Executive Summary

Advanced Driver Assistance Systems (ADAS) promise to deliver a substantial contribution to road safety. In May 2019, the European Parliament agreed that several safety systems like driver drowsiness and intelligent speed assistance must be present on new car models from July 2022 and on all existing models from 2024. To reap the potential safety benefits of ADAS, a variety of conditions should be met. The technical optimization of ADAS is crucial, both in terms of system limitations and Human Machine Interface (HMI). At the same time, measures should be taken to increase drivers' awareness of ADAS.

Fédération Internationale de l'Automobile (FIA) has set up a research project to examine the optimal way for the deployment of six ADAS technologies mandated for cars in the European Union from 2022: Advanced Emergency Braking (AEB), Intelligent Speed Assistance (ISA), Emergency Stop Signal (ESS), Adaptive Cruise Control (ACC), Lane Keeping System (LKS) and Driver Monitoring (DM) for drowsiness detection / distraction recognition. This research has been carried out by a partnership between Royal HaskoningDHV (lead), HAN University of Applied Sciences and TNO (Dutch Organisation for Applied Scientific Research). This research provided insight in the features, functionality, and potential of the six selected systems and aimed to provide policy recommendations to tackle the challenges that hinder reaching the full safety potential of ADAS. In other words, the aim was to answer the following question:

"Which policy recommendations can be formed to maximize the benefits of ADAS on road safety, taking into account the systems' current functionality, limitations and user awareness?"

A variety of research methods has been deployed to seek answers to the research questions. *Desk research* has been the main research tool to provide the state of the art in ADAS functionality, limitations, and safety risks as well as HMI and technical implications. A *Round Table meeting* with international experts from different ADAS fields has taken place to provide more insight in the findings of literature research on HMI, while *expert interviews* were conducted to complement literature findings on costs of ownership. With regards to user awareness, an *online survey* has been issued in six European countries (The Netherlands, Germany, Italy, Denmark, France, and Austria) to gather information on user's knowledge, expectations, and satisfaction of ADAS. This research step has been complemented with *expert interviews*. In parallel, an *online assessment of car manuals* and a scan of car websites have been used as input for a *"mystery shopping assignment"* at exclusive and independent car dealerships.

The results of this study have confirmed the conclusions of previous literature studies and managed to get insights in knowledge gaps in ADAS' functionality and limitations, HMI issues, user's knowledge, awareness, quality of available information as well as safety assessment procedures relevant to On Board Diagnostics and Lifetime Safety and Security. The main findings can be summarized in the following policy recommendations.

1. **Better information supply on ADAS functionality needed**
   To begin with, a good explanation to end users of the systems' limitations and Operational Design Domain (ODD) are significant in determining the expected contribution of ADAS to road safety. The desired insights into the limitations of the selected ADAS, however, do not appear to be sufficiently available.

2. **Improved accuracy in systems' functioning needed**
   Furthermore, accurate functioning of the systems is of utmost importance as it affects the consumer's trust in the latter. This study's findings indicate that the accuracy level of the studied

systems is yet insufficient. There is, therefore, a lot of space for the improvement of the ADAS' accuracy.

3. **Improved fail-safe communication needed**
   Potential safety risks (like failure to detect threats) may arise. This study concludes that even in case the systems fail to function, potential road safety risks can be avoided by proper fail-safe communication. However, for the six studied ADAS, a failure to function is (almost) never communicated to the driver. As a result, drivers expect to be assisted when they are not. Inability to react to a traffic situation because of false expectations from the systems can be the cause of road accidents.

4. **Prerequisites for HMI design should be followed more closely**
   Concerning Human Machine Interface (HMI), ADAS that rely on a good (human centred) interface for their basic functionality are LKS, ISA and ACC. In the other three systems (AEB, drowsiness detection and ESS), a user interface is not (or hardly) involved. The findings on the prerequisites for the HMI framework (e.g. the system should react and behave predictably and the driver should be informed about any malfunction within the system that is likely to have an impact on safety) can be applied to any ADAS system for which an HMI framework is eminent and can be a base for creating policy guidelines for the ADAS HMI design.

5. **Clear maintenance and calibration processes needed**
   With regards to the impact of the ADAS' age on the systems' functionality, age-related issues can be solved with clear maintenance and calibration processes, making the latter increasingly important. In case ADAS gets damaged, the broken sensors mostly do not get repaired but get replaced as a whole. This increases the individual damage repair costs, because of the need for specialized equipment, qualified personnel, and higher spare part prices.

6. **Better instruction and training to drivers needed**
   The online survey, which collected responses of more than nine thousand drivers in six European countries, showed that most users do not receive training, but rely on information from the car seller, the user manual or they apply the 'trial-and-error' method. The quality of both information and instruction via these learning methods is found to be imperfect, which means that drivers are provided with incorrect and/or incomplete information and instruction. Compared to the respondents' trust in the six ADAS, it seems that a great number of respondents highly trust the systems, although they have insufficient knowledge of them. This is a type of overtrust in the systems which can lead to unsafe traffic situations. The mystery shopping assignment showed that car dealers are more aware of the ADAS' functionality, capabilities and limitations than shown in previous studies. However, the dealers' knowledge is transferred to the car buyer only under certain and limited conditions. These findings highlight the necessity of ADAS in training as well as the improvement of information and instruction given to all ADAS users.

7. **Safety assessment procedures: more accessible and updated in time**
   The last part of this research regarded On-Board Diagnostics (OBD) and Lifetime Safety and Security. This part makes clear that importance should be given to accessible safety assessments of ADAS. In this way, the correct operation and degradation can be identified and diagnosed, and the driver can be notified in time of the malfunction. However, the functionality of these systems cannot be currently quantified through OBD as there is no data to diagnose them. Moreover, serially produced passenger cars that use public roads must meet certain type approval requirements and regulations. This approval applies to vehicles as well as to vehicle systems, components, and separate technical units. However, once approval is obtained, it remains valid even if admission

requirements are changed later. The current directives for type approval admission requirements need to become stricter and receive frequent updates.

8. **Need for an integrated safe system approach**
An integrated multi-channel “driver-vehicle-infrastructure” approach is needed to embrace and increase the safety potential of ADAS. To begin with the *driver*, focus should be given on the role of the driver, the existing limitations of the systems and on the aspects of the systems that are still unknown. Also, minimum harmonization requirements should be applied for the information car dealerships should provide to their customers during the purchase process of an ADAS equipped vehicle. Regarding *vehicle* related improvements, minimum (technical) requirements must be set and all ADAS should comply with the same standards that state what the system is capable of and more importantly what it is not capable of. Also, a clear standard must be set for lifetime guarantee of ADAS. Regarding the Human Machine Interaction, improvements should not focus on interface (controls and displays) as a stand-alone item but consider it in combination with the rest of the ADAS functions. Finally, the systems’ functionality should ideally be reflected through the names of the systems. According to the present study, there are both advantages and disadvantages regarding uniform ADAS names. Therefore, it should be still researched and discussed if this reflection should happen together with terminology unification. As for *infrastructure*, national road operators and traffic agencies should collaborate towards a uniform “future proof” road network with priority to the highway and provincial roads. Such a network facilitates the necessary physical and digital infrastructure, considering and compensating for dangerous "hotspots" and gaps in the systems’ ODD. Finally, the current legislation should be complemented and provide clarity in all three aspects of this integral approach to ensure the beginning of initiatives and the application of regulations.