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Determining traffic safety impact of AD using a multi-level approach

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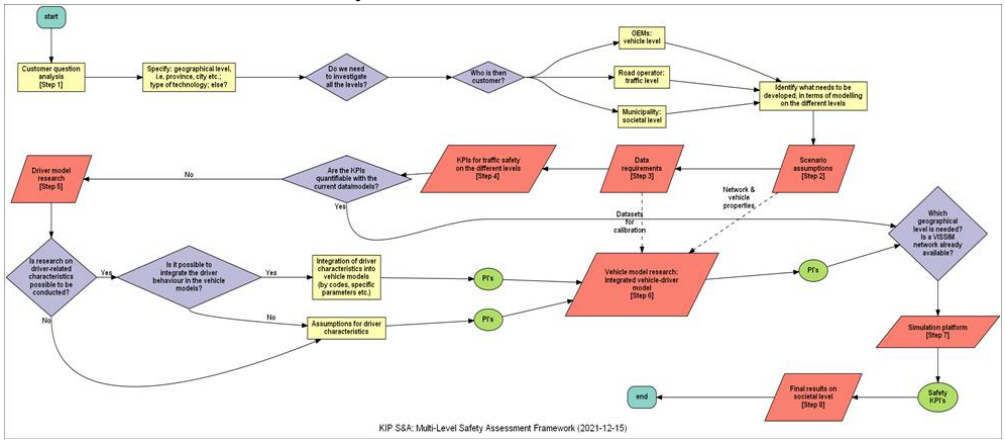
The transport system keeps evolving, our mobility behavior adapts and technological developments and innovations promise a safer traffic environment. However, achieving a smooth transition and ensuring positive safety impacts is a big challenge for municipalities, governments as well as road operators and OEMs. Hence the need for a methodical and comprehensive framework for safety assessment. Considering the rapid introduction of vehicles with automated driving functionalities, the need to assess their actual impact on traffic safety becomes imperative. Safety impacts of Advanced Driver-Assistance Systems depend on a variety of factors, such as driver behavior, vehicle functionalities, surrounding traffic and large-scale implementation. Detailed modelling and simulations of these factors play a vital role in assessing future impacts, from the driver up to the societal level. This research discusses the development of a multi-level safety assessment framework, adopting an approach which estimates safety risk factors towards number of accidents, facilitating the mitigation of risks for traffic safety.

The main focus point of this research is the development of an evidence-based and/or scenario-based methodology that will give insights into which aspects of the traffic system contribute to a(n) (un)safe traffic situation, paying attention at the impact of automated driving functionalities in vehicles. An overall approach that connects the different aspects and levels that play a role in determining the impact of ADAS functionalities on traffic safety, is being built to achieve a comprehensive methodology for a safety assessment. In this approach, we connect the (safe) driving behaviour of an individual vehicle with automated driving functions in a certain (local) situation, with a certain driver to a large area with multiple vehicles, multiple drivers in multiple situations. This implies that the driver level, the vehicle level, the combination of them (driver and vehicle as one object), the traffic level and eventually, the societal level for the overall traffic safety impacts are all being examined. The approach provides insights into the factors that play a role in traffic safety and help in answering the high-level questions. This approach has been formulated into a, so-called, Multi-Level Safety Assessment Framework (MLSAF).

For the development of the framework, relevant literature on existing impact assessment frameworks has been reviewed. Many of the frameworks address various societal impact areas, while in this study we focus specifically on assessment of traffic safety, under mixed traffic conditions, with automated driving systems, where simulation tools are mainly used for this purpose.

Our proposed methodological approach consists of eight concrete steps, which are also presented in the form of a flowchart in Figure 1. The steps are: 1) Analysis of the stakeholder question; 2) Scenarios and assumptions; 3) Input data requirements; 4) KPIs for traffic safety; 5) Research on the driver and interactions among users; 6) Research on the vehicle; 7) Simulation platform; 8) Final results.

A use case for implementing the MLSAF, which focuses on the question “What traffic safety effects are expected at intersections on provincial roads at different Adaptive Cruise Control (ACC) market penetration rates?” has been elaborated, in order to test the framework. The data required for the validation, with distributions of safety KPIs, such as the TTC and harsh decelerations have been calculated for this specific use case. Application of the framework shows that the integration of all the different models and data comes with additional risks of availability. Also, determining a relation between micro level KPIs and societal level effects appears difficult due to lack of data. Lastly, it is expected that a considerable amount of time is needed to research this relation.



Summing up, our proposed MLSAF has been tested, theoretically and not empirically yet, with an initial use case, on the question traffic safety effects at intersections on provincial roads at different ACC market penetration rates. Further elaboration of the framework is being conducted, after application and testing of other use cases.