

D5.2 Description of the driver simulator experiment for identifying safety tolerance zones and the performance of in-vehicle interventions.

Interview with Bart De Vos

The conceptual framework of the i-DREAMS platform integrates aspects of monitoring (such as context, operator, vehicle, task complexity and coping capacity), to develop a Safety Tolerance Zone (STZ) for driving. In-vehicle interventions and post-trip interventions will aim to keep the drivers within the STZ as well as provide feedback to the driver. This conceptual framework is tested in simulator studies and three stages of field trials in Belgium, Greece, Germany, Portugal and the United Kingdom with a group of participants representing car, bus, truck, tram and train drivers.

The aim of this deliverable is to elaborate on a detailed design for each of the simulator trials, based on design recommendations and specifications that were presented previously in [D3.4: Experimental Protocol](#). The three main goals of the driving simulator trials in i-DREAMS are: to test driving behaviour and validate the STZ mathematical model, to test the monitoring equipment and real-time intervention technologies in assessing the STZ, and to obtain user feedback about these technologies

To get a better insight in deliverable 5.2 we had a talk with Bart De Vos, author and an expert in building driving simulators. Bart, the driving simulator experiments are very important in the development of the i-DREAMS system. Can you explain why?

Bart: “The main reason why simulation is used in product development in general is that it has the potential of reducing development time, development costs and improving the final design. This is because simulation makes it possible to replicate high controllable conditions that allow to make design choices early in the development cycle, based on rapid evaluation of multiple design concepts. Actually, in most cases, simulation reduces the need for (expensive) prototyping. By including these simulator trials in the i-DREAMS development cycle before (large scale) on-road field trials, potential issues with technology or effectiveness of the real-time interventions can be identified and solved and acceptability and user experience aspects investigated. Driver feedback and experiment results can be used as a first benchmark and to further optimize the i-DREAMS system.”

Which simulator trials are organised in i-DREAMS?

Bart: “We organize multiple simulator trials in the five countries for the different driving modes. In Belgium we organize truck trials, in Germany and Greece we organize car trials, in Portugal bus trials and in the UK tram trials. Unfortunately, we were not able to organize train trials in the UK due to the strictly regulated environment of trains.”



How did you prepare for this technically?

Bart: *“We ourselves at DSS built two complete simulators: the car simulator, used in Germany and the heavy vehicle simulator, used in Belgium and Portugal. The shape and size of the two simulators are different. The car is based on an actual passenger car, while the heavy vehicle simulator resembles the experience of driving a truck or bus as closely as possible. While the mechanical design of the simulators is different, the architecture and functionalities of both simulators are almost identical.*

The other simulators already existed. For all these simulators, an architecture was developed that allows the simulators to interface with i-DREAMS equipment in real-time. This was done in such a way that the key equipment such as Mobileye, the gateway, CardioWheel and the device for the display of the real-time warnings, is almost completely interchangeable between simulator and vehicle, to avoid having to develop a completely separate i-DREAMS system for the simulators only. A generic design for all simulator trials was made to ensure consistency between the different trials, taking into account the specifications that were defined in [D3.4](#).



Figure 1: Simulators used to organize the i-DREAMS simulator trials



Besides simulating what we will do in the field trials, we have the additional advantage in a driving simulator that we can evaluate certain aspects that are impossible to evaluate during the on-road field trials. For instance, the additional inclusion of eye-tracking metrics or haptic interventions, which were, given the available resources, both found to be unachievable for the large number of vehicles that are included in the on-road field trials. Additionally, the driving simulator set-up in i-DREAMS allows that each participant can be closely monitored during the complete experiment, something that is difficult to achieve in the on-road field trials.”

And how did you prepare strategically?

Bart: “For each trial, we follow a three-step process. In the first step we collect general information such as research (sub)goals to provide an overview of what can be investigated. The second step is about exploring how these research goals can be achieved. This includes identifying risk factors (e.g. tailgating, speeding, etc.) that are relevant for each respective mode and assigning one or two risk factors and an additional condition (e.g. distraction, weather, sleepiness) to each simulator trial. This is done in such a way that when combined, the simulator trials cover all the risk factors that are most relevant within i-DREAMS. In a third step, a detailed description is created for all the driving scenarios that are used in all the simulator trials. Each drive will include 3 dangerous events of which the order will be different between participants to decrease the possibility of order effects. Other road users that trigger the dangerous events will be randomized to reduce learning effects. Additionally, masking events and filler pieces will also be used. Variables of interest that can be collected in the simulator are defined for each trial, they mostly depend on the risk factor that is under investigation. Furthermore, a detailed description of roadway environment and dangerous events is created.”

What does a standard i-DREAMS simulator experiment look like then for the participant?

Bart: “One session, or what you would describe as one experiment, takes no longer than two hours and consists out of two practice drives and three experimental drives. During the first practice drive (5 min) the participant gets the chance to familiarize with the simulator, during the second practice drive (5 min) the participant will be subjected to several events and will be asked to perform some tasks. The first experimental drive will be used as a monitoring scenario to get a benchmark of driving behaviour without the i-DREAMS system. After we explain some information about the technology and real-time interventions to the participant, i-DREAMS technology is turned on for the second and third experimental drive. The third experimental drive is used to widen the scope of the simulator trials and introduces a condition (sleepiness, distraction, weather) that would change the timing of the real-time interventions. Before, during and after the session, the participant will be asked to fill out questionnaires that poll for demographic information and technology acceptance.”

Are there any risks involved in participating in such an experiment?

Bart: “No, definitely no risks, but sometimes participants in driving simulator trials report feeling physical adaptation symptoms. In that case they show symptoms such as eye strain, headache, postural instability, sweating, nausea... which can of course influence the behaviour and performance of participants and thus can lead to invalid results. For that reason, in the i-DREAMS experiments, we limit the duration of each drive and the use of turns and curves. Each drive has a duration of approximately 20 minutes. As a result, dependent on the speed limit, each drive has a length between 15 km and 27 km. Whereas car and city bus drivers will drive through



relatively short drives (i.e. around 15 km) within relatively low speed zones (e.g. 50 km/h), coach and truck drivers will drive through longer drives (i.e. around 25 km) within higher speed zones (e.g. 100 km/h). In this way, the simulator drives are more representative.”

OK Bart, I think we have a better idea now of the simulator trials in i-DREAMS. Very impressive work! Thank you for talking with me.

Edith Donders

i-DREAMS DisCom manager

**Deliverable 5.2 is part of WP5:
4-stage, 5-country experiment**

[Download the report here](#)

Researcher in the spotlight



**BART
DE VOS**

Graduated as Automotive Engineer in 2017

Employed at DriveSimSolutions since 2019

Passionate about driving simulators, automation and cycling

Tasks in i-DREAMS: Development of driving simulators, installation of i-DREAMS equipment during field trials in Belgium and assistance in the development of software and firmware for real-time interventions and backend processing.

