20 years Hyundai Motor Europe Technical Center – the improvement of Hyundai's and Kia's performance to meet customers' expectations

Dr. Moo Sang Kim, Managing Director,
Hyundai Motor Europe Technical Center GmbH

P.E. Pfeffer (Ed.),*7th International Munich Chassis Symposium 2016,* Proceedings,
DOI 10.1007/978-3-658-14219-3_2

The History of Hyundai Motor Europe Technical Center

Foundation of HMETC

Hyundai started selling vehicles on the German market in the early nineties of the last century. In 1995 the Hyundai Motor Europe Technical Center (HMETC) GmbH was founded which is responsible for developing vehicles for the European customer since then. In 1998 Kia Motors was merged into the Hyundai Kia Motor Company (HKMC). Sales figures have increased strongly since the beginning of the millennium and reached more than 8 million vehicles worldwide and around 1,1 million (160,000) vehicles in Europe and Russia (Germany) in 2015. The importance of the European market for HKMC can also be seen in the operation of the production facilities in the Czech Republic, Slovakia, Russia and Turkey with an overall capacity of 1.5 million vehicles / year.

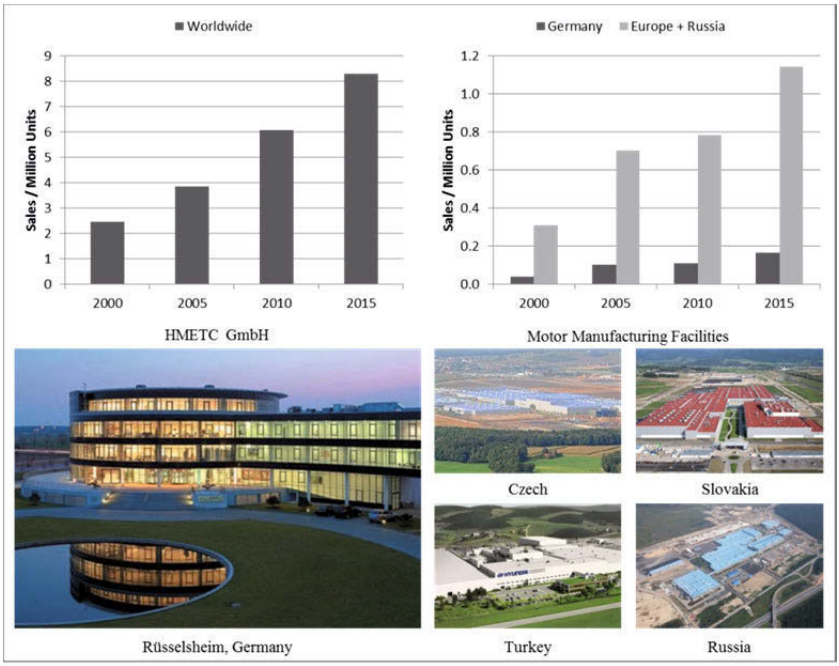

Figure 1: Sales Numbers HKMC and Facilities in Europe and Russia

Quality and Competitiveness

After entering the European market mainly by appealing pricing, HKMC quickly focused on good vehicle quality and reliability to remain competitive in the strong competition. The development is clearly oriented towards the European customer and the performance of suspension, steering, tires and vehicle stability systems like ABS or ESC on European proving grounds or on public road profiles. To develop a typical pleasant driving feel for the customers of each Hyundai and Kia car, the European competitors are evaluated closely in benchmark tests confirming our targets concerning ride and handling.

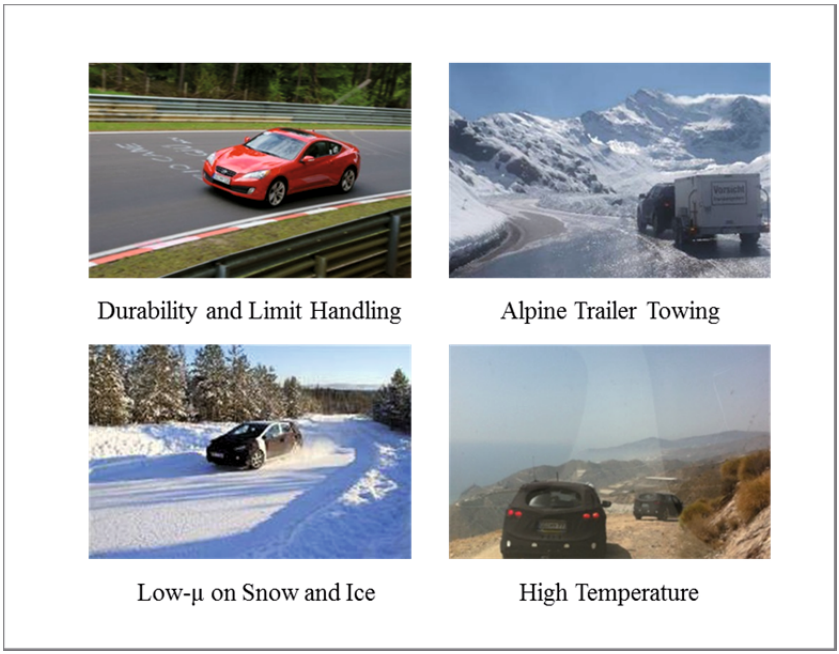

Figure 2: Vehicle Development in Europe

Limit Performance

Additionally to the normal customer's driving range in the lower area of lateral acceleration the performance at the limit plays an important role for the European market. For example the electronic stability control should not only cover the basic demands

concerning vehicle safety, but it should also be capable of enhancing the vehicles performance in terms of sporty driving and fun-to-drive. The test center at Nürburgring was opened in 2013 acting as the perfect headquarter for test driving at the limits of vehicle dynamics on the more than 20km of Nordschleife allowing to confirm the performance of current Hyundai and Kia models.

Figure 3: Nürburgring Test Center

Differences between Asian and European Market

Hyundai Motor Group (HMG) realized early that it is important to differentiate between markets to guarantee customer satisfaction and an acceptance of brands. The demands and expectations for a car especially concerning steering and suspension are strongly divergent between the domestic customers in South Korea and those in Europe. While Korean customers are focusing strongly on comfort, they expect softly tuned suspensions, steering systems with low effort and good noise cancellation. This does not come as a surprise having in mind the traffic situation around the metropolitan area of Seoul with its permanent stop-and-go condition. Contrary to that European customers often have higher demands concerning sporty handling, good performance at high speeds and general driving fun, accepting a firmer ride or a steering system with higher holding efforts.

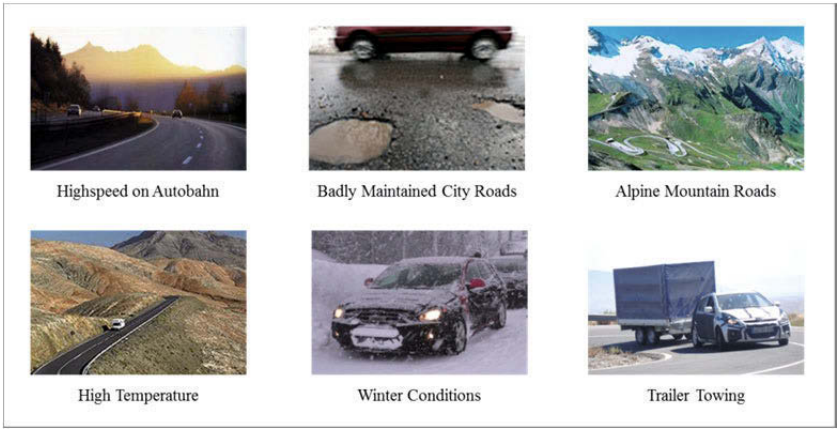

Figure 4: Challenges of European Market

Technical Improvements for Europe

To cover the different demands in terms of vehicle dynamics, ride and steering in Europe it can be necessary to modify whole concepts of steering or suspension systems.

Suspension

To reach an optimum compromise of driving safety, comfort and dynamics the current Hyundai i30 is sold in Europe with a multi-link rear axle. This concept can deliver several advantages for handling and comfort versus the compound twist-beam axle (CTBA) that is used on the Korean market. The analysis of elastokinematics shows advantages of the wheel's longitudinal motion during vertical bump. The multilink concept can easily be designed to allow a rearwards motion in bump reducing the accelerations felt by the driver while passing obstacles. At the same time the toe change characteristics can be setup for compliance toe-in at the outside wheel during cornering which improves the vehicle's lateral stability.

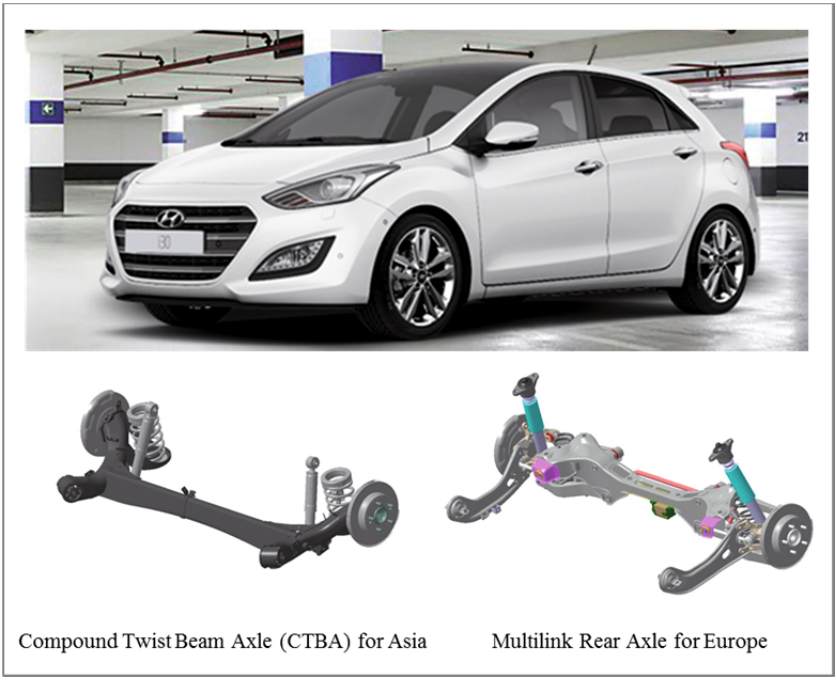

Figure 5: Comparison of CTBA and multilink rear axle

Steering

Steering feel is an important factor for the overall driving experience of European customers. Avoiding elasticities in the steering assembly allows to reach a more precise steering feel and gives the customer a better feedback of the road and driving condition. The current SUV models of Hyundai (Tucson) and Kia (Sportage) use steering systems with motor driven power steering (MDPS) installed at the rack exclusively tuned for the European market. In contrast to the versions for the Asian market with the MDPS at the column close to the steering wheel, forces can be covered closer to the position where they are generated to minimize torsion of the steering columns.

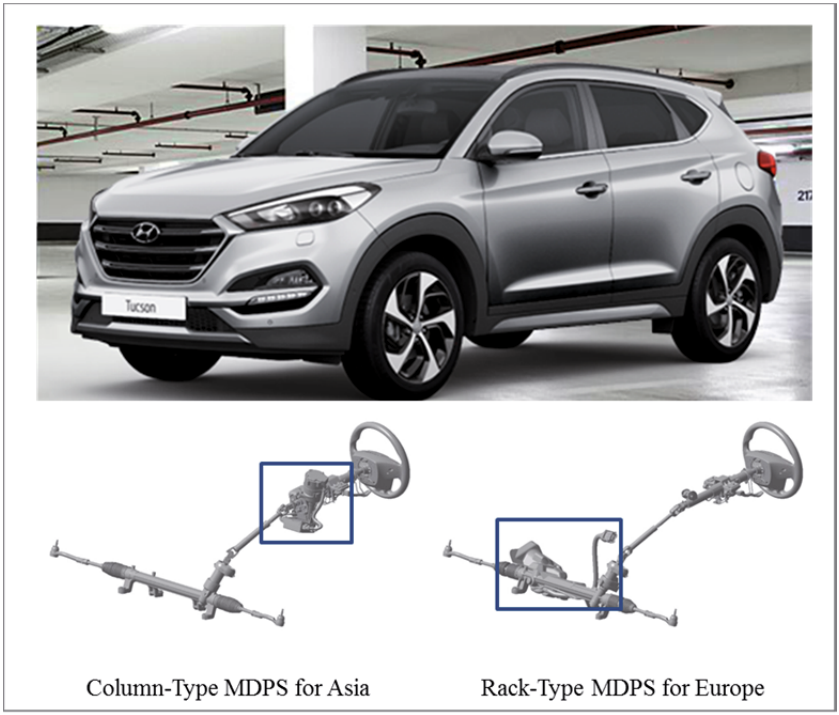

Figure 6: Comparison of Column-MDPS and Rack-MDPS

Brakes

Additionally to the pure braking distance optimization, where current Hyundai and Kia models receive top marks, the HMETC is responsible for developing requirements like pedal feel, brake cooling and fading. Differences to other markets can be found in genuinely tuned systems like traction control, anti-locking system and stability control and in hardware modifications e.g. brake sizes. Those are adopted for various climatic conditions and different friction conditions for the European customer.

Subjective Driving Evaluation

Evaluation drives and confirmation tests of steering and suspension settings are performed by the HMETC in close collaboration with the development teams in Korea. The special requirements of the European customer are verified by internal and independent

experts on representative test roads. This subjective impression of the vehicles driving behavior is the most important criterion for defining the performance of Hyundai and Kia vehicles. As described above this impression can be influenced by cultural and individual factors and is often not easy to communicate. Additionally to detailed subjective evaluation ratings covering the most important areas of ride comfort, handling and steering the correlation to objectively measured parameters is crucial.

Objective Measurements

During the development of European steering, ride and handling the divisions in Rüsselsheim and Namyang conduct regular objective measurements confirming the target parameters. The HMETC uses its own state-of-the-art test equipment for measurements of kinematics & compliance, dynamic steering & handling and ride comfort to generate objective test data, new test methods, specifications and parameters for a detailed analysis of the vehicle's characteristics.

Figure 7: Objective Measurements at HMETC

Hardware-in-the-Loop Tests

Tuning of mechatronic systems is a great challenge for OEM's concerning a high number of variants and parameters. Modern MDPS systems allow to adopt the same steering hardware on different vehicles by varying the software parameters. To support the steer-

ing feel tuning a feasibility study was carried out by the HMETC, IPG and Munich University in 2014 making use of a Hardware-in-the-Loop (HiL) test rig and proving the advantages of a simulation-based tuning process. Accordingly in 2015 HMETC setup their own HiL-steering test bench which is implemented into the European development process. This test bench allows to verify the performance of the real steering system including ECU in dynamic conditions. Steering input comes from an electric actuator connected to the steering wheel and steering rack forces, calculated in real-time, are transferred via linear actuators to the tierods. In that way the same conditions as in real-world driving can be reproduced in the laboratory. On the test bench steering characteristics can be optimized easily by modifying the same ECU parameters like in the real car test. Currently HMETC works on the implementation of Design-of-Experiments based automation for an even more efficient tuning process.

Figure 8: Hardware-in-the-Loop Steering Test Bench at HMETC

Results and Market Feedback

The approach of improving Hyundai and Kia vehicles for the European customer is confirmed by rising sales numbers, positive customer feedback and good results in press tests. Comparison tests in car magazines with vehicles located even in higher price regions have become normality and especially the current SUV-models Hyundai Tucson and Kia Sportage are praised for their competitive performance. The desired differentiation between both brands concerning a more comfortable Hyundai and a more agile Kia is clearly recognized confirming the internal tuning targets and objective handling measurements. Additionally, for the first time ever Hyundai won the 'Golden Steering Wheel (Goldenes Lenkrad)' in 2015 for the i20. Looking back at older press results it can be seen that the potential for improvement has been achieved.

Figure 9: Hyundai Tucson, Kia Sportage and Hyundai i20

Outlook

The development of Hyundai and Kia vehicles is on-going and will be even more complex for steering and suspension in the future. Higher performance for handling is targeted with the newly founded N-brand that will develop vehicles capable for the race track. Aiming for customers in that range of the market means completely new challenges for the development divisions in Europe and Korea increasing the need for modern methods and concepts. The HMETC will play a major role in that story.

Figure 10: Hyundai N-Brand Development

http://www.springer.com/978-3-658-14218-6

7th International Munich Chassis Symposium 2016
chassis.tech plus
Pfeffer, P. (Ed.)
2017, XXI, 957 p. 560 illus., Softcover
ISBN: 978-3-658-14218-6