The Future of Active Safety

The next steps towards autonomous driving

Active safety and driver assistance systems are taking big steps towards greater autonomy, as systems are becoming increasingly "connected" and algorithms to process the data are becoming more and more advanced. Nissan has announced plans to develop a fully autonomous car by 2020, Volvo aspires to have autonomous cars on roads by 2017, Mercedes demonstrated its self-driving S-class in 2013, and Google has been testing its self-driving car on Californian roads since 2012 for a planned product launch by 2018. Many passive safety features and driver experience attributes in today's cars make the cars heavy, bulky and costly. Taking human error out of the equation enables OEMs to rethink the car. OEMs and automotive suppliers who excel in managing the technology portfolio, project risk and partnerships can reshape personal transport and capture the future value it will bring.

Automotive safety is and will continue to be a key industry and governmental focus

As passive safety technologies mature, the industry turns to active safety, enabling a new leap in vehicle safety

Road traffic accidents in the EU alone cause 40,000 deaths and 1.3 million casualties each year, to an estimated total social cost of €160 billion. In an attempt to redeem this, the European Commission has set an ambition to halve road deaths by 2020. Historically, such advancements in safety and safety standards have relied largely on improving vehicles' passive safety systems – systems lessening the impact of accidents in progress. Passive solutions are mostly mechanical in nature – for example, improving the collision impact absorption of the vehicle structure via airbags and seatbelts, and reducing the physical impact on its occupants. However, passive safety technologies have, by now, reached a high level of technological maturity and stand little chance alone of enabling the leap in automotive safety envisioned by the European Commission. The industry has instead shifted focus towards more and more advanced active safety systems to tackle the challenge ahead, and the emerging semiautonomous and autonomous accident mitigation technologies and advanced driver assistant systems hold the true potential.

Cars have become safer over the past decade, but focus on passive safety through strong body structures drives both vehicle cost and weight.

Passive safety refers to solutions that help reduce the effects of an accident, and includes: airbags, seatbelts and the physical structure of the vehicle.

Active safety refers to solutions that help prevent an accident, and includes: brake assist and electronic stability control systems, as well as advanced driver assistant systems (ADAS), such as adaptive cruise control, driver drowsiness detection and lane assist, and more comfort-oriented applications, such as automatic parking assistance.

In the near future collision mitigation systems will be as common as the airbag

Demands put forth by regulation and safety rating agencies will increase active safety adoption, but reduce direct revenue opportunities for OEMs

Active safety systems have initially enabled pioneering car manufacturers to offer consumers novel and distinguishable functionality, in turn allowing differentiation by presenting their vehicles as incorporating the leading edge in technology and safety.

Lexus has used its driver monitoring systems to market and profile its top-line models from as early as 2006. Several car manufacturers have made its commitment to safety clear, among them Daimler, but also Volvo, who in 2011 was first to offer a collision mitigation system as a standard installation in a consumer vehicle, empowered by the solutions of Mobileye. Following these, active safety systems have been gradually introduced by more car manufacturers, to wider portions of the automotive market. .

Active safety systems are progressing into being regarded in much the same way as passive safety systems are – as a standard component of any car. Looking ahead, the trend is that the sensors and technology that in part constitute the active safety systems will have an even greater presence. This is much due to the high likelihood that regulation and consumer safety ratings will continually call for its wider use. In the European Union, tire pressure-monitoring systems and electronic stability control systems are already mandatory in all new vehicles. By 2015, advanced emergency braking and lane departure warning systems will be mandatory in all new heavy vehicles, with regulation for passenger vehicles to follow. Similar regulation is expected in Japan, whereas in the United States, electronic stability control was already made mandatory in 2011, and tire pressure monitoring in 2007. As a consequence, global adoption rates for active safety systems are expected to increase significantly over the coming years, driven partially by regulation and partially by consumer and inter-governmental safety testing agencies. (See Figure 1.)

Safety assessment agencies such as Euro NCAP, in turn, put increasingly tough demands on cars, and gradually put greater emphasis on accident prevention in their ratings. (See Figure 2.)

Although the ratings themselves only cover commercially available systems, Euro NCAP awards new and emerging active safety systems within its "advanced" program to encourage OEMs to push development further. Within Euro NCAP's present scoring system, premium and midrange vehicles score, on average, 4.9 on a 5-point scale1) and, as a result, in European market consumers are highly likely to expect such cars to continue to score a high rating. To remain on par with these expectations within Euro NCAP's evolving scoring system, vehicle manufacturers must constantly raise their safety performance – as consumers expect them to. Vehicle manufacturers are, as such, driven to include increasingly advanced safety features with each consecutive model – but at a maintained overall price level. As a consequence, active safety systems, like safety systems at large, are increasingly likely to fall into the realm of standard installations that are expected by consumers and needed to maintain a high score in Euro NCAP's evolving scoring system and conform to regulatory demands. In other words, increasingly advanced active safety technology will be demanded of future cars, but it is, in essence, technology that car manufacturers will find more difficult to directly charge for.

Figure 2. Euro NCAP point distribution

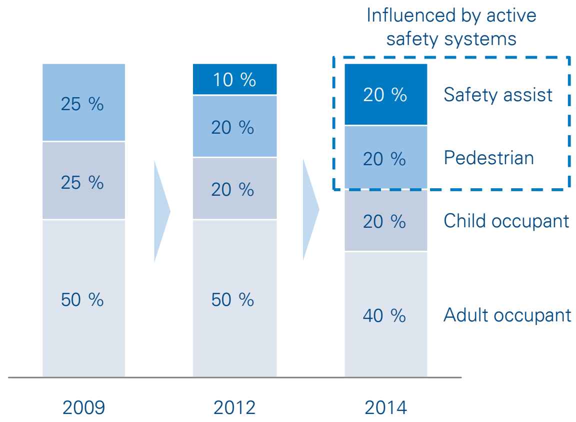
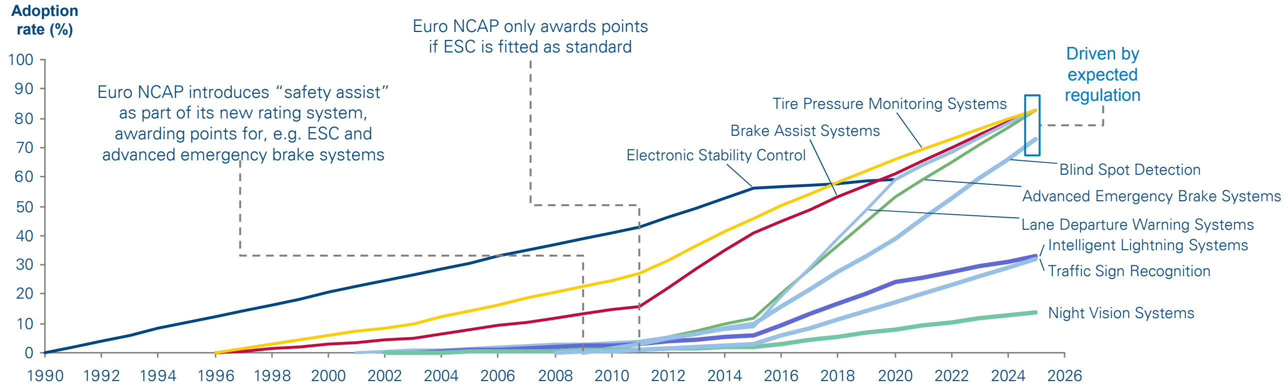


Figure 1. Evolution of global penetration rates for active safety solutions in light vehicles



Source: Arthur D. Little analysis, Kepler Capital Markets, Euro NCAP

Note: 1) Based on the Euro NCAP scores for 2009-2013 in vehicle classes Large off-road, Large family, Small family, Large MPV and Executive

The next generation of ADAS will be more integrated, connected, and comfort-oriented

The continued adoption of active safety technologies and advanced driver assistance systems will lay the groundwork for new comfort functionality, empower the connected car, and bring cars closer to autonomous driving

The present landscape of adopted active safety systems consists largely of independent systems, between which information is increasingly shared. Present applications are, to a greater extent, derived from the refinement and combination of information, rather than from the introduction of new hardware. Delphi's collision mitigation system can be regarded as an example of such an integrated system, combing previously introduced adaptive cruise control and automatic braking systems, among other things, and integrating them to form predictive collision warning systems. If one were to classify between different generations of driver assistance systems, one could describe these systems as assistive (see Figure 3), in that they are not yet fully automatic, but are one step ahead of the user-guided systems of the past. The next conceptual generational step for driver assistance systems is likely to entail a certain expansion of individual sensors, but will primarily be fueled by further sharing of information between sensors, which will be enabled by a networked environment and information exchange between individual systems.

A networked environment, made possible by initiatives such as AUTOSAR[2), in which sensor information is available for other uses, enables new applications and presents new opportunities by combining information in innovative ways. As applications begin to reach into the autonomous range, applications focus will also tend to shift from purely safety to include more comfort-oriented functionality. Automatic driver assistance systems such as car parking (for example, those made available by Volkswagen, Mercedes, Toyota and Ford, among others) are one example of such applications that bridge the gap between the assistive and autonomous system generations. In essence, they are an extension of bundled active safety functionalities, which will instead together form a feature with a combined safety and comfort function. They aid the prevention of parking-associated accidents and damage, but primarily provide a comfort feature in that they function autonomously within limits, relying on input from a network of installed sensors to enable the driver to sit back while the car steers into the parking space.

Moving further along, the autonomous path is likely to pass three stepping stones in particular: driver monitoring, connectivity to external sources of information, and legal requirements.

- Connectivity to external sources: To enable fully autonomous functionality, the car must be aware of its immediate surroundings, but also attentive to information beyond the vehicle's visual periphery. This can be achieved by combining the external-looking sensors of the vehicle, detailed electronic maps, vehicle-to-vehicle communication – e.g. the car knows that an ambulance is approaching at the next intersection – and vehicle-to-infrastructure communication – e.g. road signs and traffic lights.
- Driver monitoring: The car must know if the driver is aware of a potential hazardous situation. This can be achieved by analyzing driver behavior. Rudimentary examples include Mercedes' drowsiness system and the Lexus system's monitoring of the driver's gaze and eyelid movements.
- Legalization: Self-driving cars are, with few exceptions, not allowed to be used on public roads, and laws and regulations must be adapted to allow for self-driving vehicles.

Figure 3. Generations of driver assistance systems

Driver assistance systems	Illustrative example	Input source	Integration between systems	Predictive	Application focus	
					Safety	Comfort
Blind	Cruise control	User	None			✓
Guided	Adaptive cruise control (ACC)	User, sensors	None		✓	✓
Assistive (Today)	Predictive collision warning systems that engage automatic braking systems, arms airbags and tightens seatbelts	Sensors, user	Some	✓	✓	
Autonomous	Fully networked active and passive systems, enabling fully autonomous driving	Sensors, user	Full	✓	✓	✓

Note: 2) Automotive Open System Architecture is an industry effort to harmonize an application runtime environment in which functionality can be shared between systems, aiming at 25% industry adherence by 2016.

The next step towards autonomous driving

The continued transition to more advanced and autonomous driver assistance systems, enabled and driven by the continued adoption of active safety systems, will present future business opportunities for car manufacturers and suppliers, as well as infrastructure providers, technology companies and telecom companies. A transition towards autonomous active safety and driver assistance systems has the potential to enable such leaps in automotive safety as those the European Commission envisions by 2020. The auto industry is presently defining platforms for further information sharing, to accommodate the gradual shift in focus from hardware to software powered solutions. In an environment in which more information is available about the car and its immediate surroundings, and the car itself is increasingly connected to external sources of information, the industry will see an increase in possible in-car functionality. As a direct consequence, firms are likely to experience a future shift with regards to the capabilities and competencies required to enable and develop such functionality, possibly empowered by engaging in and properly managing key intra- as well as inter-industry partnerships. The firms that are able to play within this new shared environment, excel in managing technology portfolios and project risk, and actively manage the partnerships over the partnership lifecycle, will not only play a crucial part in designing and determining the shape and form of future personal transport, but will also be the most likely to capture the future value it will bring.

Looking further ahead, removing the human error from driving would allow OEMs to think beyond current passive safety requirements and driver experience attributes and design lighter, smaller and more energy-efficient vehicles.

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