GLOBAL INNOVATION REPORT

Trends in Automated Driving and Advanced Driver Assistance Systems in Europe

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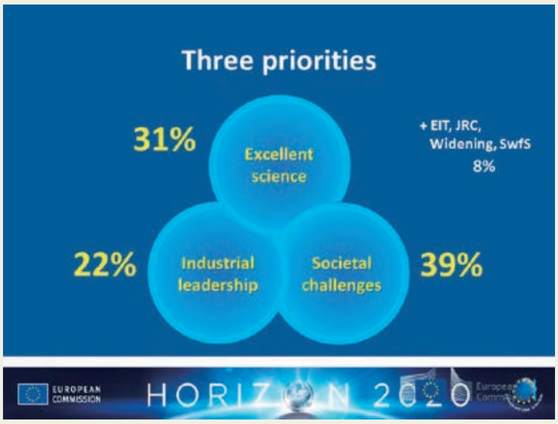
Toward Automated Driving in Europe

With considerable work going into the achievement of automated driving around the world, European countries are engaging in research and development (R&D) through a list of strategies on both the individual country level and across the entire European Union (EU). This R&D is aiming to deliver to the driver a better quality of life (QoL), seeking to reduce major accidents caused by human error, providing alternatives for the steadily aging driving population and for people who do not feel confident behind the wheel, rationalizing traffic flows to reduce emissions of atmospheric pollution, and freeing up time wasted in traffic jams for interests such as reading or writing and browsing the Internet. Although Japan receives considerable amount of information about this, especially eye-catching news about automated driving developments provided by press releases from German manufacturers, developments aimed at achieving automated driving are also making steady progress in other European countries.

In Sweden, the "Drive me" project jointly undertaken by the public and private sectors involves a large-scale trial in a mixed-traffic environment where both automated and non-automated vehicles share the road. Vehicles equipped with functions equivalent to level 4 automated driving (limited to specified sections of ordinary public roads) are being rented to the public. It is hoped that the project will shed light on the relationship between automated driving systems and people in terms of 1) how the driver sitting behind the steering wheel reacts to the decisions and actions of a vehicle equipped for automated driving, 2) how the drivers of nearby non-automated vehicles react, and 3) how drivers react when control is handed back to them from the system, such as when the vehicle reaches the end of a section of road where automated driving is permitted, or during particularly severe weather conditions.

In the UK, meanwhile, the Department for Transport has launched driverless car projects for achieving automated driving. Development aimed at achieving fully automated driving over the long term is being undertaken based on an action plan that involves progressively establishing requirements for running automated driving trials in the UK, clarifying problematic regulations in the UK and the possibility of revising them if possible, and clarifying problematic regulations internationally and collating the necessary changes.

Figure 1 | **Europe's Horizon 2020 Framework**



With government agencies playing a central role, the Netherlands is looking at the relationship between automated vehicles and infrastructure, building systems for car-to-car and car-to-infrastructure communications, and actively pursuing research into schemes for testing and certifying the safety of vehicles equipped for automated driving.

In addition to these country-level initiatives, a variety of joint industry-government-academia projects are underway through the Horizon 2020 framework for encouraging new research and development and innovation in Europe as a whole (see Figure 1).

Although, it was undertaken under the Seventh Framework Programme for Research and Technological Development (FP7), the Automated Driving Applications and Technologies for Intelligent Vehicles (AdaptIVe) project had a budget of 25 million euros, ran for 42 months from January 2014 to June 2017, and involved comprehensive research and development on a large scale by 28 project members over eight countries (France, Germany, Greece, Italy, Spain, Sweden, the Netherlands, and the UK). The project defined typical use cases for automated driving that covered driving on highways and ordinary urban roads, parking, and traffic jams, and undertook research and development of the technologies required to achieve them. It conducted testing on demo vehicles, and also extended to collating the necessary laws. The results of the project are expected to serve as an important reference for the future development of automated driving.

Meanwhile, in addition to the acquisition of a supplier of highly accurate maps needed for automated driving by an industry association of large German car companies, there is also upheaval in international alliances around artificial intelligence (AI). In this way, rapid progress toward automated driving is being made in the technical developments taking place among countries, among automotive manufacturers, and also outside the traditional boundaries of the automotive industry. This is also true of the restructuring of business schemes that is proceeding in parallel.

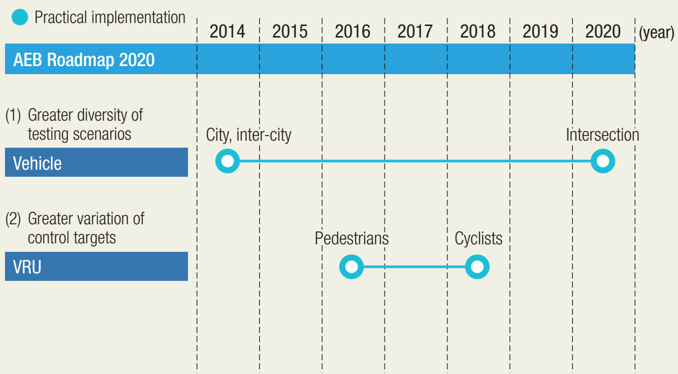
ADAS Trends in Europe

Advanced driver assistance systems (ADASs), classified as level 2 or lower under the automated driving levels defined by the Society of Automotive Engineers (SAE), are being introduced as the base technology to support higher levels of automated driving. The spread of collision mitigation braking systems is particularly rapid, with growing awareness among the driving public. However, the system configurations used to implement collision mitigation braking vary widely, including systems that use, respectively, infra-red, monocular cameras, or stereo cameras, and systems that use a mix of cameras and millimeter-wave radar.

Naturally, the different system configurations have different limitations in terms of vehicle speeds over which they can operate, the scope of control, and the situations in which they are effective. This makes it difficult for normal drivers to understand these distinctions and assess their relative value. This has led to having the systems evaluated by the European New Car Assessment Programme (Euro NCAP), a consumer organization that is independent of vehicle manufacturers and other companies in the automotive industry. Euro NCAP publishes ratings for the safety of vehicles sold on the European market that are expressed as a number of stars and are easy to understand. To date, assessment has focused on ADAS safety performance in collisions (what is known as passive safety), and the results have been published widely. In recognition of the difficulty of evaluating different system configurations, however, new assessments were added from 2013 for ADASs classified as active safety systems, starting with collision mitigation braking systems. Euro NCAP ratings have been quoted both directly and indirectly in a wide variety of forms, including in articles by journalists, technical publications, and news releases. With the ratings now exerting a significant influence on buyer behavior, developments in this area are something that companies in the automotive industry are unable to ignore.

Recently Euro NCAP is expanding to cover, not only vehicle passengers, but also vulnerable road users such as pedestrians and cyclists. These new protocols will have big impact on the design of new ADAS systems. for this reason and instead of passively observing trends, an active participation in the elaboration of new assessments is important in order to actively anticipate the arrival of new ADAS systems (see Figure 2).

Figure 2 | **Euro NCAP AEB Roadmap**



Euro NCAP: European New Car Assessment Programme
AEB: autonomous emergency braking VRU: vulnerable road user

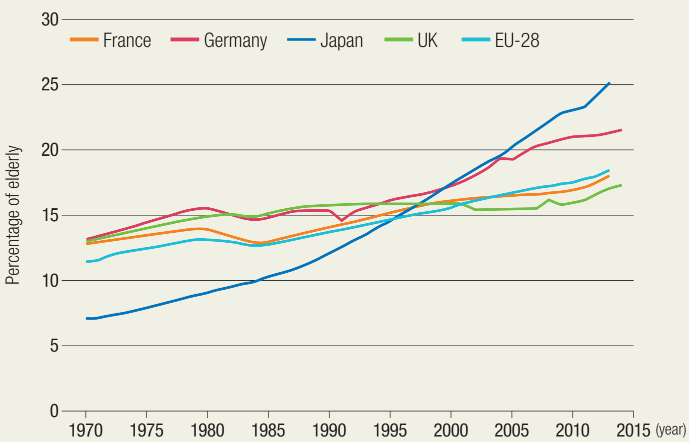
Challenges Faced by European Countries in Achieving Automated Driving

As presented before, each European country is having its specific challenges. The local aspect of these challenges makes it difficult to cover by general trends like EuroNcap.

Among the frequent experiences people have when driving through urban areas of France, for example, are motor bikes weaving at risky speeds between vehicles stuck in a traffic jam and cyclists making their way around tourist sites. These chaotic situations mean that it will be a challenge to design systems to prevent these situations. Similarly, a shopping trip often entails driving around city streets looking for a place to park on the side of the road. Even if the driver is lucky enough to find a place somewhere, he needs to make an on-the-spot decision as to whether the vehicle will fit into the very small space available, and needs to have the driving skills to quickly maneuver the vehicle into it.

In Germany, on the other hand, the lack of a speed limit on parts of the autobahn gives drivers a wide choice of speeds, resulting in very large speed differences between vehicles. One such example would be a vehicle driving in the fast lane at a speed of more than 200 km/h encountering another vehicle traveling at about 100 km/h when it unexpectedly changes to the same lane. In this case the two cars would have a relative speed of 100 km/h. In Japan, this equates to suddenly seeing a stopped vehicle in the lane ahead while driving on a highway at 100 km/h. Situations such as this require sensors that are able to perform accurate sensing at longer ranges. Moreover, speed limits on the autobahn vary by lane depending on the level of congestion, and this information is displayed on electronic signage. Failing to see a speed limit sign can result in not knowing the maximum permitted speed. There is also a need for techniques that can collect and interpret information like road markings, which can sometimes confuse even human drivers, on those frequently encountered sections of road on both the autobahn and ordinary roads where maintenance work is in progress, and where the white lines, showing the original lanes, overlap in complex ways with the orange lines, showing the temporary lanes for use during the road work.

Figure 3 | **Comparison of Elderly Populations**



On the other hand, and as shown in Figure 3, Germany has an increasingly high proportion of elderly people, even by EU standards. This has led to problems similar to those experienced in Japan, including elderly drivers driving the wrong way down the autobahn (what the Germans colloquially call "geister-fahrer," meaning ghost drivers), and an increase in accidents caused by drivers mistaking the accelerator for the brake pedal.

Looking at the countries of northern Europe, their high latitudes mean that the angle of the sun throughout the year is lower than in Japan. During winter, in particular, this exposes camera systems to severe sunstrike due to sunlight angled almost horizontally. Added to this, the snow cover present for long periods of time and over large areas makes it difficult for current camera systems to detect white lines on the road, which frustrates the use of this information for determining which lane a vehicle should drive in.

Efforts of Hitachi Automotive Systems Europe

As noted above, in developing products and technologies suitable for the European market, it is important to pay close attention to the trends and to proceed with development based on a technology development roadmap that has been formulated in line with these trends and is carefully attuned to the circumstances in each country.

Accordingly, Hitachi Automotive Systems Europe GmbH is proceeding with technology development that looks to the future by participating, in collaboration with the research and development (R&D) team at Hitachi Europe, in the Adverse Weather Environmental Sensing System (DENSE). This project aims to develop sensor systems with a robust ability to cope with adverse weather conditions such as thick fog, etc. The ultimate goal is to enable advanced automated driving (see Figure 4).

Hitachi is also participating in the Human Drive project, which aims to develop automated driving technology capable of replicating the smooth proficiency of a skilled driver on roads that include roundabouts, one of the distinctive features of European roads.

In addition to technical developments like those described above, these activities play important roles as ways of actively joining in with groups in which industry, government, and academia work together, to drive the technology trends in Europe, and Hitachi is continuing to participate in these types of projects.

Operating ADAS functions such as lane departure warnings or prevention systems is difficult in snowy conditions. To deal with conditions like these, Hitachi is proceeding with the initial development of systems aimed at extending existing lane departure prevention. Hitachi Automotive Systems is proceeding with functions to provide road departure prevention, using a road edge detection technique that takes advantage of the characteristics of stereo cameras, a product identified as strategic by Hitachi Automotive Systems, to detect guard rails or snow banks and identify that they are road boundaries (see Figure 5 and Figure 6).

Figure 4 | **Overview of System Configuration under Development by the DENSE Project**

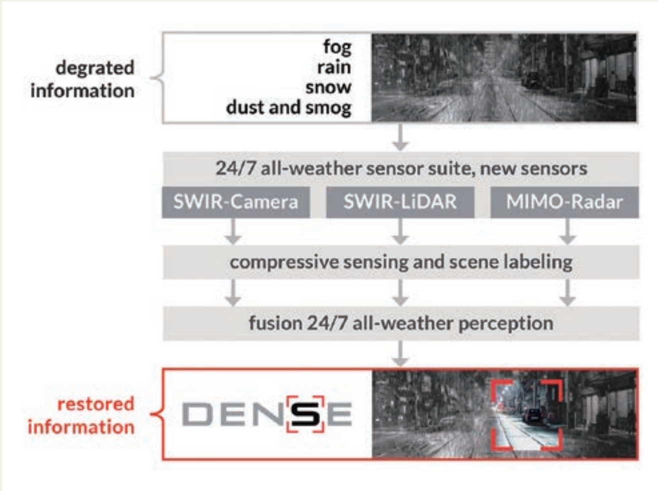
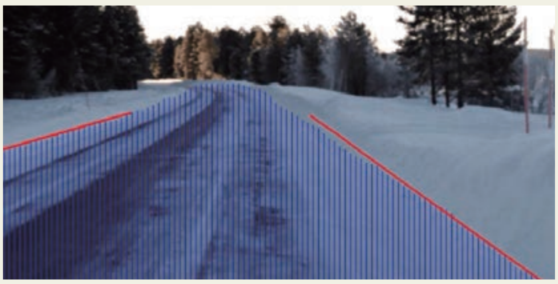


Figure 5 | **Testing at a Cold-climate Test Course**

Figure 6 | **Operation of Road Edge Detection (Detected Road Edge Shown in Red)**



This road edge detection technique can be used to identify road boundaries by detecting guard rails or curbs that have been put in place temporarily, or continuously placed poles, in places where there is a complex overlapping of white and orange lines due to road maintenance work, etc.

Hitachi is also actively engaged in trials using actual vehicles that are aimed at dealing with the diverse road and driving conditions found in Europe, including techniques for detecting speed limits displayed on electronic signage, primarily on the autobahn, and other road signs.

References

1) SlidePlayer Website, http://slideplayer.com/slide/7828887/
2) EuroNCAP website, https://www.euroncap.com/en
3) OECD Website, http://www.oecd.org/
4) DENSE Project Website, https://dense247.eu/
5) AdaptIVe Project Website, https://www.adaptive-ip.eu/
6) DENSE Project Website, https://dense247.eu/

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