



Adapting driver behaviour for lower emissions

MODALES D6.1: Evaluation Plan – *Executive Summary*

WORK PACKAGE	WP6: User trials and evaluation
TASK	T6.1 Evaluation plan
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Executive Summary

The MODALES project works towards reducing air pollution from all types of on-road vehicles by encouraging adoption of low-emission driving behaviour and proper maintenance choice. This deliverable is part of Work Package 6 (WP6) on User trials and evaluation, which is one of the five technical Work Packages of MODALES. It constitutes an internal plan that covers the verification, validation and impact assessment of technical developments that are being carried out in MODALES.

This report describes the MODALES impacts and innovations, then the evaluation methodology, which was inspired by the EU projects FESTA and CONVERGE, following a V-diagram that links step-by-step the different technical Work Packages of MODALES, identifying each technical development and the impact it is aims to address.

For the plan, high-level Research Questions (RQs) have been set, which should be answered by the evaluation process. Each RQ is associated with a hypothesis and will be measured by one or more performance indicators. These RQs focus on each MODALES development for its validation, and on the overall expected impact for the Impact Assessment. This is because some technical developments will not be implemented on their own but as a complement to others.

The Technology Solutions (TS) being developed in MODALES and their respective RQs for validation are as follows:

- TS1: Personal driving assistant implementing real-time recommendations to reduce emission levels (smartphone app, with the provisional working acronym DALED: Driving Assistance app for Low-Emission Driving); and TS2: Material to understand, become aware of and learn low-emission driving (i.e. guidelines, training courses):
 - Do drivers using the app and training reduce emissions?
 - How well do drivers accept the app and follow the recommendations?
 - Do drivers using the app and training reduce energy consumption?
 - To what extent does using the app affect the speed of the user?
- TS3: Data correlation module to study the relationship between driving variability and exhaust emissions:
 - Can exhaust emissions be correlated with driving variability?
- TS4: Data correlation module to study the relationship in real life conditions between driving variability and brake and tyre emissions:
 - Can brake emissions be correlated with driving variability?
 - Can tyre emissions be correlated with driving variability?
- TS5: Driver profiling methods, considering data flows collected from his/her personal equipment (i.e. phone, OBD dongle):
 - How does performance vary by driver profile?
- TS6: Retrofitted emissions control systems for (diesel) passenger cars:
 - What is the baseline performance of the system in good conditions (Modelling)?
- TS7: Retrofitted emissions control systems for heavy (urban) vehicles (NOxBUSTER® upgrading):
 - What is the baseline performance of the system in good conditions (Lab)?
- TS8: Diesel particulate filter servicing:
 - What is the impact of diesel particulate filter (DPF) servicing?
- TS9: Procedure for identifying a vehicle's emission rate (roadside emission testing):

- Can MODALES procedures more efficiently detect high-emitters than today's EOBD and present-day procedures used in periodic inspections?
- TS10: Data collection module to detect powertrain parameters and provide real-time estimate of emissions (exhaust, brakes, tyres) via an EOBD interface:
 - How reliable is it to estimate powertrain parameters and emissions in real-time using EOBD data?
- TS11: Capability of EOBD to detect elevated emissions due to poor maintenance and/or deliberate tampering:
 - How reliable is EOBD in estimating high emissions due to poor maintenance or tampering?

RQs are also defined for impact assessment:

- Expected Impact Area 1: Contribute to reduction of emissions from the existing combustion-engine car fleet:
 - How much can MODALES help to increase the detection rate of tampered/poorly maintained vehicles?
 - How well does the retrofit system perform in real use cases?
 - What is the potential reduction of brake and tyre emissions (for different vehicles and road conditions) due to MODALES?
- Expected Impact Area 2: Contribute to reduction of unnecessary driver-induced emissions through a better awareness by the public of their role in controlling polluting emissions:
 - To what extent can vehicle emissions be reduced by using the MODALES DALED app and training?
 - What is the range of impact across different road types/conditions, vehicle types and driver profiles?

This report then describes the approach and plan for:

- Verification: Assess whether the outcome works and complies with the specification or requirements
- Validation: Assess whether the outcome does the job it was created for.
- Impact Assessment: Assess whether the outcome has reached the expected impact, higher or lower. For the Impact Assessment, two main impact areas have been identified that can be tested during the project:
 1. Contribute to reduction of emissions from the existing combustion-engine car fleet;
 2. Contribute to reduction of unnecessary driver-induced emissions through a better awareness by the public of their role in controlling polluting emissions.

Finally, a first plan for the on-road trials is provided. These trials are planned to start in Month 19 of the project, i.e. March 2021 in Barcelona (ES), Bergamo (IT), Helsinki (FI), Leeds (UK), Luxembourg (LU), Istanbul (TR), Thessaloniki (GR) and Nanjing (CN). The plan sets the basis for the trial sites in order to ensure coherence and minimum commonalities among them, yet allowing flexibility and diversity for each site due to their local aspects. Prior to the trials, two ramp-up pilots are planned in Barcelona and Luxemburg in early 2021 as a preliminary experiment. These will check the whole process in order to identify and solve possible issues the trials may encounter.

Users of the mobile app will all be equipped with their own smartphone, and will optionally have access to an OBD dongle that will be funded by the project to obtain additional data, collected automatically. This means that the trials will cover two types of users: basic users, who will only have the DALED mobile app (installed, without any additional equipment; and specific users, who will have in addition to the mobile app an OBD dongle, which will collect emissions and vehicle-specific data to run advanced profiling models. Once the data is collected on the smartphone, the driving profile can be calculated and recommendations given.

In addition to the data collected automatically on the phone, three main types data will be regularly requested manually from the user: contextual information that can serve as a ground truth for the classification models that will be created in the project; profile information requested from the in the mobile app, so as to get to know them better (e.g. age, driving experience, information on their vehicles); and finally questionnaires for the impact assessment (outside the mobile application).

As the trials will have 30-50 vehicles per site and rely on volunteers, a perfect representation of different vehicle types as well as age groups, gender, driving experience and trip habits is not possible. The primary selection needs to be on the vehicle type, as for cars EURO4 or newer ones are needed, but not less than five years old (older models cannot provide the required OBD data and newer models have cleaner engines and hence the advice from the DALED app would have less effect). For commercial vehicles, the fleets depend on the companies which agree to cooperate with MODALES on these trials. In both cases, these requirements mean that the personal profile becomes of secondary importance.

This deliverable is relevant to all other MODALES technical Work Packages and clarifies most of the aspects that were not clear at the beginning of the project. It is a living document that will be updated when required for internal project purposes, particularly as data collection requirements become clearer, as volunteer drivers are identified and as a result of the preliminary trial and ramp-up phase which is due to start in January 2021.

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