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Publishable Executive Summary

This deliverable intends to summarize the activities performed in Task 5.3 of the AEROFLEX Project. The main objective of this work has been to design a new front-end concept for a truck. This front-end has been developed considering its Passive Safety performance in crash and pedestrian impact scenarios, as well as developing the design guidelines and validation plan for the Active Safety Systems.

Several options of front-end countermeasure designs were developed considering their potential contribution to enhancing the Passive Safety crash performance of the truck. Several concepts were designed basing the approach on different types of areas that could benefit from the proposals. These areas were: crash performance between trucks and passenger cars, pedestrian protection and front visibility from the driver position.

Once the design concepts were completed, the most relevant crash scenarios to be addressed have been identified by means of an analysis of accidentology data. With this information, an analysis based on Computer Aided Engineering (CAE) simulation has been carried out. This has been used as a design validation of the conceptual countermeasure designs from a Passive Safety crash perspective.

As to the pedestrian protection activities, the accident scenarios were assessed using accidentology data. This information made it possible to evaluate which occupant models to use in the study. Next, the front-end design was simulated in pedestrian impact conditions using Human Body Models (HBM). The equivalence between the simulation procedure to be followed when using HBM and pedestrian protection impactors was identified. Once this was completed, further pedestrian protection simulations were run using pedestrian protection impactors and evaluating the results as per current pedestrian protection protocols from the European Market. The simulation results made it possible to propose and validate some conceptual changes on the front-end design that remarkably improved the VRU protection level of the design.

Finally, the effect of the front-end design concept was also addressed from an active safety perspective. To start this section, the accident analysis was performed, and the different accident scenarios were prioritized considering: the safety benefit from using ADAS technologies in these load cases, the limitations of passive safety measures, etc. Once this was studied, the different possibilities of active safety sensor layouts were evaluated. Then, the virtual models of the truck (including suspension, steering, driveline, gears, engine), the sensors and the AEB model were defined. To end this section, the design validation plan was developed to prepare the simulation matrix for the activity to be continued at other stages in the Task 5.3 of the AEROFLEX Project.

To summarise, the development of this new front-end architecture for trucks resulted in the design of three different protective structures – “Crash-box only”, “Crash-box + Honeycomb”, and “Crash-box + casted bracket”. The first one has been specially designed to mitigate the effect of an impact on passenger car occupants, and the other two are related to the protection of long-haulage truck drivers in case of crash with the back of a semitrailer.

For “Crash-box only”, validations through CAE simulations showed several benefits regarding safety, for instance a decrease in the car intrusions due to energy absorption. By contrast, for both “Crash-box + Honeycomb” and “Crash-box + casted bracket” solutions, benefits were very poor. For this reason, avoiding passive safety structures to protect truck occupants, and installing some active systems such as Automated Emergency Braking (AEB) instead, is suggested.

Moreover, the performance of the revised front-end design has been evaluated for pedestrian impacts involving a Vulnerable Road User (VRU). To solve issues related to head impacts, some recommendations such as selecting the appropriate material for the windscreen are made. Lastly, to improve results in upper leg impact, giving space for energy absorption is advised.