the weekend is the Dunhill Soapbox Challenge.

Soapbox races are an old tradition, but the soapboxes of today have become technically more sophisticated every year and the modern soapbox race is a serious affair.



In the races on Saturday and Sunday, the vehicles race down the hill, with two vehicles always racing each other. The soapboxes – open roadsters and enclosed streamliners – only maintain their speed through the impetus of the downwards movement, the force of gravity and special aerodynamic form. To start, the drivers simply release the brakes and away they go. A push start is not permitted. At the end, the team which has reached the fastest time on both days wins.

Twenty-one out of 24 soapboxes that applied qualified for this year’s Soapbox Challenge. However, only 18 actually made it to the end. Our driver, Barry Lee, one of the best 20 drivers in the world, qualified without problems. In wet conditions, he showed his excellent skill by negotiating bends faster than all the others. Competitors included teams from Ford, Lotus, Bentley, Bugatti,

Showtime: Barry Lee with Bertrandt engineers.

Eager anticipation: Colleagues from Bertrandt UK with their driver.

Tuning: Can the vehicle be improved further?

In the driving seat: Lord March, organiser of the Goodwood Festival of Speed, with David Roche.

Excited: Barry Lee in the “Bertrandt stable”.

Ricardo and the Porsche Owners Club. It is difficult to describe the excitement we felt each time the soapbox rolled off the starting line. We experienced every kind of emotion. On Friday, after being rammed by another soapbox we feared the worst, on Saturday we were buoyant again and on Sunday we felt both fear of our fast opponents and excitement at the thought of a possible victory. The collision on Friday caused some damage to the rear wheel suspension, so that the vehicle lost about two seconds. On Saturday, we borrowed a welding tool from the Bentley GT Team – this year's winner of the LeMans race – to repair our wheel suspension. However, we didn't have time to balance the wheels properly before the race. The fact that we had to start with a lower tyre pressure than usual meant that we lost about another two seconds during the race. Nevertheless, we were able to beat our opponent in this race, Ford, by 0.4 seconds.

The corrections which we made on Saturday night and Sunday morning allowed us to achieve a more aggressive trim. As a result, we were 2.1 seconds faster than on the previous day. But we lost the race by 0.19 seconds against Bugatti. However, all the disappointment about the loss of victory disappeared when we realised what we had achieved – and when we saw the beaming faces of our sponsors. In the end, we had an overall placing of sixth and fourth in the Roadster class. This is an amazing result for us. The organisation team had told us beforehand that a place among the top 15 would be a huge achievement. The weekend in Goodwood, including all the preparations, was one of the most exciting times of my professional life. Everything was there, from the technical challenges up to and including the emotional roller coaster. The co-operation between our team and the sponsors was unique. Under these circumstances, I would be happy at any time to face a challenge of this magnitude. ■

David Roche, BCC2 Project Manager, on the race: We experienced every kind of emotion.

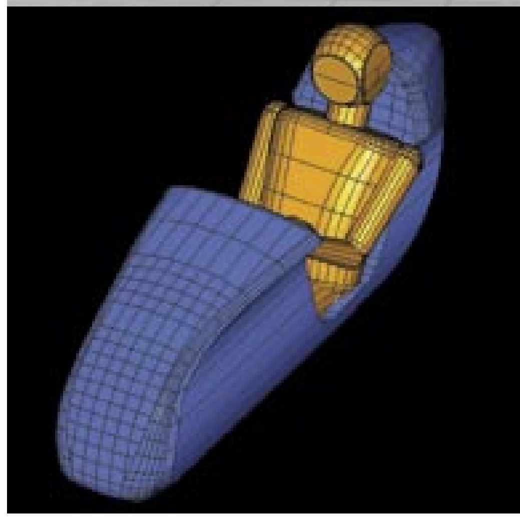
The Bertrandt Composite Car 2

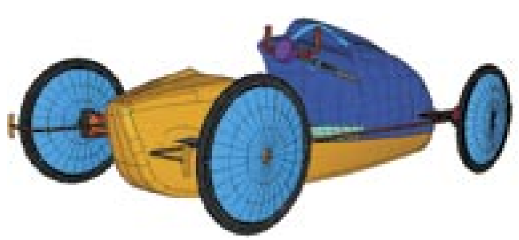
The vehicle which Bertrandt UK decided to race was completed in just nine weeks, from design, through to development to production. The team working with Dave Roche, CAE (Computer Aided Engineering) Team Leader, worked very hard with the sponsors. The result was a soapbox which could stand alongside the best.

The short development time – other teams had had 52 weeks to do this – was met because this soapbox was developed exclusively in a virtual environment. Particular attention was paid to the aerodynamics, because the BCC2 had to be able to move as quickly as possible without power. The conditions set by the Goodwood race organiser also had to be observed. One good example is the size of the soapbox length 1,950 mm, width 1,100 mm and a maximum weight of 135 kilograms. The eye level of the driver sitting in the cockpit has to be at least 770 mm. Also the maximum wheelbase and track are specified exactly. The dimensions were checked via an ultimate test, "The Absolute Device", where a wooden crate without a floor with the corresponding dimensions is placed over each soapbox. If it is too big, it is not allowed to race.

The virtual creation process

Virtual design starts with optimisation. When using composite materials, the calculation work is many times greater, which was the case with the BCC2. Taking into account all the specifications, and with the aid of a CAD model of the driver, Barry Lee, Dave Roche and his team designed the outer form of the vehicle. These vehicles were then used for the optimisation process, when an algorithm was used to determine the load paths through the vehicle. The composite layer was specified with the "Patrans Laminate Modelling" software.





The soapbox was developed in an exclusively virtual environment. The monocoque form was created on a 5-axis milling machine.

The sponsor, MSC, provided the licences for using the Patran program, Nastran and ADAMS – a new algorithm, which optimises the fibre direction and lamination.

Using this technology, the partner succeeded in building a monocoque structure weighing 14 kg, but with a torsion strength of 40 KNm/degree. The chassis was made in a similar way. The ADAMS program was used to determine the optimum curvature, the best wheel after-running and also the track adjustment. A digital model of the slope was

The Sponsors of the BCC 2

then simulated and the ADAMS Soapbox was driven down it virtually to test the settings.

Vehicle build

Hope Technology supplied high strength aluminium hubs and adaptable hydraulic brake discs for making the BCC2. SKF Advanced Composites Group provided the racing wheel bearings made in ceramic. These were made specially for the vehicle and had 40 percent less rolling resistance than comparable steel bearings. The Advanced Composites Group supplied various types of carbon fibres and other key materials for the monocoque construction; SPA Composites made the pre-calculated monocoque construction from these. To do this, the carbon fibres were laid in special moulds and cured in an autoclave for more than 200 hours – a process that requires considerable know-how. The moulds were made on a five-axis milling machine from H. Eccles Patternmakers Ltd. The material consisted of special temperature-resistant high-density foam. The leather seat for the Bertrandt Composite Car was made by Protrim. All the components were assembled at Bertrandt UK in just two days – just in time for the qualifying test for the race.

On 3rd June, Bertrandt UK qualified for the Festival of Speed with its soapbox. The driver, Barry Lee, achieved some very impressive times, when the car reached a maximum speed of 108 km/h. The race was on… ■

Delighted Bertrandt Engineers: David Roche, Matt Ralph, Simon Hulett, Keith Drewrey, Jon Bowden.

The story of the soapbox race

Source: http://history.oldcolo.com

The story of the soapbox race began in 1933. When the American Myron E. Scott watched three boys travel down a slope in a side street in Dayton, Ohio, in a car they had made themselves, he was absolutely fascinated. He organised a race for these boys and their friends. The "racing cars" were a complete mish-mash, made of anything they could get their hands on – orange boxes, metal plates, tyres from pedal cars and other "old plunder". He christened this race "The Soapbox Derby". From the original race with 19 schoolboys in Ohio, the Derby ultimately became a big, hard-fought national competition.
At the height of its popularity, The all-American Soapbox Derby attracted 25,000 competitors to 120 races and gripped an audience of around 1.5 million throughout the country.
The sport also became very popular in Great Britain. Up to 1994, the National Soapbox Association organised a championship every year. The heats, in which up to 100 drivers competed, were held in villages and on private roads.
After that, soapbox races went quiet for a time. This exciting sport celebrated a major comeback at the Festival of Speed 2000, when Lord March, the initiator of the festival, managed to attract 24 teams for the Dunhill Soapbox Challenge. These teams were financed by racing car manufacturers, vehicle manufacturers and a handful of enthusiastic individuals. Many drivers had already measured their capabilities on the impressive Goodwood downhill and the event has since become one of the most popular of the festival. Goodwood's regulations limit the size and shape of the soapbox and also the budget, whereas at the same time they allow the teams considerable room for creativity. The result is spectacular races with modern high-tech soapboxes which take their inspiration from the world of motor sport.

The results of the tenth Goodwood Festival of Speed

	1st Race	2nd Race	Combination	Times behind the winner
1. Ricardo	1:09.744	1:09.826	2:19.570	
2. B&W Loudspeedster	1:10.657	1:09.130	2:19.787	0.217
3. Lotus Type 119b	1:10.211	1:10.738	2:20.949	1.379
4. AVD Windcheetah	1:10.757	1:11.492	2:22.249	2.679
5. Bugatti Prescott Flyer	1:14.317	1:12.233	2:26.550	6.980
6. Bertrandt BCC2	**1:14.358**	**1:12.391**	**2:26.749**	**7.179**
7. Ford Centennieal	1:14.709	1:15.576	2:30.285	10.715
8. CTG Special	1:16.085	1:14.817	2:30.902	11.332
9. Visteon Velocity	1:16.085	1:14.967	2:31.052	11.482
10. Cummins Special	1:16.359	1:16.359	2:32.758	13.188
11. Unisys	1:19.881	1:19.589	2:39.470	19.900
12. Porsche Speedster	1:19.981	1:21.012	2:40.993	21.423
13. VSCC Grafton Spider	1:22.961	1:21.084	2:44.045	24.475
14. Brooklands	1:22.720	1:21.764	2:44.484	24.914
15. Vauxhall	1:24.233	1:30.551	2:54.784	35.214
16. C&B	1:34.314	1:31.524	3:05.838	46.268
17. A.T. Kearney Stealth	1:34.231	1:32.113	3:06.344	46.774
18. Honda	1:35.574	1:33.779	3:09.353	49.783
Bentley				not placed
Goodwood Racing Team				not placed
Prodrive				not placed
Revelation Racer				not placed

The new Audi A3

“A highly demanding specification with maximum driving fun” is how the special edition of Audimobil of March 2003 described the DNA of this project, the development of the second generation of the Audi A3. The Bertrandt office in Gaimersheim worked extensively on the vehicle between 2000 and 2002.

Bertrandt Gaimersheim

The project

The ability to meet the high development demands in the premium compact class segment was proved in a broad range of services. A team, involving over 100 specialists some of the time, successfully worked in the areas of body development and interior development

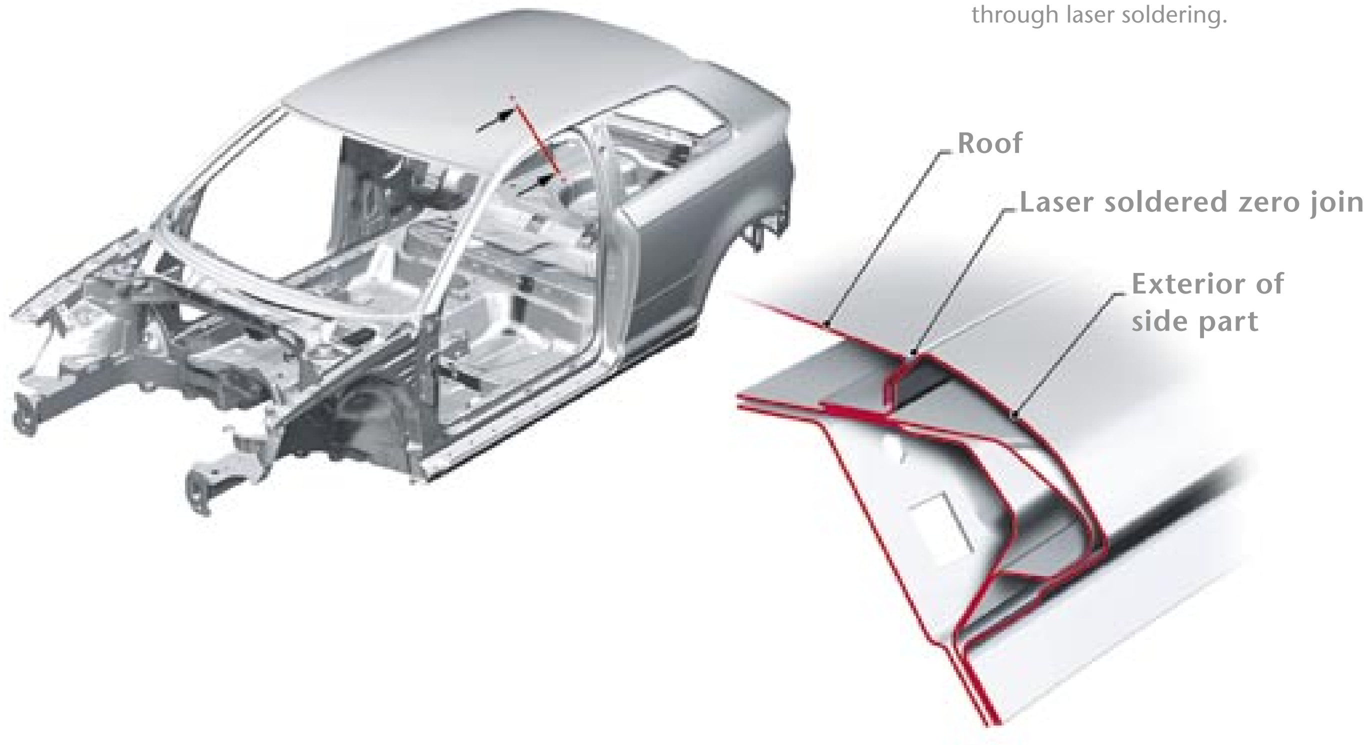
> **Complex, Interdisciplinary, Professional**

– including calculation, prototype build and testing. All the areas were accompanied by technical documentation, graphics, and co-ordinated and controlled by effective project management. Evidence of the result achieved has been seen on the streets since May of this year.

Complex

The body development of the A3 successor, with the group vehicle code title of AU350, was a complete package consisting of superstructure, front, doors, bonnet and tailgate. Right from the start, the Bertrandt project managers from the different departments were involved in the relevant SE teams (SE = Simultaneous Engineering) at Audi. These teams were responsible for co-ordinating the design with Production Planning, Quality Assurance, Customer Service, Simulation and Logistics. The PQ-35 vehicle platform, developed at Audi at the same time, formed an important interface. The so-called “Hat” for the Audi A3 was to be built and developed on this platform. Optimum use was made of the links within the Bertrandt network to guarantee a problem-free exchange of information over and beyond this interface. To achieve this, a resident engineer from Tappenbeck was the local contact and he was responsible for providing information. The main targets of the body development were to improve the structure in terms of crash performance, strength, rigidity and vibration comfort and also improved join appearance. For example, a “zero join” was made to join the roof and the side wall frame. In this case, both parts were connected to each other without a join using laser soldering, which allowed the roof channel and roof strip to be omitted. Through the use of a one-part side door panel using Tailored Blank technology, it was possible to improve the door rigidity. An additional strut in the door shell also increased safety in the event of a crash.

Zero join: Improved join appearance through laser soldering.

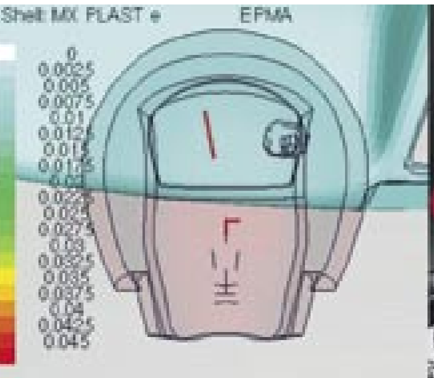


‣ Interdisciplinary

Sporty and elegant are terms that define the interior design of the new A3. A high centre console with optimum ergonomic gear shift position, the upright accelerator pedal typical of sports cars and round air nozzles in an aluminium finish contribute to this impression. The interior development project team was responsible for the design side of these important details. The cockpit, trim, floor covering, boot trim, belts and what is known as the greenhouse – in other words a roof and upper pillar trim – were combined in the structure installed for the project. Particular importance was attached to the interdisciplinary co-operation of the different development areas. For example, apart from the pure design input in the cockpit and greenhouse, calculations, simulations and tests were carried out. The cockpit development also included prototype parts. This form of integration was reflected in an optimum interaction of design, calculation and testing when taking into account occupant protection, for example (FMVSS 201 U) as part of the greenhouse development. Simulations with existing design versions regarding meeting the legal occupant protection requirements were carried out at an early stage in continuous operation in order to be able to influence future design if necessary in the early stages, and therefore save costs. The subsequent prototype tests were able to confirm the results of the simulation and also met the legal requirements of the parts made.

Cockpit prototype parts: Developed and built by Bertrandt.

FMVSS 201 U simulation: Testing head impact on the vehicle interior is simulated on the computer at an early stage to meet passive safety standards.



FMVSS 201 U test: The head impactor is projected onto the interior at a speed of 24 km/h.

‣ Professional

During development, all the processes were integrated into a project management process over and beyond the total period of the project. This guaranteed the monitoring and control of the development in terms of time and budget, managed interdepartmental communication and information flows and, before the project start, paved the way for effective planning and structuring. The process was supported by the provision of methods and aids especially tailored to the needs of the project by the project management and also through the use of SAP-R/3. The design FMEAs (FMEA = Failure Modes and Effects Analysis) development work represented the Quality Assurance instrument. The FMEA teams, which, like the SE teams, are made up of representatives of Design, Quality Assurance and Production Planning, identify and evaluate possible failures and their effects, also determine measures for preventing faults and ultimately check and monitor their implementation.

Through continued efforts to achieve the highest possible quality, the use of efficient tried and tested methods and processes that are part of the continuous improvement cycle, Bertrandt Gaimersheim considers itself well equipped to be a reliable partner for Audi in complex projects involving future vehicle generations. Through the experience acquired, Bertrandt Gaimersheim and the entire Bertrandt network are well placed to take on other major challenges. ■

Project house: Floor unit development, from concept to SOP

Through an innovative idea, the co-operation between VW Commercial Vehicle Development in Wolfsburg and Bertrandt AG in Tappenbeck has grown:
The "project house" for the development of the T5 floor unit.

Bertrandt Tappenbeck

Project house leads to important synergies

The T5 floor unit "project house" is the idea of WV-NE-GB department Head, Ernst Peter Otto, and also Roland Kirsch, Head of the Bertrandt office. The departments involved, the system supplier and the SE team are combined into a network. What was created in office containers is now, after six years, being successfully continued in a 4,300 sqm of office space and 2,300 sqm of testing and test rig area at the Bertrandt development centre. Through the direct link to the A 39 Autobahn, VW's research and development logistics have also improved considerably.

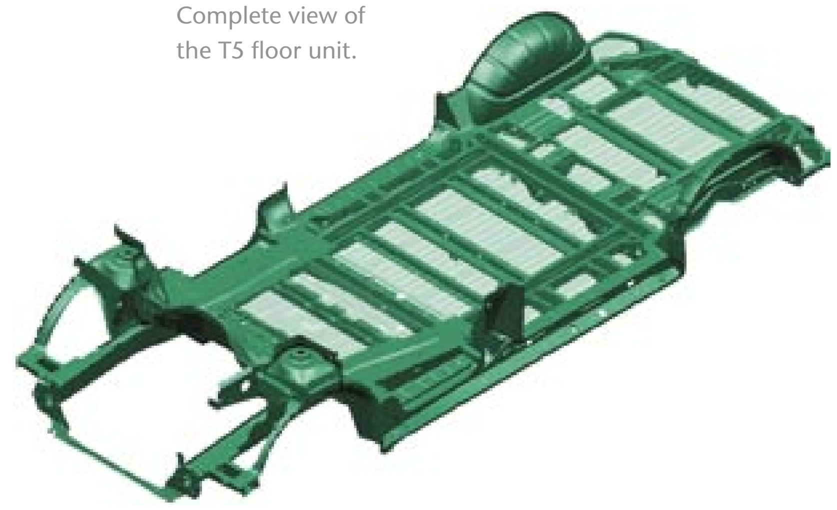
The success of the "project house" idea is essentially based on three factors:

- Physical proximity
- Integration of system suppliers involved
- Hardware and software infrastructure

The result is a close-knit group in which Bertrandt performs the integration task set by VW. The physical and procedural integration of system suppliers, VW Commercial Vehicle Development and the Bertrandt developers, is leading to important synergies. The fruits of this benefit the project as follows:

1. Reduction of development loops
2. Higher degree of development progress through validation of the development milestones
3. Optimum confirmation of the development level at the start of the series

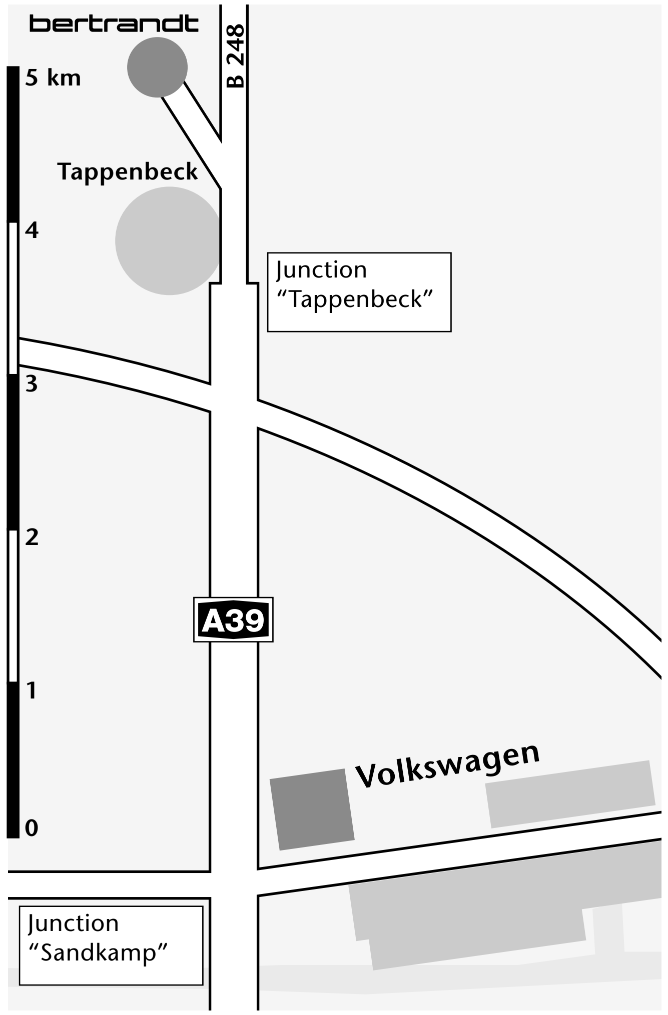
The hardware and software infrastructure makes an important contribution. An optimum data link to VW has been created through specific investment in a 100 MB/s data line. Complex vehicle development processes are much improved with the use of its own VPM system, which has been specially adapted to VW requirements. One highlight is the virtual proof of the vehicle front, platform and complete vehicle.



Complete view of the T5 floor unit.

T5 floor unit – intelligent and variable systematic

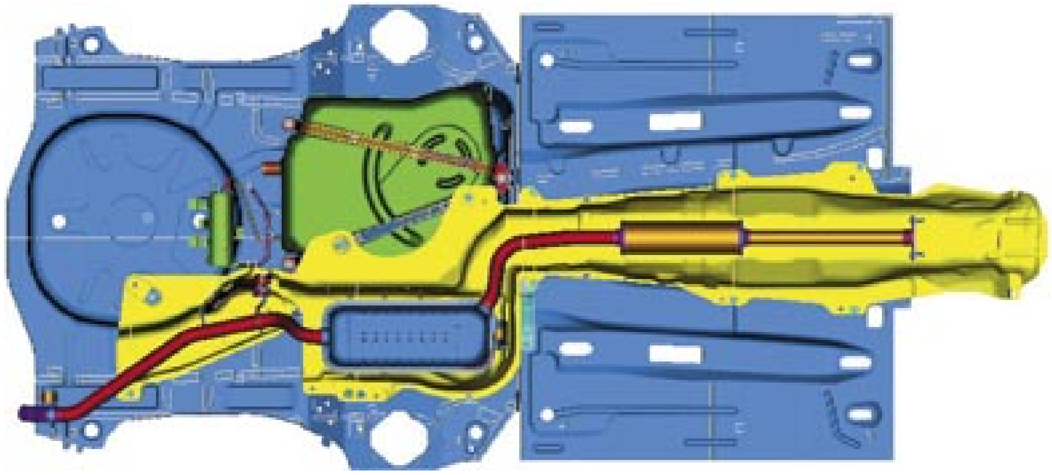
The result can already be seen on the roads: The T5 Multivan went into series production in autumn 2002. As a premium segment van, the Multivan satisfies the highest demands and is also the top vehicle of a variable modular system. The basis for this modular system is the T5 floor installation with its intelligent system. It represents a wide range of variants, such as closed superstructures, open superstructures, two wheelbase versions, 4x4 drive and also chassis for superstructure variants. As a new vehicle generation, naturally the body seal is PVC-free. Instead of the PVC seal, a complete plastic floor trim is used that is easy to remove and therefore recyclable.



One of the success factors of the project house:
The physical proximity to VW Research and Development.

Conclusion

The "project house" model has proved ideal as a basis for targeted and successful development, clearly illustrating the future direction of automotive development. Increasingly complex and broad-based development projects and also increasing responsibility with regard to derivatives or even a whole model series are on the agenda. The experience gained with the T5 floor unit "project house" provides a basis for future challenges. ■



Underfloor (blue) with tank (green), exhaust system and heatshields (yellow).

Bertrandt Cologne Designs heatshields for Sevex AG to protect against heat intrusion

Since 2nd February 2003, when the Columbia disintegrated upon re-entry into earth's atmosphere, most people are now aware how important protection against excessive heat is. Safety and protection against heat has always been an important topic for the automotive industry, too. Heatshields on the vehicle ensure the right temperature in heat-sensitive areas.

Heatshields are used throughout the area of the underfloor along the exhaust system and in the engine compartment of a car – anywhere in fact where considerable heat is generated and can cause damage. The shields consist of aluminium wrought alloys and are fixed to the underfloor with studs (welding studs) at intervals of 10 mm to 30 mm on average. The air layer created by the gap acts as an insulating cushion which keeps the hot air developed by the exhaust and engine away from the part components to be protected. Components particularly at risk are the tunnel area, the tank area with its pumps and fuel lines and also the spare wheel recess, with its plastic parts, located above the tail pipe.

Heatshields for the C1 platforms

Under the Supplier's Contract from Sevex AG, Switzerland, Bertrandt in Cologne is developing heatshields for the C1 platform (Ford/Volvo/Mazda). Sevex will convert the IDEAS data provided by Bertrandt. Prototype tools will then be made on site based on the data. Sevex largely makes the heatshields designed by the Cologne office in the "one step process". This means that the heatshields are pressed, drilled and cut in a single operation, thus saving both time and money. ■

Advantages of aluminium as a heat shield material

- good electrical conductivity
- rigid and self-supporting
- compared with steel it can be made into complex shapes in some instances
- will not corrode in air or water
- high sound absorption (structure-borne sound absorption)
- recyclable

These are just a few of the advantages of aluminium as a material. Generally speaking, a material that transfers or emits heat quickly to the environment can be used in heatshields. The heat shield achieves the necessary insulation through the air cushion between the shield and the component to be protected.

A consistent module throughout the development chain and also the pre-series and series stages

The QM Control Plan, also known as the Test Plan, supports the manufacture of quality products according to the customer's requirements. It includes all the test parameters that a product has to satisfy, from development to manufacture and, finally, use. It is also used to ensure the systematic quality checks in series production up to and including the production of parts that have to be documented as required by law.

What is the QM Control Plan?

The QM Control Plan is used and managed throughout the product life cycle for monitoring the process and for product Quality Assurance. It obtains its basic tools via a structured approach in the development stage. This allows it to prove the processes, components and the product. The QM control plan also reveals the monitoring methods used, the monitoring systems and their implementation and helps to minimise process and product differences. A large range of processes and technologies can be covered within the Quality Assurance process by using the QM Control Plan. As a "live" document, it is updated continuously, so it can also be linked with other documents.

The way to the QM Control Plan

A cross-functional team is used to prepare a QM Control Plan. To generate information from the process flow plan, the team uses the FMEA (Failure Modes and Effects Analysis) and also experience from similar processes and products. The know-how of the team concerning the product creation process, the possible optimisation methods (e.g. QFD: Quality function representation), statistical test planning (DoE) and the cause/effect diagram (Ishikawa diagram) are also used. There are five points that have to be taken into account on the way to the Control Plan and these are detailed as follows below:

Advantages

The benefit of the development and implementation of a Control Plan is reflected from the quality side in improvements regarding development, manufacture and assembly of the product, a thorough formulation of the methodology and the evaluation of products and processes. Customer satisfaction is also increased by concentrating on the processes and the products, integrating both wishes and requirements and also reducing costs.

Conclusion

As part of the extensive product reliability and increasing quality demands of the customer, Quality Assurance is playing an ever-more important role in the product creation process. As a development service provider, Bertrandt offers first class services and products on the market. This can only be achieved through an intelligent and targeted application of the individual Quality Assurance methods on behalf of the customer. ■

The way to the QM Control Plan

Project planning and specification

- Customer's requirements and requests
- Business plan/Marketing strategy
- Benchmark data for product or process
- Product/process assumptions
- Product reliability investigation
- Design targets
- Reliability and quality targets
- Provisional parts list
- Provisional process plan
- Provisional list of special product/process features
- Performance specification
- Management support

Product design and development

- Failure Modes and Effects Analysis (design FMEA)
- Production and assembly-centred development
- Design verification
- Design test
- Prototype build
- Technical drawings
- Technical specifications
- Material specifications
- Changes to drawings/specifications
- New requirements concerning equipment, tools, etc.
- Special product and test equipment
- Requirements concerning measuring and test equipment
- Commitment of the team to manufacturability

Process design and development

- Packing standards and guidelines
- Evaluation of the product/process quality system
- Process flow plan
- Work structure plan
- Feature allocation table
- Failure Modes and Effects Analysis (process FMEA)
- Pre-series plan
- Process instruction
- Measuring system analysis plan
- Plan for provisional process capability investigation
- Packing specifications
- Management support

Product and process validation

- Trial production (trial run)
- Measuring system analysis
- Provisional process capability investigation
- Production release
- Product validation test
- Series test plan
- Completion of the quality plan

Feedback evaluation and corrective measures

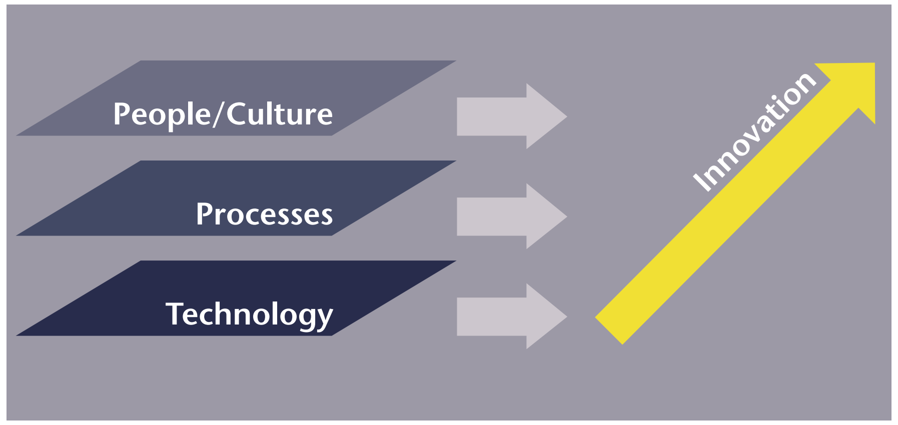
- Reduction of differences
- Customer satisfaction
- Supply and service

“If you cannot control your own business processes, it is not a good idea to network with others.”
(Prof. Bullinger, Head of Fraunhofer IAO)

The interaction between people, processes and technologies within projects, between different companies and across borders often requires a rethink about working methods and organisation. Standardised processes of the partners of the international automotive industry are a pre-requisite for dealing with complex processes successfully. The linking of the design and development of products with the production equipment and resources is of particular importance in a world of flexible product ranges and shorter model cycles. In this case, the ability to integrate all the resources available in an overall operating development and company environment now dictates the success of the company. Only in this way can product introduction times be reduced and the necessary information forwarded to all those involved in the project at exactly the right time. It is important to optimise quality and cost of the product, from product planning, through development and design, up to and including product recycling.

Challenge: Processes, technology and qualification

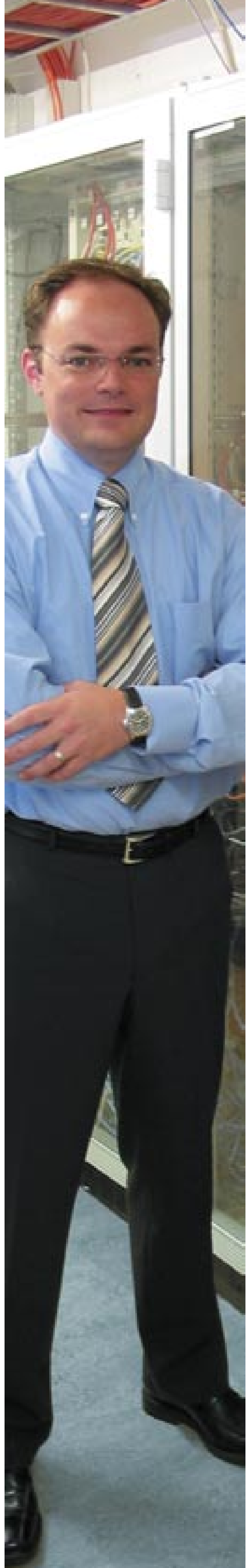
Interdisciplinary co-operation between development partners requires interfaces to harmonise between the processes, technologies and the different partners.
Each level is a complex structure in itself. Computer-aided process and project data management systems, like Enterprise Resource Planning (ERP) and Product Lifecycle Management (PLM) systems improve the reproducibility of cycles, for example. Internet technologies provide the best conditions for simultaneous engineering and therefore make all project-related information available to each workstation. However, the shifting of business processes to network infrastructures also makes considerable demands on the consistency of the processes and their quality. Part solutions or organisational uncertainty have to be ruled out. The most important factor for implementing complex cycles is people: the qualification of skilled workers is a precondition for the smooth running of a product development programme in order to be able to control and monitor the digitised business processes.



3-dimensional model: Innovations are only possible by considering and treating people and culture, processes and the necessary technology for implementation as a whole.

The b.Xcellent project – a holistic approach

The demands on service providers, suppliers and manufacturers in the automotive industry require the use of process-centred and technical standards for project management, product data management and communications. In addition, processes have to be checked continuously and a suitable implementation method provided. With the internal b.Xcellent project, the Bertrandt Group, together with partners from the consultancy and software sector, is developing interdisciplinary solutions for integral vehicle development, particularly in the fields of engineering management, project management and digital engineering (product development). b.Xcellent creates a basis for interdisciplinary co-operation between internal and external development partners. This is mainly based on the standardisation of processes and technologies. The results provide solutions for integration and communications in joint product development processes by Bertrandt network, manufacturers and suppliers. In the “Corporate and Engineering Management” sector, aids are being defined and provided for improvements in management, project control and project management processes.
A further improvement of existing processes and aids is necessary for project control in order to handle projects efficiently. A co-operative application of these standards is an essential part of the entire development process chain. Further improvements in process cycles have been made, mainly together with Bertrandt’s own SAP Competence Center (SAP-CC). “Digital and physical engineering” centres are based on a common infrastructure (Enterprise Backbone) in order to make project data and information available within the Bertrandt Group. Particularly in view of the different requirements of customers, the flow of information in a heterogeneous process and system environments is one of the most important principles. Examples include integration of a customer-specific, consistent change and approval management system. The corporate functions department is concerned with the introduction of the system requirements for supplier management, material management and control and logistics. It also co-ordinates all the processes, particularly in the field of Quality Assurance and Total Quality Management (TQM).



Conclusion

b.Xcellent creates the necessary procedural conditions to allow Bertrandt – in addition to the sustained integration in the development processes of its customers – to improve its own processes and use its synergies as a specialist in a development association. In this project, the Bertrandt Engineering Network supports the establishment of standards in product data management and communications. This way, internal and external development departments can be integrated into its own process and system environment quickly and in the best possible way. Advisors and software partners ensure that the results are also harmonised internationally with processes of different manufacturers and suppliers, both within the automotive industry and also with IT suppliers. In an environment marked by change, partnerships and project-based co-operation, the project is very important for maintaining and expanding Bertrandt’s leading process engineering position within the automotive industry. As an engineering service provider to the manufacturing and supply industry, it is particularly important for Bertrandt to be a proactive and reliable partner in technology and process engineering as well as in human terms. ■

bXcellent

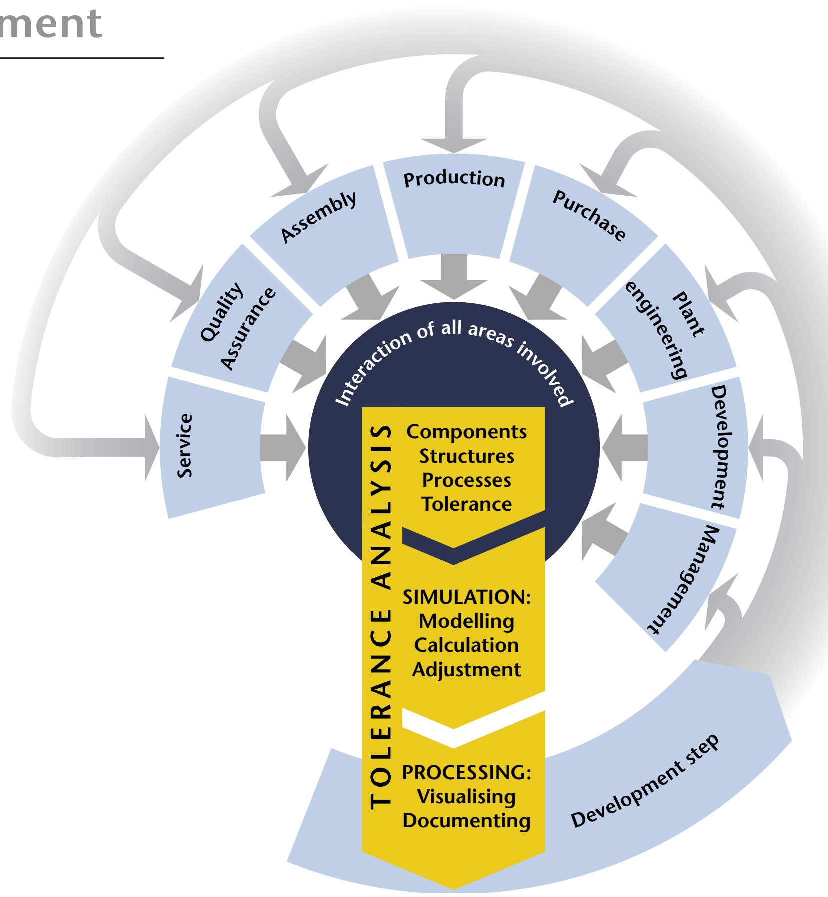
Corporate/Engineering Management			Digital/Physical Engineering			Corporate function		
GF Management	**CO** Project controlling and reporting	**PM** Project Management	**SLK** Parts list and configuration	**PEP** Product creation	**PTA** Prototype build	**LPM** Suppliers and partner management	**MWL** Material planning and logistics	**TQM** Total Quality Management
Key areas • Strategy • Market • Customers • Business areas • Product	Key areas • Classification • Cost control • Budgets • Prj. controlling • Prj. reporting • Monitoring	Key areas • Prj. mgmt. • Prj. control • Documentation • Data mgmt. • Change mgmt. • Approval • DMU mgmt. • Offers	Key areas • Parts lists • eBOM • (mBOM) • (xBOM (SAP)) • (Configuration) • Reference features • Key alternatives • Version • Update	Key areas • Quality Gates • Framework plan • PEP phases	Key areas • Program plan • Assembly • Production volume planning • Deployment control • Build planning • Personnel planning • Assembly planning • Interference suppression mgmt.	Key areas • Procurement • Purchase • Goods Inwards • Supplier selection • Supplier monitoring • Supplier evaluation • Complaints • Tool control	Key areas • Mat. planning • Distribution • Devel. logistics • Goods Inwards • Inventory	Key areas • QM tools • Auditing • Prod. Manual • TQM docu. • Forms • Approval • Sampling • Q gates reviews • Q gate planning

Organisation of Bertrandt’s internal b.Xcellent project.

For further information, please contact Bernhard Zechmann, Head of CAx strategy, Telephone: +49 7034 656-4425

Dimensional Management

Automotive manufacturers are encountering increasing demands in terms of the quality of their products. One important component is Dimensional Management during development. This is used to channel information on functional dimensions, work holder concepts, component tolerances and proving these before SOP and to make consistent progress for ensuring that these requirements are met. At the same time, it ensures the optimisation of the design with regard to tolerance links through analyses that continue throughout the development process.



Technikum Ehningen

For some time now, buzz words like "gap width" and "zero defects" have been very popular and they represent increased demands on development and production. For example, a door gap 2 mm wide must be designed to avoid any functional or aesthetic problems like scraping of the door or an inaccurate join. At the same time, with a greater level of automation, the need for reworking in production must be minimised and there must be no rejects.

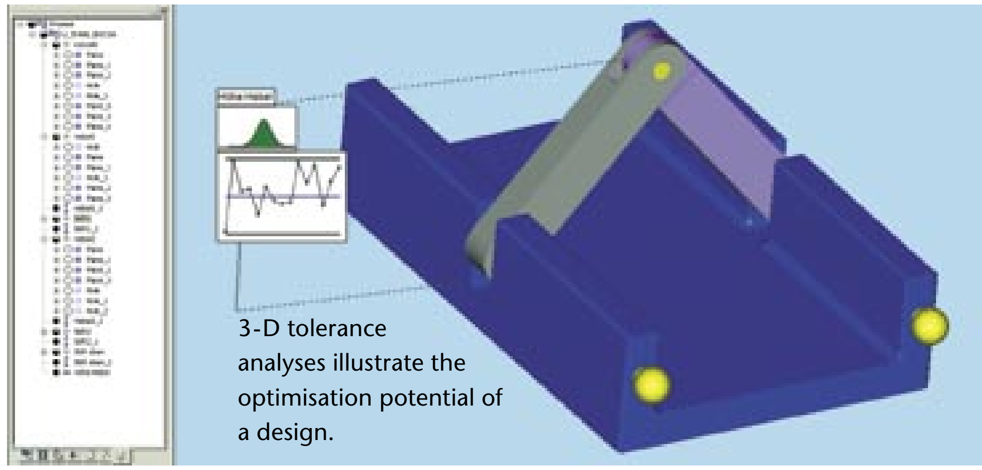
Transparent production through communication

Most of these quality requirements are established in the development stage. A component embodies a function, it holds an axle or transmits crash forces or performs several functions at the same time. It must also be capable of manufacture and installation. To guarantee all these things, precise knowledge of the production processes and their specific implementation is necessary. Therefore, it is essential for Development and Production to exchange information within the companies.
A joint database supports communication between departments. This makes sure that everyone is talking about the same thing. Functional dimensions, which have been defined by Development, are accepted by Production. Conversely, Production results are fed back to Development to allow improvements for successor projects. The common database also includes a consistent tolerance concept. It is no use if the test indicates that a dimension is not met but no conclusions are drawn from this. The developer must know what can be done to return the dimension to the green zone.

Responsibility for quality requirements

The functional dimensions of components must be defined, and over several component levels must be confirmed beforehand in order to achieve the required quality level.
At the end of the day, the tolerances of all the components involved may be met but, because of the geometric connection, those of the assembly run out. To avoid this, tolerance analysis investigates the tolerances in the assembly and proves the production process beforehand. The manufacturer is responsible for the tolerances of the components. Since the required component tolerances are a significant cost factor, the supplier must also be involved in specifying the tolerances. Confirming whole modules is just as important. Only when the connecting dimensions are specified can the system supplier quantify the price. It is even more important to define these as early as possible. The system supplier needs the tolerance analysis to guarantee the components of the module. The car manufacturer in turn requires the supplier to meet the connecting dimensions by reliable analysis. Therefore, the OEM points the way to the suppliers, which they then follow in their own establishments.

Making full use of the optimisation potential of a design



3-D tolerance analyses illustrate the optimisation potential of a design.

Dimensional Management phases

The task of Dimensional Management during development is to create a steady flow of quality-related information between all the departments involved in the product creation process. This guarantees the quality level of the product, from the concept phase to the start of the series, and also beyond in some instances.

Committee ensures effective Dimensional Management

The work of Dimensional Management starts with the concept phase. The essential basic information, such as functional dimensions and their permitted tolerances, are specified at an early development stage. For an effective procedure, it is advisable to set up a Tolerance Committee (TC) consisting of members of all the departments involved in the product creation process. This committee monitors any tolerance guarantee process up to the series stage. The Tolerance Manager, who implements the most important decisions and supplies the group with information, assists the Tolerance Committee. The Tolerance Committee establishes the tolerance concept of the entire construction based on this information.
A measurement plan is developed and the framework conditions are decided for the quality (process capability, reject rate, confidence range) for bought-out parts. Tolerance analyses are made to guarantee the functional dimensions which provide information on whether the functional dimensions can be met. Suggestions for improvement can be derived from these at the same time. The Tolerance Committee agrees on the implementation of the proposed improvements and obtains the input data for the next development loop. This iterative process basically determines the work of the Tolerance Manager and undergoes continuous changes.
An overall tolerance concept is not achieved in a day. The component manufacturing industry is interested in this work because of the advantages of the process, because it is also supported and implemented by the OEM. The development service providers, as partners of the car manufacturers, suppliers and system suppliers, have adapted the requirements and guarantee their customers products by means of competent Dimensional Management.

Dimensional Management during development is an aid for making high quality products. When used correctly, it is a very important tool on a long workbench. ■

Dimensional Management in the automotive industry

The target value definition starts the process. It determines which functions have to be guaranteed and what the series vehicle should look like, taking into account all the tolerances. The target values are documented in a function dimension catalogue. The targets are then guaranteed by tolerance analysis. The tolerance analysis evaluates the individual part tolerances, reference points, assembly and holder concepts the target values can be achieved. Co-operation with the individual disciplines (development, production planning, quality, suppliers) is required. The result is the tolerance concept.
This is confirmed on the basis of prototypes. The theoretically defined targets are checked on the vehicle and if inadmissible differences occur, it is analysed whether these are caused because the tolerances are too high or because the tolerance concept is defective. Mistakes in the concept are remedied by relevant development steps. If the tolerances are too high decisions are taken as to whether the tolerance requirements are too strict and need to be relaxed. Iteration steps are used to improve the concept.
The tolerance concept is guaranteed at the beginning of the series and is used as a basis for Statistical Process Control (SPC) in production.

Design modelling

Three-dimensional models make ideas tangible

Bertrandt Cologne

Depending on the development level, three-dimensional models are needed for the design and development of new vehicle models which – based on design drawings – make ideas "tangible". These hand-made models are created in the four-strong studio at Bertrandt Cologne using a large number of working methods and materials.

1:4 Styling model of the GT Supercar.

Styling models for perfect surfaces

Styling models are needed to design near-real surfaces which will also be seen later in series production. Important ergonomic and aesthetic aspects are taken into account at the same time as the technical development. Several scale models, usually 1:4, are made on the basis of the design sketches. A layer of clay, approximately five centimetres thick, is applied to a wooden understructure with roughly prepared blocks of polyurethane foam which is softened in the oven at approximately 60°C. This compound becomes dimensionally stable at room temperature and is easy to work. With a dimensional accuracy in the range of tenths of millimetres, this material is suitable for perfect surfaces, from the first model sketch to the outside of a vehicle of original size. For presentation purposes, the clay can be covered with a latex skin inside which imitates the different plastic surfaces. Expandable painted foil is used for the outside. Milled and painted parts, such as aluminium wheels, headlamps or instrument panels, are added to the models.

Function models represent processes

Function models are used to visualise innovative ideas on technical details or also more extensive concepts, such as a new interior design, for example.
The aim is to present the essential using the simplest possible means and refine the model step by step. Function models provide a first impression of how something functions, of the dimensions that a new component assumes, or of the feeling of space various components give the user relative to each other. A wide variety of materials is used, such as wood, polyurethane foam, foam board, plastics or metal. A function model can be an armrest or a pull-out table, but also a more complex project, up to and including what is known as a "mock-up", a skeletal representation of a complete vehicle plus compartment components.

1:4 Foam model for representing a variable interior concept.

1:1 Clay model of the cockpit and of the centre console for presenting the Ergoseat at IAA 2003.

In-house concept developments reveal innovation capability

Based on internal Bertrandt projects, the design studio in Cologne is also creating its own developments. Implementing these ideas offers Bertrandt an opportunity to draw attention to its capability and arouse customer interest by presentations at fairs or roadshows. The extensive areas of activity in the Bertrandt Engineering Network offer the right conditions for these projects, together with motivated employees, who are able to see further than the end of their nose and can take the company forward through innovative ideas. ■

For three years now, Bertrandt Cologne has been offering design modelling services. The 450 m^2 studio is equipped with all the machines and tools needed for a fully equipped model build workshop. These include, for example, a measuring plate (the size of a car) and a clay kiln.

10 years of Bertrandt Cologne

Branch Manager, Stephan Vogt.

Cologne branch building.

Reliable development partner to Ford

On 16th October, Bertrandt Cologne celebrated its 10th anniversary with an open day. The editor of the Bertrandt*magazine* spoke to Stephan Vogt, who has actively shaped the development of the company since the beginning and has been in charge of the branch since October 1998.

B*m*: Mr. Vogt, what conclusion do you draw after ten years?

Stephan Vogt: When we started on 1st October 1993 under Peter Dorling, there were six of us. Today, around 320 people work here in close co-operation with Ford and also suppliers and system suppliers in North Rhine Westphalia. We have succeeded in building up our business relations with Ford, which is evident from the joint development of the Mondeo and also the Focus successor, C-Max.

B*m*: What were the highlights for you in this period?

Stephan Vogt: The highlight was the granting of "Tier 1 Supplier Status" in 1999, which entitles us to handle development projects with Ford throughout the world. I remember the building of our own development centre for the automotive industry and its partners on the industrial site in Feldkassel in 1998 and also expanding it three years later.

B*m*: To what do you attach importance in your co-operation with your customers?

Stephan Vogt: Alignment with the wishes of our customers and also optimum care during the project work are top priority. The fact that we are a reliable business partner in meeting quality, cost and delivery requirements is illustrated by the Q1 Awards 2002, which Ford awards to suppliers for special services connected with customer satisfaction.

B*m*: What are the aims of Bertrandt Cologne?

Stephan Vogt: We want to remain a reliable development partner for Ford and the component manufacturing industry. When we expanded our range of services over the last few years, particular attention was paid to interior, seats, electronics, design and also locking systems and lighting engineering.
We have also continuously built up and expanded our know-how in the Body-in-White sector. Together with our colleagues in the Bertrandt Group, we are continually strengthening our commitment towards derivative and module development, further specialist areas and also services during the development stage.

B*m*: How do you see the position of Bertrandt Cologne in the local competitive environment?

Stephan Vogt: I am happy with the positioning of our company, but I still see considerable potential in co-operation with system suppliers in North Rhine Westphalia. I would like to convince all customers, old and existing, of the service capability of our company and of the "Bertrandt Engineering Network" and thereby continue to increase our customer portfolio. ■

Q1 Award.

Prominent visit: As part of his tour, "pro NRW training", the then Minister-President and now Economics Minister, Wolfgang Clement, visited the Cologne office in 2001.

Eco² Design Conference

Experts discuss ecological and economic product development

A lively exchange between speakers and audience.

The conference sponsors Dietmar Bichler, Chairman of the Board of Bertrandt AG and Dr. Wilfried Sihn, Deputy Manager of Fraunhofer IPA.

Successful Eco² Design Conference at Bertrandt in Ehningen

The first Eco² Design Conference took place at Ehningen on 3rd July 2003. Representatives of the German component manufacturing industry and also of the teaching and research sectors attended the Bertrandt Technikum for the conference entitled “Eco² Design – the Automotive Industry’s answer to the prescriptions of the old vehicle ordinance“.

The one-day event informed the 80 delegates about old vehicle legislation. The Federal Ministry for the Environment also described the further updating of the legal requirements. According to the requirements, manufacturers have to know and control the environmental effects of their products at an early stage of their development. Numerous requirements, such as avoiding harmful and problem substances, meeting recycling quotas or ecological product information have to be met. The speakers representing the car producers DaimlerChrysler, Audi, BMW, VW, Opel and smart explained how their companies deal with these aspects. Their presentations were rounded off by contributions by the University of Braunschweig and Fraunhofer IPA and also two speakers from Bertrandt, who presented ecological and economic product development based on practical projects.

One thing emerged loud and clear from the many discussions at the event: Some debate is still needed regarding the old vehicle legislation and its implementation. Encouraged by the positive reactions of the participants, Eco² Design Workshops are now being organised at the individual branches of Bertrandt AG. The principal aim is to acquaint designers with the legal requirements and illustrate their implementation in practical exercises. The workshops will be offered to the customers of the German branches representing local automotive manufacturers and system suppliers. ■

CD ROM

Eco² Design Conference – The Automotive Industry’s answer to the prescriptions of the old vehicle ordinance

The CD ROM contains the conference papers and additional information on ecological and economic product development and can be obtained for 110 Euros from the following address:

Bertrandt Technikum GmbH
Alexander Willig
Birkensee 1
D-71139 Ehningen
Telefon +49 7034 656-8279
alexander.willig@de.bertrandt.com

Bavaria’s Economic Minister, Otto Wiesheu, finds out about the smart crossblade from Bertrandt Managing Director Michael Neisen (to the right of the picture).

“Supplier Innovative 2003” in Ingolstadt

Bertrandt Gaimersheim presented the company’s derivative capability at the fifth BAIKA annual conference at the Audi Forum on 2nd July 2003.

Prominent visit

The smart crossblade, developed and built by Bertrandt, acting as general contractor, was the main focus of the Bertrandt stand. Michael Neisen, Managing Director of Bertrandt Gaimersheim, welcomed the Bavarian Economic Minister, Dr. Otto Wiesheu, as one of the first visitors. He happily accepted the invitation to “take a seat” and took the opportunity to find out what was special about the vehicle and the project work done by Bertrandt.

Media interest

The press also showed a keen interest in the stand and its exhibits: A radio interview with Radio IN, the local station and TV interviews with Bavaria 3 and SAT 1 followed.

Presentation of the range of services

The day flew by with many interesting discussions. Any lack of information was soon remedied by the stand team consisting of Wolfgang Morscher, Michael Neisen, Thomas Rossié and Christian Ruland. Visitors saw that apart from development, testing and prototype build, Bertrandt also supplies components for small series and can organise complete Production Planning, Logistics, Parts Procurement and Quality Assurance for a derivative. There was also an opportunity to get to know competitors and make contact with suppliers.

The general conclusion is that it was a very good day: The presence at the “Supplier Innovative” annual conference was a complete success, because customers could take a look at the Bertrandt network way beyond the limits of the local market. ■

Techshow at Ford

Bertrandt Cologne presents its range of services in Merkenich

On 22nd and 23rd July, Bertrandt Cologne organised its Techshow in the benchmark bay on the Ford site at Merkenich. Here Bertrandt presented its extensive range of services and also the development skills of the entire Bertrandt network to Ford employees.

The highlight was the smart crossblade, which Bertrandt uses to present its services throughout the development process chain to interested visitors. Skills in the prototype and vehicle build sector were amply demonstrated using the Bertrandt Competence Car, a Pick-Up which it developed and built itself, and also the prototype parts of the crossblade.
The individual departments at Bertrandt Cologne presented themselves as part of the Bertrandt Engineering Network with details of their specific know-how that can be used on an intercompany basis, with the corresponding references. Several door handles, headlamps and interior lights were shown. In the design sector, Bertrandt presented a 1:4 foam core model, based on the Ford Galaxy, with the emphasis

on the interior concept, and also a 1:4 clay model. The "Techshow" was well worth it. Some 450 employees of Ford Merkenich used the two days to find out just what Bertrandt can do. ■

Corporate calendar

05.11.2003	University contact event: HOKO, University of Munich and ZWIK 2003, Zwickhau Town Hall
05.11.-06.11.2003	Talk by Bernhard Zechmann, Bertrandt AG: European CATIA Forum, Disneyland Paris
11.11.-12.11.2003	AUTOMOTIVE Interior Conference, Ludwigsburg
13.11.2003	Additional event for the AUTOMOTIVE Interior Conference at Bertrandt: • Organised by Bertrandt Technikum GmbH • Talks on the Ergoseat and FMVSS 2001
14.11.2002	VDI news recruiting day, Forum am Schlosspark, Ludwigsburg
17.11.-18.11.2002	University contact event: Bonding fair, University of Karlsruhe
25.11.2003	University contact event: Career day, HTS Automotive Engineering, University of Arnheim
08.12.-09.12.2003	University contact event: Bonding fair, Technical University of Aachen
18.12.2003	Press Conference, Stuttgart
18.02.2004	General Meeting, Stadthalle Sindelfingen

[Bertrandt in brief]

+++ Investor Relations:
In July, Bertrandt was represented at investor meetings in Munich, Frankfurt and London. The Bertrandt share was quoted at 15.00 Euros at the end of play. +++

+++ Catia V5:
Bernhard Zechmann, Head of CAx Strategy at Bertrandt AG, gave a talk on "Catia V5 at Bertrandt" at the 7th Automotive Engineering Conference of the journal ATZ/MTZ in Stuttgart. The focus of the event was the question how development times and costs can be reduced and higher quality standards achieved at the same time with a Virtual Product Development (VPD). +++

+++ Recertification:
The renewal and partial extension of the ISO 9001 2000 certification was successfully completed for the entire Bertrandt Group and also according to VDA 6.2 for Ehningen and Rüsselsheim.
The assessment reveals a continuous improvement in the efforts of the Bertrandt Group towards achieving high quality throughout the process cycles. +++

+++ Football tournament:
At the fourth football tournament for the Bertrandt Cup, the "Dogwalker" team from Bièvres beat "L'agence tout risque" by 1 goal to 0 in an all-French final. A total of 17 teams took part from Bretzfeld, Ehningen, Gaimersheim, Cologne, Munich, Neckarsulm, Rüsselsheim and also three teams from France. +++

+++ Training:
Good training is an important investment for the future. This was the result of a trainer conference of the Association for the Promotion of Young People in Industry (VFgN), which was held at Bertrandt AG in Ehningen in June. Bertrandt itself offers trainees opportunities to enter 20 commercial and industrial professions. +++

+++ Triathlon:
Sponsored by Opel, Sandro Hans of Bertrandt Rüsselsheim successfully competed in the Ironman Deutschland in Frankfurt am Main. +++

+++ Motor sport:
Bertrandt team is still successful in the Fiesta ST Cup. After five out of eight races, Ralf Martin – who won all the races up to now – is in overall lead. Bertrandt employee Jürgen Rother lies eighth at the moment. +++

+++ Quarterly report:
After nine months of the financial year 2002/03 (01.10.02 to 30.09.03) the sales of the Bertrandt Group amounted to 158 million Euros. The operating result amounted to 3,2 million Euros. +++

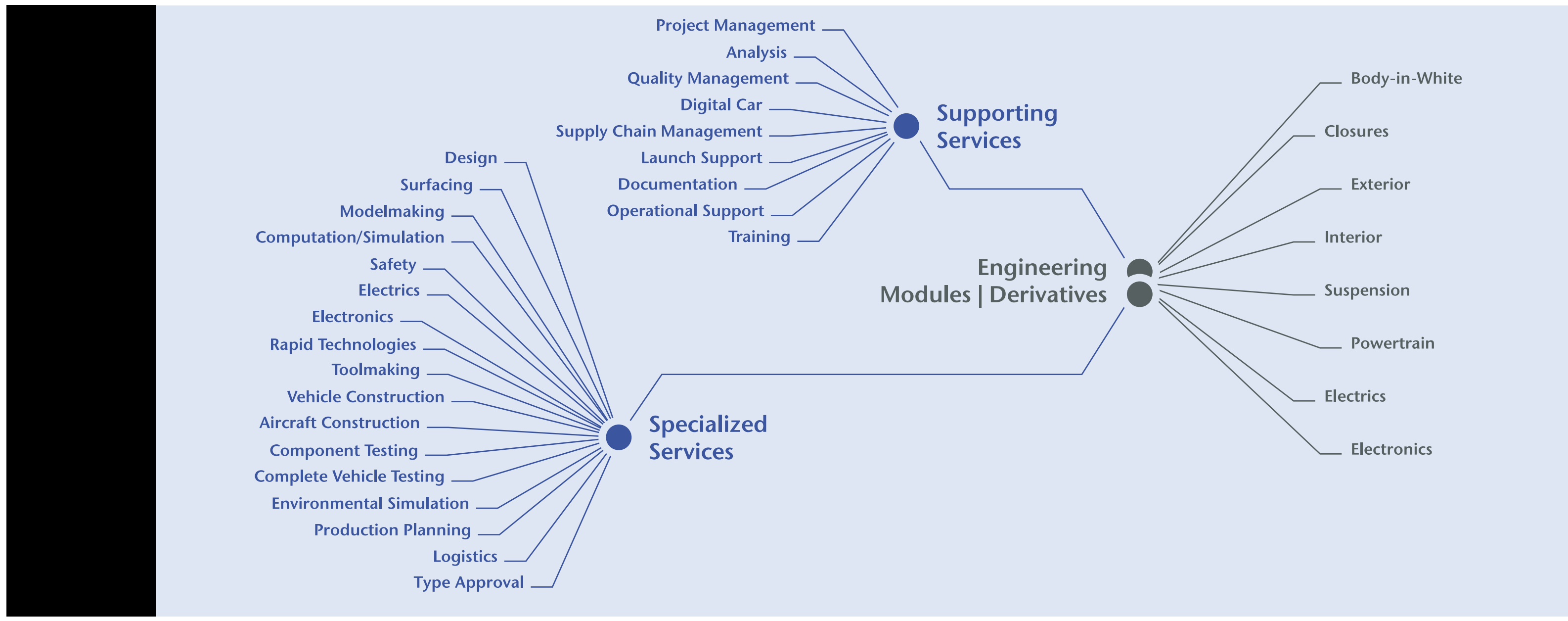
Portrait of Nils Boerner

Nils Boerner
Branch Manager of the
Hamburg office

Nils Boerner has been the Branch Manager of Bertrandt in Hamburg since 1st September 2000. Before he took up the job, he had been working at Bertrandt Sindelfingen since 1994 in vehicle build, which is where he started his career – first as an undergraduate, then as designer and latterly as team leader.

Born on 25th January 1969, Nils Boerner spent his youth in his native Hamburg. He studied automotive engineering, specialising in body design, at the University of Hamburg, and graduated in 1994. Nils Boerner has been known at Bertrandt since his university days, because it was in Sindelfingen that he did his main Body-in-White placement and wrote his thesis on the modular seat system. After graduating, he worked in Body-in-White at Sindelfingen, where he monitored various projects, such as the Mercedes Benz C Class Coupé, for example, and implemented special protection projects for DaimlerChrysler.
Nils Boerner was appointed as Body-in-White team leader in October 1998. From then on, he built up his qualifications, in addition to the design area, by adding technical and commercial monitoring and planning of development projects and gaining important experience.
When Bertrandt decided in 2000 to build a new site in Hamburg, they soon decided on Nils Boerner to head it up. So he said good-bye to Swabia and returned home to help build up the new office.
On 1st September 2000, Nils Boerner was installed as branch manager of the Sindelfingen company in Hamburg and since that time, has made an important contribution to publicising Bertrandt and its range of services and also acquiring new customers.
Since 1st October 2002, the former Sindelfingen office in Hamburg became an independent branch known as "Bertrandt Ingenieurbüro GmbH". At the moment, it employs a team of 35, mainly concentrating on concept and design work. The branch also supports and performs customers' test and project management orders. Current important projects include CAD development and also the production control of components of different types and sizes for the aircraft industry.
Following successful DIN/ISO 9002 2000 certification, Nils Boerner is looking optimistically to the future. "We are convinced that with a combination of a slim corporate structure and broad customer spectrum, we are well geared for the challenges of the future. New interesting areas are opening up all the time. He believes that everything will be possible in the future provided that we are prepared to look beyond the end of our noses".
Nils Boerner's life outside the office is preferably spent with his wife, three children and dog. As an enthusiastic sailor, he loves to sail on the Schlei, a Fjord in the Baltic near Schleswig, when the Nordic weather – and time – permits. ■

The Bertrandt Engineering Network supports clients locally all over the world.
We devote all our energies to accelerating the development of mobility.
www.bertrandt.com



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Masthead

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