

Press release
11 November 2020

BMW Group sets new standards for driving simulation.

#NEXTGen 2020 offers exclusive insights before the new Driving Simulation Centre starts work.

+++ Most progressive and diversified installation of its type in the automotive industry +++
+++ Ideal simulation tools for every phase of vehicle development +++
+++ Pioneering building design for seamless simulation experience and maximum customer focus +++

Munich. The BMW Group is creating every opportunity for its vehicle research and development engineers to simulate and test the product requirements of the future under realistic conditions with its new Driving Simulation Centre. With 14 simulators and usability labs covering an area of 11,400 square metres, it is the most advanced and diversified simulation centre in the automotive industry.

As Michael Brachvogel, Head of BMW Group Research Interiors, User Interaction, User Experience and Driving Simulation, explains, "The aim of the new centre is to provide the ideal simulation tool for every area and every phase of the vehicle development process, all under one roof." The focus on the customer in the development stage is also being raised to a whole new level. "We can perform test drives for studies with up to 100 test persons per day," says Brachvogel.

The optimum simulation tool for every stage of development.

From the early concept phase through to the final function validation stage, the centre provides the various specialist areas in vehicle development with an ideal simulation tool.

Facilities range from static simulators without a motion system to the high-fidelity simulator, which transports the road into the lab to remarkably realistic effect with its nearly 400 square metres of motion area. Whether it's innovative entertainment technologies and display and operating concepts, multimodal interaction between occupants and vehicle, fine-tuning of the chassis, or wide-ranging driver assistance functions all the way up to interior scenarios for fully automated driving – virtually every aspect of car development can be tested here in terms of suitability for the customer.

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The virtual test drives are regularly performed by external test persons and not just by BMW Group engineers. “The new Driving Simulation Centre makes an enormous contribution to our customer-centric product development,” says Michael Brachvogel. “We can integrate direct customer feedback into the development process at any given moment.”

Simulated testing of every last detail: sampling driving pleasure in virtual form.

For years now, driving simulation has played a key role in driving dynamics development at the BMW Group. The new Driving Simulation Centre will enable the virtual development process to be further expanded, reducing the number of prototypes that need to be built as well as the duration of the development cycle. Tyres or entire axles can be swapped in a matter of seconds and test routes all over the world selected at the push of a button in the driving simulator. It’s even possible to seamlessly transition from summer to winter. All the various influencing factors can be reproduced with a high degree of accuracy in the simulation. “Both in the early phase of development and at the validation stage, every nuance that goes into making the driving feeling for which BMW is renowned can be sampled in the state-of-the-art simulators,” says Thomas Lachner, a driving simulation expert with the driving dynamics development team.

The new Driving Simulation Centre is the perfect response to the ever-increasing demands involved in developing intelligent, highly connected vehicles. New display and operating concepts can be subjected to intensive testing to analyse the risk of driver distraction or the effectiveness of the multimodal control methods. “With the aid of extensive tests in the driving simulator we can design our systems in such a way that our customers in their vehicles obtain the right information at the right time and in the right place – all in the simplest and most intuitive way possible and in every conceivable driving situation,” says Marion Mangold, team lead User Interaction Concept.

Driving simulation offers major advantages for the development of future driver assistance systems and automation functionalities, in particular. Road situations that involve risk or occur only rarely in real-life driving are almost impossible to test on the road. In the simulator, they can be replicated safely and in great detail as often as

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required. And individual aspects of scenarios can be varied and combined with one another as desired. The upshot is that complex systems can be tested under varying, realistic conditions before road-testing has even started. "Our preparations for the introduction of our driver assistance functions are extremely thorough. Driving simulation is a major factor in ensuring that we can develop the best and safest products for our customers," says Manuela Witt, expert for Safety-in-Use and Effectiveness Analysis.

Thanks to an installation concept featuring an ingenious transportation and docking system, all the simulators can be used on the same day with different vehicle models if required. The centre thereby offers a high level of flexibility for all specialist areas of development, while also enabling maximum utilisation of capacity.

Total immersion: the Seamless Simulator Experience.

The BMW Group's driving simulation experts have devised a Seamless Simulator Experience in order to offer test persons an even more realistic simulated experience and therefore increase the validity of results. In future, test persons in selected studies will wear a VR headset as they make their way to the simulator. They will be in a virtual BMW or MINI dealership, for example, with the vehicle parked in front of the dealership ready for the test drive. While they walk through the virtual space, they are actually moving towards the driving simulator. They only remove the headset immediately before entering the simulator. "We attain an extremely high degree of immersion with the Seamless Simulator Experience," says Driving Simulation Centre project manager Martin Peller. "This allows the study participants to immerse themselves far more fully in the driving situation, which in turn means that we obtain very valid and robust results for optimising our user functions."

High-tech on an impressive scale: the high-fidelity and high-dynamic simulators.

The high-fidelity and high-dynamic simulators are the standout highlights of the new Driving Simulation Centre, both visually and technologically. They create the type of test



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conditions that in the past could only be experienced with actual test vehicles on the road. Besides targeted optimisation of innovative user functions, testing in the lab has the added benefit of making it possible to reproduce specific driving situations as often as required, significantly increasing the validity of the evaluated test results. The driving simulators can also be used for acting out test scenarios that seldom occur in real-life driving and only under unusual circumstances, or that involve an element of danger and therefore cannot be recreated for test purposes alone out on an actual road. However, findings from on-road testing can be checked and validated by means of realistic simulations in the lab.

The high-fidelity simulator:

- Development focus: user functions in challenging driving situations, such as those encountered in urban driving.
- Simultaneous longitudinal, transverse and rotational movements possible.
- Acceleration of up to 0.65 g
(similar acceleration to a BMW M3 sedan: 0 to 100 km/h [62 mph] in 4.2 sec)
[353 kW/480 hp; fuel consumption combined: 10.8 l/100 km (26.2 mpg imp); CO2 emissions combined: 248 g/km.*]
- Motion area of nearly 400 square metres.
- Over ten metres in height.
- Moving mass of around 83 metric tons.
- Peak electrical power required: up to 6.5 MW.

In the high-fidelity simulator, real-life driving scenarios are reconstructed in exceptional detail. Braking and accelerating in corners, negotiating a roundabout, and a quick succession of turns can all be recreated with high precision on this installation's motion area, which measures nearly 400 square metres. This means that complex urban driving situations – which present a particularly wide range of challenges for automated driving systems – can now be replicated under laboratory conditions.

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The high-dynamic simulator:

- Development focus: user functions in highly dynamic driving situations.
- Highly dynamic longitudinal and lateral acceleration of up to 1.0 g (acceleration similar to the BMW iFE.20 Formula E racer: 0 to 100 km/h [62 mph] in just 2.8 sec.)
- Sled length 21 metres.
- Moving mass of around 23 metric tons.
- Over nine metres in height.
- Peak electrical power required: up to 3 MW.

The new high-dynamic simulator is capable of generating longitudinal and lateral acceleration forces of up to 1.0 g. It replicates highly dynamic evasive action, emergency braking and hard acceleration when testing out new systems and functions.

The longitudinal and lateral movements of both simulators are produced using a sophisticated system of wheels and rails, which reacts virtually instantaneously to driver inputs such as steering commands. This allows all the characteristic nuances of driving pleasure in a BMW to be experienced in the simulator. This is achieved by using linear electric motors with no moving parts. In order to generate the necessary forces, these electric motors hover above a series of magnets with poles alternating in quick succession, similar to the magnetic levitation technology found in high-speed maglev trains. Supercapacitors deliver the peak power required by the motion system in fractions of a second, with the motion system then recuperating energy by means of regenerative braking and feeding it back to the supercapacitors.

The tests take place inside a platform of the driving simulator with a distinctive dome shape. Here, the systems for testing are installed in a vehicle mock-up. The dome is

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mounted on an electromechanical hexapod system and can be moved in both a longitudinal and a lateral direction by means of a further electric drive unit. Inside the dome, the vehicle mock-up stands on a turntable for recreating rotary movements.

The dome is used for a 360-degree projection of the surrounding area to give drivers a realistic visual image of the simulated traffic situation. Precise synchronisation of the visual projection with the vehicle mock-up's movements gives the simulated driving situation a very realistic feel. The visual impressions and the longitudinal, lateral and vertical acceleration forces acting on the test person merge to create a near-perfect overall sensation of dynamic motion. Completing the virtual test drive scenario is a simulated soundtrack that is likewise matched exactly to the situation being replicated. The test persons enter the vehicle in the dome via a gangway similar to those used for boarding an aeroplane.

Completion of a major project in challenging times.

Construction of the world's most sophisticated facility for simulating real-life driving situations got underway at the Research and Innovation Centre (FIZ) site in the north of Munich in mid-August 2018. Despite the extensive global restrictions imposed as a result of the COVID-19 pandemic, building work was completed on schedule in May 2020. Since then, installation of the simulators has been progressing apace.

BMW Group has decades of expertise in the field of driving simulation.

Modern driving simulators have become an indispensable tool for the development and testing of driver assistance systems and display and operating concepts, in particular. They make it possible to thoroughly test the functionality and practical suitability of new systems at a very early stage of development. The driving simulator acts as the link between the function tests on individual hardware and software components and road-testing with complete systems. The BMW Group has amassed many years of experience with the use of such facilities. Static driving simulators were already being used to assist with the development of BMW models in the early 1990s. And in 2006 the company supplemented these with a dynamic driving simulator, enabling it to

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reproduce road traffic occurrences even more precisely. To cope with the increasing demand on capacity, a second dynamic driving simulator was installed at the BMW Group's Research and Technology House in Garching in 2016.

*The fuel consumption and CO2 emissions figures are determined according to the European Regulation (EC) 715/2007 in the version applicable.

The figures refer to a vehicle with basic configuration in Germany. The range shown considers the different sizes of the selected wheels/tyres and the selected items of optional equipment, and may vary during configuration.

The values are based on the new WLTP test cycle and are translated back into NEDC-equivalent values in order to ensure comparability between the vehicles. With respect to these vehicles, for vehicle-related taxes or other duties based (at least inter alia) on CO2 emissions, the CO2 values may differ from the values stated here (depending on national legislation).

Further information on official fuel consumption figures and specific CO2 emission values of new passenger cars is included in the following guideline: 'Leitfaden über den Kraftstoffverbrauch, die CO2 Emissionen und den Stromverbrauch neuer Personenkraftwagen' (Guide to the fuel economy, CO2 emissions and electric power consumption of new passenger cars), which can be obtained free of charge from all dealerships, from Deutsche Automobil Treuhand GmbH (DAT), Hellmuth-Hirth-Str. 1, 73760 Ostfildern-Scharnhausen and at <https://www.dat.de/co2/>.

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The BMW Group

With its four brands BMW, MINI, Rolls-Royce and BMW Motorrad, the BMW Group is the world's leading premium manufacturer of automobiles and motorcycles and also provides premium financial and mobility services. The BMW Group production network comprises 31 production and assembly facilities in 15 countries; the company has a global sales network in more than 140 countries.

In 2019, the BMW Group sold over 2.5 million passenger vehicles and more than 175,000 motorcycles worldwide. The profit before tax in the financial year 2019 was € 7.118 billion on revenues amounting to € 104.210 billion. As of 31 December 2019, the BMW Group had a workforce of 126,016 employees.

The success of the BMW Group has always been based on long-term thinking and responsible action. The company has therefore established ecological and social sustainability throughout the value chain, comprehensive product responsibility and a clear commitment to conserving resources as an integral part of its strategy.

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