

Innovation Days 2009 – Interior, Infotainment, Mobility. Contents.

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Innovation Days 2009 – Interior, Infotainment, Mobility. (Short Version)

Researchers and development engineers at the BMW Group are facing important questions. Some examples: What must displays be able to offer in a few years' time? What will the car seat of the future be like? What will MINI infotainment be like tomorrow? How can we make further progress through BMW EfficientDynamics? How can we optimise the driving experience through light and sound? What is the BMW Group's vision of individual mobility? And how can different traffic routes be perfectly connected with one another?

Possible answers to these questions are being developed in Research and Pre-Development Projects.



1. In the Car of the Future.

1.1 Putting Things in the Right Light.

So far most of the lights within the car have been central light sources focusing light above all in the middle of the passenger compartment. The outside areas of the passenger compartment are hardly illuminated, there is hardly any impression of space and surfaces generated by indirect, more gentle light. "Light" is therefore seen in this context only as a function.

For the BMW Group this is not enough. Some time ago, therefore, BMW decided to give the interior of the car a new and more distinctive look – a look created specifically and, indeed, exclusively by light. The objective is to move beyond the conventional light scenario described above and instead to create special, harmonious light effects within the interior even enhancing specific situations – light effects clearly accentuating the character of the respective vehicle.

This turns light into a conscious instrument of design providing even better support in motoring and highlighting individual materials, trim, and surfaces. Light therefore underlines the character of the car and provides an even more emotional driving experience.

„Light is emotion.“

(Hans-Peter Bailer, Project High-Value Light Design)

To reach this objective, BMW Group researchers and development engineers are conducting thorough research and studies with all the tools and instruments available for this purpose. Starting with the analysis of suitable light sources through tests on the appearance of materials under various light conditions, all the way to the most advanced virtual tools, the research engineers are using all kinds of methods and concepts. Finally, specimens show how the overall use and presentation of light "shapes" the car in the real world, test drives during the day and at night proving that the efforts made are paying off.



1.2 Car Seats – Lighter but Nevertheless Safe and Comfortable.

The seat of a car is far more than just a simple frame structure with a piece of padded cloth or leather on top. On the contrary – the seat of a car these days must meet many different demands, with safety requirements constantly becoming stricter and the customer's comfort expectations greater than ever before. And the seat should always offer the same ergonomic benefits for every occupant, with superior comfort and safety, regardless of the size, stature and weight of the driver.

The objectives of new seat concepts are clear: To win back more space inside the car, to reduce weight and cut back fuel consumption without making any concessions in terms of safety and comfort. Leaving aside the general requirements in series development, the development engineers are intentionally querying the seat structures used so far and follow a completely new approach.

„In everything we do, the human being sets the yardstick.“

(Matthias Franz, Seat Development Engineer)

The result of this research is three new seat concepts consistently oriented towards the anatomy of the human being and offering enormous potentials in saving weight:

- The Bionic Seat is inspired by nature. It offers its potential on and around the backrest with an improvement of 20 per cent over conventional seats.
- The Space Comfort Shell is derived from human body imprints and, using adaptive seat cushions, ensures an optimum cocooning effect around the occupants. The weight reduction on the research model is up to 50 per cent versus the standard seat.
- The Ergo Seat combines certain ideas carried over from both of these projects, but is closer to series production. It is up to two kilos lighter than the BMW sports seat (which is about 10 per cent) and offers greater functionality.

1.3 What Displays will Offer in Future.

For many years the BMW Group has been conducting intense and thorough research on the reliable and safe presentation of information to the driver, with virtually no distraction. A big step was the introduction of the Head-Up Display in 2003. Now, with display concepts being consistently enhanced and optimised, BMW is focusing in particular on the further potentials of the Head-Up Display and the Central Information Display.

„The Head-Up Display hugely intensifies the driving experience in a BMW – with your focus always on the road.“

(Gunnar Franz, responsible for development of the Head-Up Display)

Research on the Head-Up Display currently goes in two directions. First, there is the trend to “more colour”, with the concept of a Full-Colour Head-Up Display almost ready for production, presenting information in all colours for even better support of the driver’s tasks and activities. Second, there is the Head-Up Max Research Project examining to what extent a larger display surface improves the potential of the information provided and how an interactive function may be successfully integrated into the Head-Up Display. This would allow the selection of specific items from lists and, accordingly, enable the driver to actively influence the Navigation, Telephone or Entertainment functions without having to take his eyes off the road.

The MINI Center Globe in the MINI Crossover Concept already showed last year how information may be presented on the centre console in future. The combination of Black Panel and laser projection technology allows crystal-clear, detailed and absolutely brilliant presentation of information in three dimensions. In the meantime Black Panel technology has reached production standard and astounding progress has also been made with laser projection.

“The Center Globe opens up a new, third dimension in the car.”

(Robert Isele, Display Technology)

Whether the Full-Colour Head-Up Display, Head-Up Display Max or laser projection – all three research projects enrich the interior of the car through well-conceived, future-oriented solutions. Through their functions they enhance the status of the vehicle as an experience in space and help to ensure an even safer and more comfortable driving experience.

1.4 Active Sound Design – a New World of Acoustic Experience.

In historical terms, acoustics in automotive design and construction serves to avoid and suppress unwanted noise. The driver should not be disturbed by any squeaking, rattling, whistling or thumping noise, and should not be induced to query the car's quality.

Soon, however, the BMW Group recognised the potential of sound design seeking to create sounds in the vehicle that are particularly attractive and even appealing.

So you feel like cruising in town with the deep rumble of a V8 and, just a bit later, breezing along winding roads with the muscular and sporting sound of a BMW straight-six? To experience that kind of thrilling diversity, all you have to do is try out the MINI prototype developed by the BMW Group's acoustics engineers where the driver, using active sound design, can change the sound of the engine at the touch of a button.

Being interactive, the sound of an engine is highly emotional. It responds to the driver, to your foot on the gas pedal, to the speed of the car. And we know not just from motorsport that the sound of the engine can easily give you goose bumps. Precisely this is why active sound design offers a great potential in emotionalising the driving experience, with a subjective sensation of driving dynamics easily influenced by sound.

"Driving dynamics is more than just metres/sec²."

(Dr Fabian Evert, BMW Group Sound Designer)

2. Infotainment of the Future.

2.1 MINI Gets Connected – the New World of In-Car Entertainment.

A very special vision has been in the process of becoming reality at MINI ever since the year 2001 - the vision to intensify the interaction of man and machine, to allow mutual communication of car and driver, and therefore to make the time you spend in your car as pleasant as possible. So how can information from the car be converted into exciting experiences and new functions for the occupants? The problem back then in 2001 was the lack of technologies required to implement the project.

Since then a lot has changed not only in the world of technology, but also in society. Today life takes place increasingly in the internet, communities such as Facebook adding new dimensions to social relations and making it easier to take up and maintain contacts across international and intercontinental borders. Web Radio, Blogging and RSS Feeds make data and information from all over the world readily available on your PC or MAC at home. And not just there, since rapid progress in the area of mobile terminals provides an increasing number of functions also while travelling, with users being online almost everywhere thanks to WLAN, UMTS and similar systems. So it is only obvious that the internet must be included in all considerations for today and the future.

In this ongoing development of both technology and society, the vision of former years is now becoming reality. MINI Connected brings the modern world of communication into the MINI and opens up brand-new perspectives in use – or, to put it in other words: MINI Connected shows what is possible when integrating an internet-compatible consumer electronics (CE) device such as a Smartphone into a MINI and intentionally feeding it with specific data from the car.

As an innovative spearhead in technology, the MINI Connected prototype for the first time demonstrates the comprehensive integration of CE devices into the car, bringing together the vehicle itself, mobile information, and entertainment to create a completely new world.



“MINI Connected blends the world of modern communication with the automotive world of MINI, by using vehicle data for entertainment features for the first time.”

(Florian Reuter, MINI Product Management)

MINI Connected communicates via the iPhone in two directions, providing two different concepts in the process: “MINI Connected Live” and “MINI Connected Buddy”. The “MINI Connected Live” Project uses access to the internet through a Smartphone to provide a connection to the world outside the car. Apart from web functions such as a local search or the use of web radio in the car, “MINI Connected Live” allows direct connections to social communities such as Facebook or Twitter.

Such integration allows the intuitive use of all functions through the car-specific MINI control concept.

“MINI Connected Buddy”, on the other hand, enables the Smartphone to access vehicle- and environment-specific car data through a vehicle interface specifically configured for this purpose, then using such data for various functions.

One example is Mission Control, where the car refers the driver through its own voice to incidents in the vehicle itself and the surrounding area. Quite literally, therefore, the MINI communicates directly with the driver.

Taking signals from the car, “Dynamic Music”, as another example, generates the appropriate sound track. The dynamic behaviour of the vehicle is converted directly into acoustic feedback and the music is adjusted accordingly. So together with sound effects matching the music played, the occupants in the MINI experience the joy of motoring also through the music they hear.

2.2 The MINI Music Map.

Introducing the MINI Music Map, MINI presents a simple and attractive option for the future, showing how increasing data volume in music archives may be kept easily accessible and controllable in the car. To do this, music is structured like on a map, forming various islands with different genres or artists.

This map concept offers a number of benefits: First, it provides a quick overview of the music files; second, it allows rapid access to the desired music files in just a few steps.

Portable data memories these days have increasing capacity. The latest iPod Classic, for example, offers up to 160 GB memory for music or other files – equal to some 40,000 songs to which the customer would like to have access also while driving. And how such enormous amounts of music data may be made accessible in the vehicle in future, we see from the MINI Music Map Research Project, with the driver taking his music collection along every time he goes for a drive.

“Particularly on long distances, you don’t want entertainment to become a difficult chore. So the MINI Music Map takes care of your entertainment requirements all by itself.”

(Dr Verena Broy, Project Manager MINI Music Map)

2.3 Personal Video from BMW ConnectedDrive.

Personalisation and customisation everywhere you go – the Personal Radio Research Project conducted in the context of BMW ConnectedDrive already showed in 2007 what potential lies in connecting the car's entertainment system to the World Wide Web. And while this service was intended only for audio content, it was clear even from the start in what direction users would develop their consumption of media in the vehicle.

"In future the customer should decide himself which programme he wishes to enjoy when, where, and how."

(Thomas Helbig, Project Manager Personal Video)

Introducing Personal Video, BMW Group Innovation Research is continuing consistently along these lines. Through its additional visual component, video presentation offers a "double attraction" and, as a result, a far higher level of information.

With moving pictures already available in the car through TV transmission, we now wish to offer this service in the customer's vehicle also through the internet. Personal Video therefore allows online access to video content, with the BMW prototype offering options the customer so far only had at home on his PC or on some mobile phones.

To ensure top quality in providing information, BMW's researchers in their pilot test have opted for a news format broadcast by Bayerischer Rundfunk, the Bavarian Broadcasting Corporation – "Rundschau news". Within 100 seconds, the viewer receives all of the day's important news in a short newscast updated several times a day and seven days a week.

Particularly such short news flashes are of interest in the car, enabling the driver to watch the news even during a short break precisely when appropriate, just by pressing a button to call up the video. Clearly, this ideally supplements existing TV coverage in the automobile through a new on-demand offer.

The challenge with Personal Video is to provide a broadband connection in the car and to adapt the feed to the iDrive control concept.

A video-compatible browser has been integrated in the car for Personal Video, the prototype requiring a wide range of programming and coordination activities since so far there have been no comparable solutions in the car due to the shortage of computer resources and demanding security requirements.

The engineers are also working hard on the provision of WLAN, UMTS and other broadband technologies in the car, pointing towards a revolution in the foreseeable future with the introduction of a self-controlled, interactive media experience in the vehicle. The car would even be able to make programme proposals and recommendations according to one's personal taste and preferences. So what sounds like the future today may well soon be a very common, everyday experience.

3. Paving the Way for the Future of Individual Mobility.

3.1 Sustainable Traffic Management.

Never before has society been as mobile as today. But at the same time the transport infrastructure in many densely populated areas is already reaching the limits to its capacity. It is therefore essential, introducing new transport concepts and intelligent traffic management, to ensure most efficient and environmentally compatible use of the existing road network, and to minimise negative side effects of mobility such as traffic congestion, accidents and burdens on the environment.

BMW Group experts on traffic management and technology have been working for more than 20 years under the motto “Innovation, not Restriction” on solutions for traffic problems – and given the restricted availability of energy and climate effects, these projects have in the meantime taken on even greater significance. In Germany alone, for example, traffic congestion is responsible for approximately 12 billion litres of fuel wasted each year – extra consumption which could be avoided. Clearly, this offers a great potential for reducing CO₂ even with the volume of traffic increasing.

“We wish in particular to promote individual mobility through sustainable concepts. And as an international company we wish to demonstrate our responsibility to society.”

(Christoph Huss, responsible inter alia for BMW Group Traffic Management)

3.1.1 Cars Able to Look Ahead.

Traffic congestion is one of the unpleasant aspects of increasing road traffic. The motorist obviously does not like red traffic lights and construction sites are always a nuisance. So providing information on traffic conditions to the driver in his car, we can enable the motorist to determine and calculate efficient routes, using EfficientDynamics accordingly and gaining information on upcoming events.

The BMW Group Traffic Manager therefore faces two questions in particular: What relevant information is available? And how can we get this information into the car?



Currently the focus is on traffic management systems such as traffic lights or traffic control centres where, through communication between the vehicle and the surrounding infrastructure, the information required could be provided efficiently. Availability of more properly analysed data increases the information we can offer the driver on the route he is taking or under current conditions, ensuring even better use of EfficientDynamics such as the Auto Start Stop function for upcoming requirements.

3.1.2 Inter-Modal Route Guidance.

Another research project examines the interaction of the vehicle with other providers of transport. The term used for this purpose – Inter-Modal Route Guidance – describes the wish to promote individual mobility by using and networking the systems available. The objective is that the customer reaches his destination as quickly as possible, relaxed and in style.

Precisely this is why the BMW Group seeks to integrate and connect the car intelligently with other means of transport, ensuring synergetic use of various transport providers. Specifically, the focus is on intelligent use of the car in conjunction with other transport providers in public short-haul passenger transport, also taking parking space into account.

In future, therefore, the BMW navigation system, whenever the inner city is overcrowded or closed to car traffic or when there is traffic congestion on the route planned, will help the driver change to public transport or use Park & Ride. The system offered also provides optimised information on parking opportunities and a “last mile” routing to the driver’s final destination, avoiding the need to waste a lot of time looking for a parking space in town and using extra fuel in the process.

The big challenge of the future is to integrate reliable, up-to-date information on a broad basis, providing a precise description of traffic conditions and the options available in public short-haul passenger transport. This is the only way to ensure high-quality, dynamic inter-modal route guidance the driver will readily accept and use.

3.1.3 TPEG – the Data Revolution.

Many ideas can only be implemented through efficient data management. So far traffic data for use in the car has been broadcast by FM radio on the Traffic Message Channel (TMC). But the current TMC standard and the bandwidth of FM radio are no longer sufficient for upcoming requirements such as traffic information-based travel services.

The solution is TPEG (Transportation Protocol Expert Group), an international standard for broadcasting multi-modal traffic and travel information independently of voice messages. TPEG allows more efficient use of far greater bandwidth than other broadcasting protocols so far.

Various broadband transmission channels such as DAB, HD Radio, GSM and UMTS may provide the basis for TPEG, which is able to present not only specific traffic events and conditions such as high traffic volume, congestion, accidents or roads closed, but also useful information such as the flow and speed of traffic, weather conditions, parking options and the occupancy of car parks, connections to other means of transport (inter-modal route guidance) as well as filling stations with the respective price of fuel.

3.2 Intelligent Heat Management.

For a long time every effort was made to avoid the build-up of heat in the car and, therefore, to prevent overheating of the car's components. But in recent years there has been a significant change in mind in the process of reducing CO₂ emissions.

"Heat is a very valuable form of energy in the car largely still unused and not easy to properly exploit."

(Dr Johannes Liebl, Head of BMW EfficientDynamics)

A lot of residual heat is generated particularly in the engine, since even in a very efficient combustion engine only about one-third of the energy in the fuel consumed is actually converted into drive power. The other two-thirds are lost as waste heat going out into the environment through the exhaust gas and the radiator.

Use of this energy through intelligent heat management offers a great potential for reducing fuel consumption and, accordingly, CO₂ emissions. While a small share of the thermal energy available is already used today (for example when warming up the engine or through exhaust gas turbocharging), further improvements for using such thermal energy would be able to reduce the car's consumption once again by several percentage points.

Depending on the context and the route profile, heat management offers various possible solutions, different technologies serving to reduce fuel consumption on both short and long distances. Insulation of the engine compartment, use of an exhaust gas heat exchanger on the petrol engine to heat up the transmission fluid, or the heating function of the exhaust gas heat exchanger on a diesel engine are appropriate options mainly for short distances. On longer routes the Thermoelectric Generator is able to make a significant contribution to greater fuel economy.

Using synergy effects, heat management will make a substantial contribution in future to the reduction of CO₂.

3.2.1 No More Cold Starts.

When starting the engine cold and while warming up, there are significant frictional losses in both the engine and the transmission, resulting in an increase in fuel consumption of up to 10 per cent versus the engine already warm. Precisely this is why the objective today is to warm up a car as quickly as possible to its regular operating temperature. At the same time it is important to maintain the temperature within the car as long as possible also at the end of a trip, in order to have the optimum temperature in the engine when starting again, thus offering the customer further advantages in terms of fuel economy.

Encapsulation of the engine is a viable solution on both petrol and diesel power units. The objective of such insulation is to retain as much heat within the engine as possible at the end of a trip in order to have the ideal engine temperature when starting again.

Insulation of the engine compartment by panels shown in a prototype is able to significantly slow down the cooling process, with the engine remaining warm even after several hours. And each degree celsius over the surrounding temperature means a reduction in fuel consumption by approximately 0.2 per cent.

3.2.2 Heating with Waste Heat.

To keep the warm-up period as short as possible, a solution particularly suitable on the petrol engine is to use an exhaust gas heat exchanger. Immediately after setting out, such a heat exchanger allows direct use of the waste heat coming from the drivetrain, actively warming up, say, the transmission fluid and quickly minimising friction in the transmission.

The main savings potential offered by an exhaust gas heat exchanger in a diesel engine is the option to heat the interior. Modern diesel engines are now so efficient that the heat going into the cooling circuit and, accordingly, into the car's heater is not always sufficient to meet the customer's comfort requirements. An additional electric heater is therefore required, with a heating output of approximately 1,000 W. To provide this kind of energy the car consumes up to one extra litre of fuel every 100 kilometres, particularly in cold winter weather.

An exhaust gas heat exchanger would allow the driver to avoid this extra fuel consumption by using waste heat from the drivetrain to warm up the passenger compartment and thus dispensing with the additional heater. And as on the petrol engine, an exhaust gas heat exchanger would help to improve the process of the engine warming up.

3.2.3 Electric Power from Waste Heat – the Thermoelectric Generator.

The thermoelectric generator (TEG) takes a completely different approach to the generation of energy from heat. Based on space technology, the TEG is able to convert waste heat into electric power.

After initially being presented as a separate module on the underfloor of the car next to the catalytic converter, the thermoelectric generator now offers further options, BMW Group engineers presenting a new, integrated solution. Using synergies among various components, the new prototype TEG is fitted in the engine compartment, to be specific in the exhaust gas recirculation cooler featured on modern diesel engines as a regular component for reducing emissions.

With exhaust gas recirculation already offering many of the features required for integrating such a generator, an elegant and sensible solution is provided here without any particular effort. When it reaches production standard, the TEG will generate 250 W, almost half the on-board consumption of a BMW 5 Series in the hands of a customer, helping to reduce fuel consumption by up to two per cent.

Used in this way, the TEG does not yet capitalise on the full potential offered by exhaust heat, since the exhaust gas recirculation system provides only some of the exhaust heat flow. Still, integration of such a unit in the exhaust gas recirculation system is an important step towards the subsequent more sophisticated integration of a TEG in the underfloor of the car or in the catalytic converter, since the solution now offered provides important information on the operating principles and on obstacles which may still have to be overcome. And this know-how may then be applied in implementing an underfloor solution.