UDRIVE

European Naturalistic Driving Study

Summary of OS preparations

Deliverable 34.1

DOI: 10.26323/UDRIVE_D34.1

EUROPEAN COMMISSION

SEVENTH FRAMEWORK PROGRAMME

FP7-SST-2012.4.1-3

GA No. 314050

eUropean naturalistic Driving and Riding for Infrastructure and Vehicle safety and Environment

Deliverable No.	UDRIVE D34.1	
Deliverable Title	Summary of OS operations	
Dissemination level	Public	
Written By	Julie Castermans (ERTICO – ITS Europe) Karla Quintero (CEESAR) Ruth Welsh (LOUGHBOROUGH University) Maartje de Goede (TNO) Mohamed Mahmod (DLR) Oscar Martin Perez (CIDAUT) Jakub Zawieska (IBDiM)	09-05-2017
Checked by	Anne Guillaume (LAB)	17-05-2017
Approved by	Marika Hoedemaeker (TNO) QA manager Nicole van Nes (SWOV) Project Coördinator	30-06-2017 30-06-2017
Status	Final	30-06-2017

Please refer to this document as:

Castermans, J., Quintero, K., Welsh, R., De Goede, M., Mahmod, M., Martin Perez, O., & Zawieska, J. (2017). *Summary of OS Operations.* UDRIVE Deliverable 34.1. EU FP7 Project UDRIVE Consortium. https://doi.org/10.26323/UDRIVE_D34.1

Acknowledgement:

The author(s) would like to thank Anne Guillaume (LAB) for her valuable comments on previous drafts and Marika Hoedemaeker (TNO) for performing the quality assurance on the final draft.

Disclaimer:

This project has received funding from the European Union’s Seventh Framework Programme for research, technological development and demonstration under grant agreement no 605170.

Executive Summary

The present document provides an overview of the Operation Sites (OS) operations during the data collection phase in the context of the UDRIVE project.

UDRIVE is a 56-month research initiative co-funded by the European Commission (7th EU Framework Programme), which objective is to analyse naturalistic data collected on passenger cars, trucks, and powered two-wheelers (PTWs) in France, Germany, Poland, The Netherlands, United Kingdom and Spain.

Over a period of around two years, 120 cars, 32 trucks and 40 scooters have been collecting vehicle data, GPS and speed data, as well as video data from a number of views including the driver's face, hands and feet, and covering both inside and outside the vehicle.

The purpose was to monitor aspects such as acceleration, speed, eye movement, road condition, etc., to provide new insights into drivers' behaviour and crash causation factors and formulate recommendations for safety and sustainability measures.

Following validation and configuration of the Data Acquisition System (DAS), each data collection site had to recruit the required participants and perform a pilot implementation, i.e. a small scale, but representative preliminary installation and data collection.

The main recruitment criterion for participation in the study was the make and model of vehicle: Renault Clios[1] and Méganes[2], Volvo Trucks and Piaggio Liberty Scooters were included in order to achieve homologation agreements and access to vehicle-based data. The project also laid out a sampling strategy, primarily according to driver age and gender.

After validation of the pilot implementation, the instrumentation of all participants' vehicles and the actual data collection could start. This deliverable details the operation of each OS, the different activities it entailed, the difficulties involved and the lessons learnt[3].

The data collection phase started with the instrumentation of the OS fleets towards ramping up and start of full-scale operations. Most OSs ramped up around October 2015, though some started even earlier while others fully ramped up somewhat later due to difficulties recruiting the last participants. Indeed, due to the delays in the workplan and the consequent postponed start of the piloting, some of the originally recruited drivers had lost interest or changed vehicle in the meantime. Thus while ready to start instrumenting the vehicles, some OSs still needed to recruit additional participants in order to meet their target.

The instrumentation process included the participant and his/ her vehicle reception, and the Data Acquisition System installation. Participants were briefed about the operations implementation, the responsibilities and requirements on both sides, i.e. participant and OS team. Participants also completed and signed the necessary forms and questionnaires.

When data collection started, OS operational tasks involved the monitoring of the vehicles, the drivers and of the data quality. The online Monitoring Tool supported this process: it helped OS teams detect and solve technical issues swiftly to ensure data quality and minimize loss of data.

[1] Series III, 2005-12 and IV, 2012-

[2] Series III, 2008-

[3] The lessons learnt included in this deliverable are summarized from the strict data collection perspective. A dedicated lessons learnt deliverable (D35.1) provides more extensive details on OS experiences in the UDRIVE study.

OSs were also liaising as necessary with participants, responding quickly to any questions or issues reported via the hotline; scheduling appointments to check the equipment or exchange the hard drive disks on which the data was encrypted. OSs were then shipping the disks to the Local Data Centres for extraction of the data to the central database for analysis.

As early as February 2017, for some, but at the end of April 2017 for most, OSs started de-instrumentation and collected the exit questionnaires from the participants. The last disks retrieved from the vehicles were transferred to Local Data Centres. At this stage, some of those disks still need to be processed so the project will only be able to determine by the end of June 2017 how much data is available in the database for further analysis by third parties, within the bounds of legal and ethical restrictions.

At the time of submitting the present deliverable, the online monitoring tool indicated that approximately 88,000 hours of data had been collected across all OSs, for a total of 285 participants across all vehicle types (including secondary drivers and re-recruitments to replace drop outs). There was however an overrepresentation of male participants and young drivers (≤ 25) were the most challenging age group to recruit and thus the least represented. A more detailed analysis of the sample and its representativity can be found in the SP4 deliverables.

The main issues encountered during OS operations concern the recruitment and the equipment. Some OSs struggled to reach their recruitment target and some shifts of participants to other OSs were necessary. The final sample is not fully in line with the initially defined study plan and OSs had to relax age and gender criteria in some cases in order to reach their target and not delay any further the start of operations. Most OSs had to face a couple of drop outs and thus had to re-recruit while finding the few last participants was already challenging. However those drop outs were not caused by the study itself, but rather by external circumstances that could not have been avoided or anticipated, e.g. change of vehicle.

Some OSs had more technical issues with the equipment than others, which could not be solved without returning it to the supplier for repair. However the waiting delays to receive the equipment back were quite long and there weren't enough spare DAS's to compensate for the loss of data not being collected during that time.

One of the main lessons learnt regarding recruitment concerns of course the conditions of the study, if as restricted as in UDRIVE regarding the make and model of vehicles, should be pre-defined from planning stage, at the same time as the operation sites selection. Indeed the sample criteria have a big impact on the recruitment possibilities if the selected vehicle types are not common in the study region. This, however, might require more investment in getting homologation from different car manufacturers.

Vehicle lease, provided there is a budget for it, makes recruitment easier as it allows to quickly find participants that fit age and gender criteria, and to accommodate different drivers in several consecutive waves of shorter study periods. Lease is also a good way to incentivise young drivers to participate.

For trucks, the influence of the Unions shouldn't be underestimated and so they should be approached from the start and informed on all aspects of the study, to reassure them on how privacy aspects are to be dealt with, and through them win over drivers more easily.

Another aspect that should not be underestimated is the approval from the competent data protection authorities regarding ethical and legal aspects of the study, which should be started as soon as the pilot site locations are fixed in order to avoid delays in the workplan.

Last but not least, it is important to establish a centralised reserve of spare parts as well as full DAS's, which can be distribured among OSs as necessary, so as to reduce fixing delays and minimize data loss in case of any issues with the equipment. Moreover service level agreements need to be established with external service providers and suppliers, which clearly define all parties' rights and obligations, specify maximum response time allowed, and foresee penalties in case of breach.

Table of contents

1 Introduction

UDRIVE ("European naturalistic Driving and Riding for Infrastructure & Vehicle safety and Environment") is the first large-scale Naturalistic Driving Study in Europe, following the footsteps of SHRP2[4] in the US and similarly to the ANDS Study in Australia.

UDRIVE is a 56-month research initiative co-funded by the European Commission (7th EU Framework Programme).The objective of UDRIVE is to analyse the naturalistic data on passenger cars, trucks, and powered two-wheelers (PTWs), collected in six European regions[5] (France, Germany, Poland, The Netherlands, Spain, United Kingdom) over a period of two years.

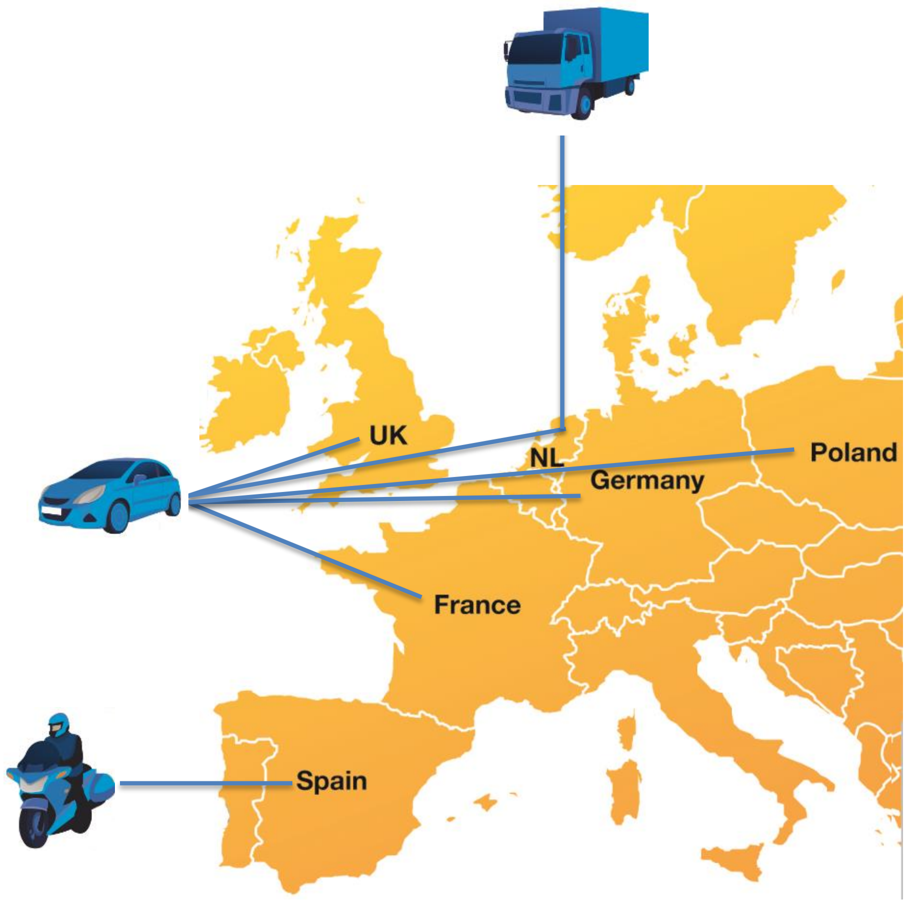


Figure 1: UDRIVE Operation sites and vehicle types

For up to 21 months, 120 cars, 32 trucks and 40 scooters in France, Germany, Poland, The Netherlands, United Kingdom and Spain have been collecting vehicle data, GPS and speed data, as well as video data from a number of views, which varies depending on vehicle type: 5 for PTWs, 7 for cars and 8 for trucks (that have an additional blind spot camera), including the driver's face, hands and feet, and covering both inside and

[4] Largest Naturalistic Driving Study in the US which addressed the role of driver performance and behaviour in traffic safety.

[5] Initially there was an additional PTW OS in Austria (Vienna) but the DAS weight led to conclude that only the Piaggio Liberty 125 model (delivery services-type, with strong luggage rack) would be suitable for instrumenting; as this model does not exist in Austria, it was decided to shift the full target fleet to Spain.

outside the vehicle. The purpose was to monitor aspects such as acceleration, lane position, speed, eye movement, traffic density and road condition.

UDRIVE ultimate goal is to provide new insights into drivers' behaviour and crash causation factors such as distraction but also interactions with vulnerable road users and eco-driving, in order to formulate recommendations for safety and sustainability measures.

1.1 Operation sites

The choice of operation sites (OS) was motivated by aiming at having a good spread over countries with different characteristics in terms of road safety records, road user behaviour, road infrastructure characteristics, the presence of vulnerable road users, climate, traffic density, etc., as well as the experience of the OS leaders with Naturalistic Driving tests:

Table 1.1: Operations Sites characterisation

OS	Main location	OS Leader	Vehicle type	Characteristics
France	Lyon	CEESAR	Passenger cars	Mixture of urban roads, rural roads and highways. Varied traffic conditions
Germany	Braunschweig (though some participants were based in Berlin)	DLR	Passenger cars	Middle-sized city; mixture of urban roads and highway traffic.
Netherlands	Alphen aan den Rijn, Almere, Culemborg, Heeg	TNO	Trucks	Netherlands-wide short haul truck driver observation, both highway usage and local distribution.
	Apeldoorn		Passenger cars[6]	Middle-sized city; mixture of urban roads and highway traffic.
Poland	Warsaw	IBDiM	Passenger cars	City traffic as well as sub-urban and rural traffic; road infrastructure under-developed with many construction sites.
Spain	Valladolid	CIDAUT	PTWs	Middle-sized city traffic, many interactions between different types of road users; extra-urban ring-road with intersections low traffic density.
UK	Two locations: Loughborough and Leeds	Loughborough and Leeds universities	Passenger cars	Operations in two distinct UK regions representing large and small urban areas and rural areas. Relatively high congestion.

The UDRIVE Operation Sites (OS) have managed all aspects of the project's data collection phase: from the recruitment of drivers and vehicles (passenger cars, powered-two wheelers and trucks) to the transfer of the

[6] The Dutch car OS was not initially planned and was established due to the difficulties met by the German OS to recruit the set target of 30 participants. 10 participants were thus shifted away to the Netherlands, which leased the cars.

collected data to the local data centres (LDC), through the installation of the data acquisition systems (DAS) in the vehicles and monitoring of the participants, their vehicles and the data collection progress.

Following validation and configuration of the DAS in SP2, each OS had to recruit the required participants and perform a pilot implementation, i.e. a small scale, but representative preliminary installation and data collection.

The main recruitment criterion for participation in the study was the make and model of vehicle: Renault Clios[7] and Méganes[8], Volvo Trucks and Piaggio Liberty Scooters were included in order to achieve homologation agreements and access to vehicle-based data. The project also laid out a sampling strategy, primarily according to driver age and gender.

After validation of the pilot implementation, the instrumentation of all participants' vehicles and the actual data collection could start.

1.2 Relation to the project structure

This deliverable provides an overview of the data collection operations carried out at the Operation Sites in SP3, following the methodology defined in SP1 and the protocols set in place in SP2. The data collected enables a series of focused analyses, conducted in SP4 based on the predefined research questions; while SP5 focuses on the impact of the collected data for road safety and sustainability measures. Finally the data collected will remain available for further analysis beyond the end of the project (within the bounds of legal and ethical restrictions).

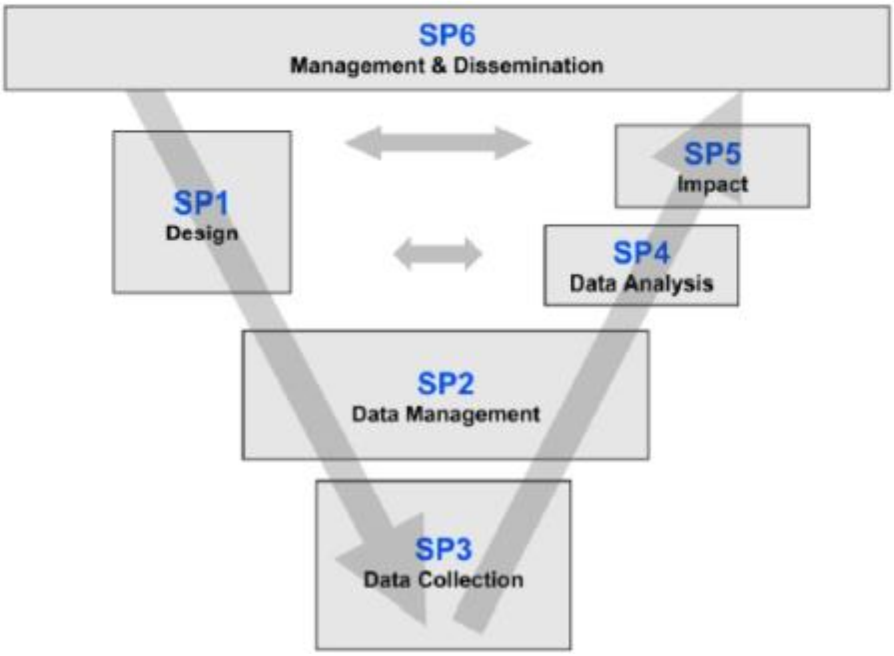


Figure 2: The overall structure of the UDRIVE project

[7] Series III, 2005-12 and IV, 2012-

[8] Series III, 2008-

UDRIVE European Naturalistic Driving Study

2 Vehicle instrumentation phase

The main objective of the vehicle instrumentation phase consisted of the gradual installation of DAS's in the entire fleet for each OS towards ramping up.

Due to the delays in the project and the consequent postponed start of the piloting, some of the originally recruited drivers had lost interest or changed vehicle in the meantime. Thus while ready to start instrumenting the vehicles, some OSs still needed to recruit additional participants in order to meet the required number.

While some OSs first needed to recruit their last participants, they started in parallel scheduling the appointments with the first participants to install the DAS's in their vehicles, perform their briefing and collect the necessary documents (subjective data questionnaire, signed consent form, etc.) from them.

The UK site was the first to ramp up as early as July 2015, while most Operation Sites were fully operational in October-November 2015. The last ones to ramp up were the Polish and truck OSs due to respectively technical issues encountered with the pilot, which postponed the recruitment finalisation, and the specific recruitment difficulties with truck companies.

2.1 Recruitment finalisation

All recruitment channels available were used, except where too expensive in some locations (e.g. newspaper advertisement): internet, advertisement in local newspaper and partners' internal networks, flyers at car dealerships or distributed in carparks; local FIA automobile clubs circulated the call for participation to their members. Where the vehicles were leased, i.e. the Dutch car OS and the PTWs OS, (re-)recruitment was easier.

The consequence was a delayed ramp up compared to the initial workplan and in the end, less data collected. Another consequence is that the final sample in some cases diverges from the initial gender/age targets as urgency to start data collection and recruitment difficulties let to accept any interested candidate.

2.1.1 France

While early recruitment efforts (via distribution of flyers in car dealerships) had already delivered 11 participants, further recruitment efforts were put on halt until the authorisation from the CNIL (Commission Nationale de l'Informatique et des Libertés)[9], the National Commission for Data protection, was received. Recruitment was completed at the beginning of September 2015, by sending a mailing to private owners of Clios and Méganes available from the Auxiliary Automotive Association (AAA) database.

2.1.2 Germany

Despite multiplying the recruitment channels (newspaper advertisement, Renault dealership, radio interview, internet and social media, flyers distribution in parking lots) and expanding the recruitment area

[9] CNIL was concerned about the possible use of personal data to determine traffic offences. They were concerned how the confidentiality and security of the data were ensured in UDRIVE study, and in the French OS, but also how participants could exercise their right with regards to their data (consultation, deletion, etc.). The authorisation for the data collection came in June 2015, with the limitation, for analysis, that only public bodies may have access to instantaneous speed data.

outside of Braunschweig (participants from Berlin were accepted), Germany had difficulties reaching its target. Indeed Renault is not a commonly driven vehicle in the area of Braunschweig, and even with 10 participants shifted to the Dutch OS, it was difficult to reach the target of 20 vehicles.

2.1.3 Netherlands -trucks

The truck OS had difficulties finding interested fleet owners and truck drivers to participate, firstly because of the multiple interlocutors to convince: the Fleet owners who do not see any commercial interest for their company; the drivers who were not receiving the incentives directly and the drivers' unions that have to approve of changes to the drivers' work environment and are very suspicious concerning privacy issues for the drivers. Moreover the type and make of trucks required are not the most common among truck fleets in the Netherlands.

A total of 26 companies were approached, of which 4 agreed to participate with a total of 32 vehicles and 47 drivers (including drivers who did not join for the whole projects and the ones who replaced them). After many efforts and no luck increasing decisively the number of participating trucks, it was decided to stop recruitment efforts in January 2016.

2.1.4 Poland

Poland waited to first finalise a successful pilot before completing their recruitment since delays had made them lose the interest of initially recruited participants and fleet manager. Indeed the aim was to recruit 15 individual drivers and 15 fleet drivers, for studying differences in driver's behaviour when using their own car vs. using the fleet car for personal needs. However since the start of operations was continuously postponed due to delays in the project and the many technical issues with the pilot installation, many participants dropped and the manager from the contacted fleet changed, whom could not be persuaded to participate.

Recruitment efforts had to be restarted. Individual drivers were recruited via internet campaign, personal contacts and flyers dissemination. Renault national club also provided support and another smaller fleet of 5 vehicles (Méganes) could be recruited.

The Polish OS struggled to reach their target when the fleet dropped and they had to recruit only individual participants. Recruitment was completed in January 2016; however the full fleet of 30 was never altogether on the road collecting data, due to the few failing DAS's that had to be sent for repair to the supplier, while others failing to log data needed recalibration and testing separately, before reinstallation in the participant vehicle.

2.1.5 Spain

From the originally recruited participants, drop outs due to delays in the start of operations had to be replaced. Not to further delay ramping up, the quickest and most efficient recruitment channel was CIDAUT institute itself. Though a good distribution of ages could be achieved, this overrepresentation of CIDAUT staff members among participants raised some concerns regarding the possible bias it could introduce in the data. Consequently a recruitment process for a second wave of participants was started in September 2016: 7 new participants were recruited to start in November 2016 to replace among former participants the ones that had proved to be riding the least.

2.1.6 UK

Participant recruitment began in April 2014 and continued for several months. Participants were recruited by targeting parked cars and leaving flyers on the windscreen of suitables vehicles. In the region of 750 vehicles were targeted and a record was kept in order to avoid duplication. Additionally, flyers were left with local Renault Dealers to attract the attention of Renault owners. By September 2014, an excess of potential participants had even been registered.

Due to the delays in the project, recruitment was suspended until February 2015 and a new recruitment campaign was necessary due to drop outs. A total of 10 information events were undertaken and 52 participants (30 vehicles) had signed agreements by May 2015.

However the respondents were predominantly Renault Clio III female drivers and so it was not possible to meet the vehicle demographics laid out in the sampling plan. This is thought to be due to the nature of the Renault fleet in the UK where it is typically driven by a female as the second vehicle in a household. In order to meet the deadline imposed for having all of the vehicles operational by the end of June 2015, anyone who fell within the required age category and drove close to the required annual mileage was invited to participate.

2.2 Mobile communication contract

DAS's were not delivered with a SIM card. The DAS's send daily messages to the OSs to provide information on their status so as to detect early any signs of DAS failure. Each OS had thus to contract a suitable mobile operator. The requirements defined by the DAS provider were:

- It was recommended to aim for a data plan which comprised around 500Mbytes/per month, with a fixed cost, which will cut communication instead of inducing any additional costs in case of overuse of data or international roaming.
- Given the moving nature of the vehicles, the operator with the best coverage in the region of operation should be favoured.
- Standard "telephone" SIM cards not allowing more than Internet browsing and email, "machine to machine" type of cards was required for communication between the DAS and the Online Monitoring Tool (OMT).
- Voicemail and SMS functionalities were not needed
- Possibility to disable roaming was also recommended
- Flexibility considering the start date and duration of the contract (as even the nominal collection time was uncertain or in case of drop outs)

2.3 Instrumentation process

2.3.1 Participants reception

Participants signed the participant agreement or consent form, filled in the participant questionnaire (electronically or paper version), and took the hazard perception test[10].

Identification pictures of the participant were taken (against a white wall, with homogeneous light, holding a writing slate marked with their unique participant ID) to complete the corresponding participant registration in the OMT.

[10] The HP test was not undertaken at all OSs: e.g. it was found confusing in the UK since the test operates a left-hand drive vehicle and road infrastructure whereas vehicle in the UK are right-hand drive. The truck and the PTW OS did not perform it either.

Figure 3: Typical identification pictures (example pictures are from a project partner)

They were briefed about the study, the equipment, the planned execution of the trial and scheduled hard drives exchanges, as well as the support and communication means. All supporting documentation used during the briefing was available in the local language.

For trucks, both fleet owners and truck drivers were briefed and the briefing also included the procedures for hard disk change as they were to perform this themselves. Moreover, as not all drivers scheduled to drive the equipped trucks had agreed to participate and signed the Participant Agreement, information sessions were organised to clarify how to switch off the data recording and reassure that any data record that did not belong to an identified participant should be deleted.

Reception of the vehicle involved the signature of the “instrumentation agreement” by the vehicle owner and the “vehicle condition report” by installation team and vehicle owner.

Questionnaires and hazard perception test data were then transferred to the Central Data Centre (CDC) as electronic files (paper-based ones were first digitised), formatted using the coding scheme so as to be suitable for analysis.

2.3.2 Vehicle reception

On starting up the installation, a tight monitoring of the participant’s vehicle was done in order to detect any malfunction. A vehicle condition report was used to enter the vehicle condition (scuffs, dents, broken, cracked, etc.), which had to be signed by both the installation team and the vehicle owner.

Information on the vehicle variables was collected in a “vehicle questionnaire” together with pictures from the vehicle, and the driver was given copy of the homologation from Renault.

Before returning the installed vehicle to the participant, the garage information notice was inserted in the vehicle instruction manual, i.e. description of the DAS, containing instructions on how to disconnect / reconnect the system from the vehicle, in the local language and bearing the telephone number of the corresponding installation team, for any garage that would need to do maintenance on the vehicle during the collection phase.

Finally the participant and installation team checked installed vehicle against condition report undertaken pre-installation and the participant signed the DAS equipment installation form stating that they were happy with the installation. They also received a contact card including the hotline number and their unique participant ID in case they needed to contact the OS.

2.3.3 Data Acquisition System installation

The data acquisition system was developed in UDRIVE by SP2 and manufactured by Sectronic. The Data Acquisition System (DAS) consists of various elements including data logger, cameras (including a MobileEye smart camera, though not for PTWs, and an additional blind spot camera for trucks only), speed sensor (only for PTW), OBD connector, GPS antenna and wiring.

OSs had to take care of the equipment installation (and later deinstallation) in the vehicles, for which they had received a comprehensive support manual. They had to decide whether to do the installation themselves or contract an external garage. The technicians dedicated or contracted by each OS for the installations participated in a two-day training provided by CEESAR experts to ensure homogeneous and quality installations across all OSs. Moreover certified MobileEye installers were required due to the particular provisions applicable to MobileEye installation.

Figure 4: Equipment to install

The infrared spots, providing light for the infrared-sensitive cameras directed at the driver, the passengers and the feet of the driver, were built-in within the cameras. The microphone was part of the forward cameras cluster (it did not record voices, only noise level) and so was the video recording switch off button, which deactivated the cameras, e.g. if people are carried who deny being recorded or, in areas where taking videos is prohibited, e.g. harbours, airports or military facilities. The button only disabled the video recording for the duration of that trip. On the next trip, when the system was booted on ignition, all videos were operational again.

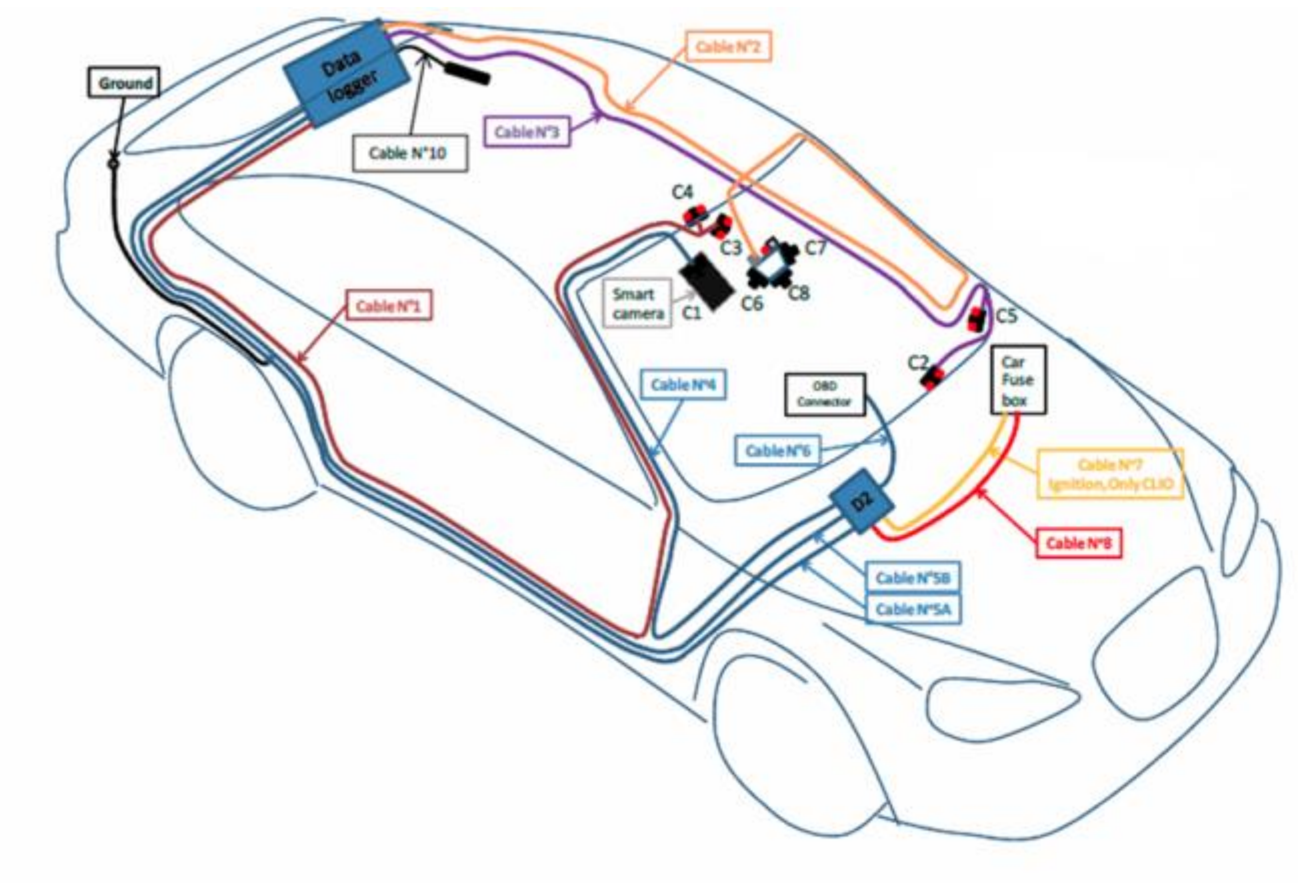


Figure 5: Car installation diagram

The MobileEye was mounted onto the windscreen, next to the rear view mirror. Three cameras built together in one unit were mounted behind the rear view mirror and looked forwards and peripherally to the left and right of the vehicle. The passenger compartment camera, pointing inwards to capture the presence of passengers in the vehicle, was mounted on the other side of the rear view mirror.


Figure 6 and Figure 7: Forward cameras and MobileEye (left) as well as driver comportment camera (right) in a UK car installation

The driver action camera (recording the interaction with vehicle controls) was fixed on the ceiling interior light, the driver's face camera, along the left windshield pillar, and the footwell or feet camera, above the pedals by way of a pedal board cover.

Figure 8 and Figure 9: Ceiling camera and cover protection clipped onto it after setting as well as driver face camera along windshield pilar in a UK car installation

Figure 10: Feet camera

Figure 11: Views from all car cameras

Trucks were also equipped with two additional blind spot cameras and an external gyro (internal for cars). The left and right blind spot cameras were mounted (on a bracket) between the roof lining and the curtain rail. The gyro was mounted behind the dashboard where the gearstick used to be mounted for trucks with manual gearbox.

Figure 12: Views from all truck cameras

The car OBD connector was placed in front of the gearshift and the GPS antenna was mounted on the roof.

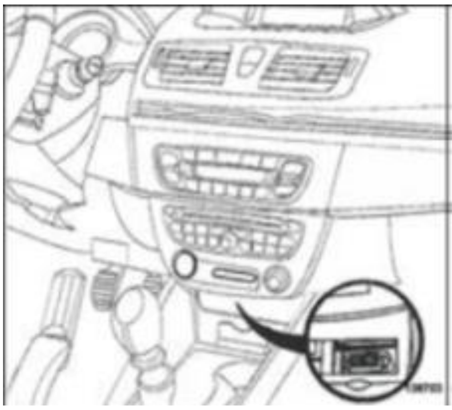
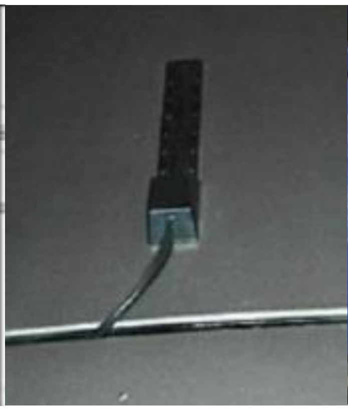




Figure 13, Figure 14 and Figure 15: OBD connector and GPS antenna

The data logger (DAS) was placed in the boot for cars, in the top case for PTWs and in the overhead compartment for trucks. The DAS had been pre-configured on the bench to make sure that the SIM card was working , passwords were set and that the firmware was flashed through the CF card. The DAS installation involved scanning the QR code of the vehicle, which was fixed in the glove box, before scanning the QR code of the DAS, with a smartphone, in order to complete the registration onto the OMT. The first hard drive disk was also scanned so as to be “attached” to that particular DAS on the OMT.


Figure 16 and Figure 17: Data logger and vehicle QR code

Figure 18: Installer calibrating and verifying all parameters

The installer then had to calibrate the MobileEye and configure the cameras following the instructions from the camera settings guide.

With help of a laptop and Local Area Network connection with the DAS, installers could access the DAS and put it into installation mode in order to run the software used to configure the cameras. Installers checked that the data logger was on and that they were getting video data streams from the cameras. Installers would then position and set correctly the cameras, adjust the focus of the image and fix the cameras definitively.

They also checked that CAN and GPS data were streaming, i.e. that there was a continuous stream of identifiers for the different sensors and that the values of data were changing.

Finally the vehicle was taken for short drive around the installation location, stopping a couple of times so that the DAS had chance to switch on and off and initiate reports. The purpose was to force some first records to be checked on the OMT, e.g. checking that the GPS was working and reports were being sent.

Before returning the vehicle to the participant, installers were checking that:

- the cables were not visible
- the rear seat cushion and rear back squab were correctly fixed
- the door joints were correctly fixed
- all cameras and the DAS were correctly fixed
- the covers of the datalogger were screwed
- the vehicle was clean

2.3.3.1 France

In France, the DAS installation was carried out at the IFSTTAR premises in Lyon by the DAS installation team of CEESAR (i.e. 2 technicians). The process to equip the fleet of 30 vehicles was carried out in a period of 5 weeks taking into account that the technicians needed to travel from Paris to Lyon and then back to Paris. In total, the installation took 17 working days. The average installation time was of 4 hours per vehicle with some very long exceptions due to data logger configuration issues.

2.3.3.2 Germany

The German OS has signed a contract with Dr. Schmid GmbH Bosch Car Service garage in Braunschweig. The installation team consists of two technicians who had taken the MobileEye online certification test and passed it.

The installation took per vehicle on average 8 hours. The installation for the whole fleet was done in several phases starting from 17 August 2015 till 16 December 2015 (due to the difficulties in recruiting the final participants to reach the target).

2.3.3.3 Netherlands

For the trucks, installations were done by an external company, Protect Effect, after instruction by a TNO technician. Protect Effect has certified MobileEye installers. Installation was done in the garage of each fleet owner. After installation technical performance of the system was monitored by TNO staff. If something appeared to be wrong, check-ups were performed by Protect Effect as well as TNO technical staff.

Installations were performed between November 2014 (first installation) and March 2016 (final installation). They took a long time since not all transport companies were recruited at the same time and also due to the difficulty to plan the trucks off work from the fleet owners. Installation took on average half a day (4 hours) per truck by a team of two technicians. Installing the whole fleet took a long time, because it was

The truck installation had a somewhat different procedure, thus the TNO technician wrote a specific step-by-step manual for truck installation which was followed by the installers

The 10 lease cars were installed at the TNO premises by the Protect Effect and CEESAR. The Dutch OS was dependent on the French OS for this, as they were not licensed to install the passenger cars.

2.3.3.4 Poland

Contracts with the licenced Renault workshop and the licenced MobileEye installers ALCAR were established. The DAS installations were carried out in DECAR, certified Renault dealer and garage. 31 cars were installed in total, by certified MobilEye installers. Each installation took on average 4 hours. All repairs and partial deinstallations conducted during the project were conducted either in Alcar or IBDiM facilities.

2.3.3.5 Spain

The DAS installation was carried out at the CIDAUT premises in Valladolid by the DAS installation team of CIDAUT. 25 scooters were installed in a first stage, and a month later CIDAUT received and installed the 15 remaining. On average, the installation took 4 hours per vehicle.

IP65 water protected cameras from Brigade were used. MobileEye was not installed on PTWs, since roll angels would prevent proper function. In addition, a waterproof case would have been required, which is very difficult to mount on the front of a motorcycle.

No CAN connection was applicable either for PTWs. The DAS was mounted inside the top-case, as well as a spare battery. Three cameras, pointing backwards and peripherally to the left and right of the vehicle, as well as the GPS antenna were fixed onto the top-case.

Figure 19 and Figure 20: Topcase for PTWs, showing the DAS, 3 cameras and GPS antenna

The driver face camera was fixed on the dashboard and the forward camera next to the rear view mirror.

Figure 21 and Figure 22: PTW forward (left) and driver face (right) cameras

A speed sensor was also installed (to allow calculating the speed of the vehicle where the GPS signal would not be available, e.g. tunnels). It was mounted on the front brake calliper (on a bracket). Moreover an accelerometer was mounted on the chassis or frame (on a bracket), which gave information on the accelerations and forces acting on the motorcycle in the 3 axis (X, Y, Z), so that the measures could be as accurate as possible.

Figure 23: Views from the 5 PTW cameras

2.3.3.6 UK

A contract was established with ArkFLEETECH to provide the installation team for the Loughborough (LBORO) and Leeds OSs. This contractor was chosen as they are accredited MobileEye installers in the UK. A vehicle LAB was prepared for the installation at LBORO and Leeds University facilities. ArkFLEETECH was supported through the installation of each vehicle by the OS manager at each site with respect to DAS calibration and cameras configuration. CEESAR made an additional visit to the Leeds OS when it became apparent that there were some issues with the labelling of some cables.

The installations varied between 4 to 6 hours per vehicle, depending on whether or not difficulties were experienced during the installation, e.g. need to reconfigure the DAS or difficulties with MobileEye calibration. The entire fleet was installed over a period of 5 weeks, from June 8th 2015.

2.3.4 Main issues during installation

In terms of the installation, there were issues due to incorrect labelling of the cables in the production DAS and different compared to the training DAS. Thus if installation instructions (which were correct) were followed, then the installation was not successful.

Small amendments were required to the camera setting guide in order to clarify the location of the required software. The actual configuration of the DAS was difficult since it would not execute the fixbat successfully for some CF cards. It was later learnt that ghost partitions were present on some cards which needed removing before the card could be flashed.

Some problems occurred during QR codes scanning: it was necessary to attach and detach the hard drive from the DAS several times, before it could read the next hard drive.

There were also some data logger configuration issues, which could delay installations: specific parameters needed to be configured that did not work all the time. The last resort solution (in case nothing else worked) was setting up the logger with the default configuration parameters.

For PTWs, the fact that the supplier did not supply the support brackets caused some delays as a solution had to be found to have them manufactured and procured.

Though before handling the scooter to the participant, it was checked that the M2M card and the cameras sent a signal to the OMT, the first feedback from the LDC pre-processing proved that it was not enough: failure with 1 of the 5 cameras on all scooters revealed the use of a wrong video channel during installations. All scooters had to be called back for fixing the issue.

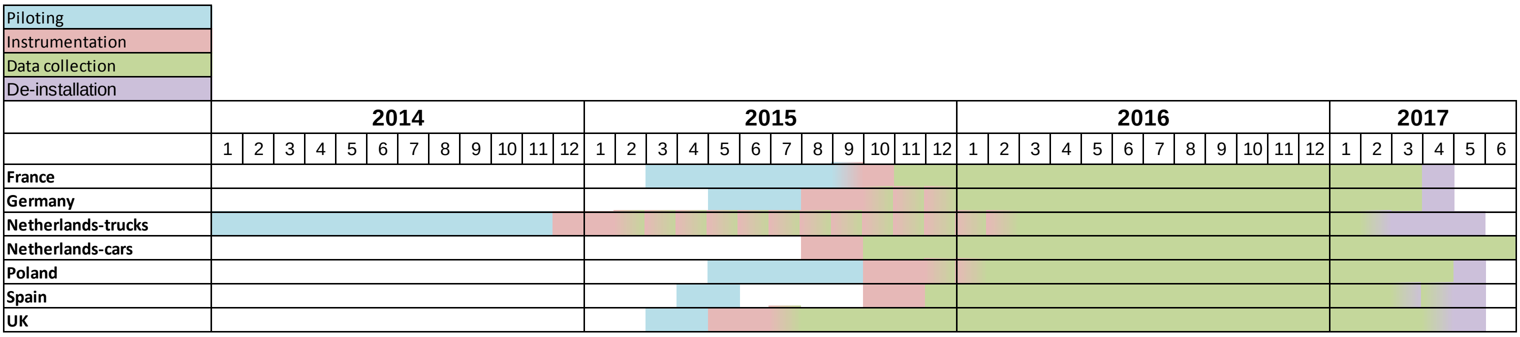
Any issues met during installation, and later during the data collection phase, were shared with other OSs as best practice if a solution had been found or to seek for advice, during regular status meetings.

2.3.5 Firmware update

In July 2015, the DAS supplier Sectronic released a new firmware version (1.5) for the DAS, which after testing and validation by SP2, was ready for use at OSs. The Compact Flash cards with the new firmware were shipped to the OSses by the end of that month.

Installations already completed by then needed upgrading to the new firmware version. This mainly concerned UK, Germany and the truck OS. For instrumentations performed from September 2015 onwards, preflashed CF card with firmware 1.5 were directly used.

2.4 Ramp up & data collection start



3 Data collection phase

This phase consisted in ensuring the data collection progress by monitoring vehicle state and replacing parts where necessary; following up with participants and responding quickly to issues in order to ensure data quality and minimize loss of data.

The main issues reported during data collection mainly concern technical failures, replacement of parts and the long waiting delays to receive back from the supplier any part sent for repair or exchange. A reserve of spare parts such as cameras or cables was collected at the Coordinator's, which made consequent shipments to OSs, as necessary, more efficient. However, as no spare DAS's had been foreseen, OSs relied solely on the supplier when all troubleshooting attempts at the OSs had failed and the DAS had to be sent back for repair. In such cases, there wasn't any other alternative than waiting for the equipment to come back; unless there had been a drop out, in which case the functional equipment from the drop out vehicle could be used to replace the missing parts in the other participant's vehicle.

There were indeed participant drop outs during the collection phase, but only a couple per OS location and for reasons unrelated to the study; most were quickly replaced from a reserve pool or through re-recruitment efforts.

3.1 Vehicles maintenance

When physical access to the vehicle was necessary to troubleshoot an issue or repair the DAS, an appointment with the participant was arranged. Typical issues included cameras falling due to vibration and temperature. Other interventions included reformatting of compact flash cards, DAS's recalibration, hardware repair or replacement of the entire DAS or parts, e.g. cables, in order to bring it back to full working order.

A spare parts' (e.g. cables, cameras, etc.) reserve was established at SWOV by SP2 leader so that OS needs could be accommodated faster than liaising with the supplier on each specific need. Moreover it was decided to convert some of the unused truck DAS's into car DAS's but the process also took very long and the DAS's came too late in the process to be really useful.

3.1.1 France

Two vehicles vandalized during the data collection, where some of the cameras, including the MobilEye, were stolen, had to be re-instrumented.

A couple of GPS antennas were also replaced to solve a recurrent issue that the GPS indicator was not showing on the OMT though the data proved to be correctly recorded when checked.

3.1.2 Germany

The German OS had a few cases of no record showing on the OMT for one or the other vehicle. After checking the data logger, the problem could either be solved by flashing the CF card and reconfiguring the data logger, or the data logger needed to be sent to Sectronic for repair.

3.1.3 Netherlands -trucks

A recurrent issue for many trucks when checking the OMT was the black snapshot indicator for the cameras facing the driver. Non-participating truck drivers sabotaged the cameras not to be recorded, despite the briefings that their records would be deleted. Fleet managers were instructed how to reset them but many times an appointment needed to be made for intervention by UDRIVE technician to solve this. Until then (which was not immediate as the trucks are running commercially and quite some time could pass between the detection of an issue and the moment a truck could be scheduled out), no video data was recorded by those cameras, which made the driver identification for analysis more challenging. The truck driving schedules were obtained from fleet managers in order to help identify when participating drivers were scheduled to drive the equipped trucks as a workaround for this issue.

Other issues were due to Hard drives not exchanged properly (fleet managers were the ones normally executing the exchanges) and technical default in DAS system or GPS.

3.1.4 Poland

Constant recalibrations were needed for DAS's that persisted in showing no data logging on the OMT. Testing of the recalibrated DAS's was then done in the vehicle of one participant that belongs to IBDiM institute, before reinstallation in a participant vehicle. When the issue kept on resurging, the DAS was sent for repair to Advantech, subcontractor of Sectronic based in Poland. However the delay to receive the DAS's back repaired was still very long: between 6 to 8 weeks. Moreover the DAS's were often returned missing some parts, which further delayed their reinstallation.

3.1.5 Spain

Pre-processing at the French LDC of the first batches of data revealed an issue with video data from one of the five cameras. The use of a wrong channel for that camera was the identified cause and all scooters had to be called back for fixing.

A battery issue was identified as the cause for some DAS's not logging data: the section of the cable going from the main battery to the additional battery was too thin. As a consequence the spare battery didn't charge properly and subsequently the DAS did not switch off adequately. Furthermore, when the spare batteries were totally discharged, the DAS did not record any data.

Other interventions on the scooters were due to mechanical failures (e.g. carburettor flooded with oil, brakes not working properly, etc.).

3.1.6 UK

Many of the DAS's required reconfiguration during the course of the data collection; this was identified when the vehicle failed to show records on the OMT. In the most cases, these were fixed in the field at participants' convenience. In some cases, reconfiguration failed to re-instigate data recording and a total of 3 DAS's from the UK were sent to Sectronic for diagnosis and repair. This caused substantial interruption to the data collection.

A recurring problem concerned the driver action camera that was attached to the interior light housing. Warm weather and the heat of the interior light caused this camera to fall loose for many participants and regular visits were required in order to re-fix the camera and check the camera settings.

3.2 Liaison with participants

3.2.1 Informal contact

Participants are contacted to schedule an appointment for hard disk exchange or for checking up the equipment, in case of suspected failure in data logging (e.g. if no data has been logged for more than a week, black camera snapshots in the OMT).

Participants were requested to take contact under specific circumstances, such as not using the vehicle for a predefined duration due to holidays or illness, travelling outside the usual driving area borders with one's vehicle, moving houses, etc. They were also asked to report any damage occurred to the vehicle or equipment, including traffic accidents.

Truck fleet owners were requested to inform on driving schedules, so it is known beforehand when a driver change will take place, in order to flag this in the data.

3.2.2 Hotline

A dedicated local telephone number was set up, staffed during normal office hours (answering machine or voice mail facility were available outside office hours), as well as a dedicated email address that was checked on a daily basis. Moreover a separate helpline number was provided to be used in case of emergency and technical issues.

3.2.3 Events log

All enquiries are to be logged, regardless whether initiated by the participant or by the OS, including the participant ID, a description of the event and the status.

3.2.4 Drop outs

To minimise drop-outs, OS Leader staff members were as transparent as possible as to the study conditions during the recruitment interview and reception briefing. During the study they liaised with the drivers as necessary to ensure that all enquiries were dealt with promptly.

Nevertheless drop outs could not be prevented as some participants changed their car or were discouraged by e.g. the need for too many technical interventions or vandalism on their vehicle perceived as prompted by UDRIVE equipment.

Specific drop outs per OS were as follows:

Table 3.1: Participant drop outs per OS

OS	Number of drop outs	Replaced YES/ NO	Reasons for dropping out
France	2	NO[11]	Participants sold their vehicles
Germany	3	YES	Participants sold their vehicles or after a medical intervention, participant was advised not to drive any longer
Netherlands - trucks	5	PARTLY (1)	Participants stopped working for the fleet owner
Netherlands - cars	1	YES	Participant changed jobs
Poland	1	YES	Participant sold one’s vehicle
Spain	3	YES	Participants were not using the scooters as often as planned - one of them was scared to drive after an

[11] Some of the equipment was used when re-installing the vandalized vehicles since no spare parts were available in the project.

UDRIVE European Naturalistic Driving Study

			accident – and were thus replaced with second wave of recruitment
UK	4	NO[12]	Participants sold their vehicles

3.2.5 Incentive payments

The total incentive budget per participant was fixed at 800 Euros. In most OSs, the payment was divided into three periods: after 6 and 12 months and the final one upon de-installation of the DAS. A larger amount was allocated to the final payment than the initial and middle one to keep the participants motivated during the whole data collection period. In the UK, a preliminary payment was scheduled at the end of Month 2, a second one at the end of Month 8, a third one at the end of Month 14 and the final one at the end of the trial. The amount paid each time was incremental to encourage participants to stay in the trial until completion.

Participants have been advised about the liability to report the income in their tax declaration.

In Spain, instead of giving the incentive to the participants, the money was used to rent the scooters and the incentive was to lend participants a scooter during the data collection period.

3.2.6 Liability & insurance issues

The insurance of the equipment itself was taken by the project with the DAS supplier. An homologation agreement was signed by Volvo and Renault, which certified that the DAS system does not affect the normal functioning, nor any technical system of the vehicles. In case of any damage to the vehicle, nothing in the participant agreement stated that it was the project’s responsibility to pay for the damages, even if the participant held the installed equipment responsible, e.g. in case of vandalism.

Participants were advised during their briefing to notify their insurance of their participation in the project to make sure that their insurance was not affected. In the UK, an extra incentive was even allocated to cover any additional insurance costs. German participants were given a form to sign and inform their insurance company.

In Spain, as the scooters were rented, a regular motorcycle insurance was contracted for each participant.. All the participants were informed in the breefing meeting that their liability was the same as if the vehicle was theirs; they were also reminded during the collection period via e-mail. In the practice, however, there were only three small issues (2 mudguards and one plastic cover broken) and CIDAUT decided to cover the damages. Moreover CIDAUT had contracted an insurance to cover any possible vandalism, robbery or damage to the equipment.

3.3 Data monitoring

3.3.1 Data quality

The Online Monitoring Tool allows centralized monitoring of the complete operations from each OS. Its server is hosted and operated by SAFER in Sweden. It gets status reports from data loggers though their GSM connection.

[12] Lack of available DAS due to long delays for DAS repair prevented re-recruitment. By the time the equipment came back the time remaining for data collection did not make the corresponding proportion of incentive remaining attractive enough to recruit a new participant.

OS teams interacted with it to get an overview of their own fleet activity and details about their records to check the data consistency. This includes checking that 1) the DAS regularly connects to the OMT[13], 2) the amount of data is in line with the plan, and 3) the quality of the numerical and video data is correct (e.g. no disconnection of a data source, no disconnection or change in framing of a camera).

They could also check the remaining available capacity on hard drives, though it was decided to exchange them every two months by default, full or not, to have data flowing to the CDC as soon as possible to start preparation for analysis.

The data was first pre-processed at Local Data Centres (LDC) that sent it in their turn to the CDC. There was an LDC in France (CEESAR), Germany (DLR) and Sweden (Volvo): CEESAR for data from France, Spain and UK; DLR for data from Germany, Poland and the Netherlands (cars) and Volvo for the truck data from the Netherlands.

After receiving the full hard drives from OSs, Local Data Centres (LDC) decrypted and processed the raw data contained in them, but also checked its quality. So possible malfunctions could be also detected then and reported immediately to the OS for intervention and troubleshooting.

3.3.2 Data flow

Monitoring the quality of the data collection was not limited to checking the quality of the data itself, but also included verifying that operational aspects such as data transfer and data storage were correctly performed.

Data is stored on a hard disc drive (HDD) or solid state drive (SSD)[14] in each vehicle and encrypted to ensure privacy in the event of theft. The disks were changed by OS team members on average every two to three months, or when a hard drive disk (HDD) was getting full.

The exchange could be done anywhere provided an appointment was made with participants of where and when to meet them to do so. For the trucks, the hard drive exchange was executed by the fleet owner. The company (BCI) who was involved in the procedural part of the experiment told the fleet owner when to plan a hard disk exchange for each truck. Fleet owners handed over the hard disks to BCI who brought them to TNO.

Figure 24: DAS Hard drive protection system, relevant for change of hard drive

[13] A status report should be generated and synchronized to the OMT for each trip.

[14] Used for PTWs, as more resistant against vibration, heat and humidity.

The new HDD was formatted, labbeled and fitted to a spare drawer prior to visiting participant for exchange. The procedure consisted in turning off the vehicle, removing the HDD rack from the data logger and replacing it with the spare rack already including a virgin disk.

Other actions were also involved when replacing an HDD and transporting it to the OS:

1. The QR code of the (full) drive replaced needed to be scanned and “detached” from DAS reference before scanning the QR code of the new hard drive and “attaching” it to the same DAS reference.
2. The QR code of the OS (to where the hard drive was being transferred) also needed to be scanned.
3. The same procedure was repeated (hard drive QR code and OS QR code scanning) to update the status of the HDD to “stored at the OS” and later to “transferred” to LDC when it was shipped.

3.3.3 Data storage & transfer

Hard drives were locked in a safe in a room protected from unauthorised access until transfer, together with participants’ contracts and subjective data, and a local back-up of the data they contained.

It was the OS responsibility to purchase suitable packaging to protect hard drives from mechanical damage, but also from electromagnetic hazard: each HDD must be protected in an antistatic sleeve before shipment (such as the original packaging that the HDD came in, which could be re-used).

A company had to be selected for shipping the hard drives to the LDC. A specific agreement with the selected shipper was arranged in order to ensure proper treatment of sensitive equipment, where “sensitive” includes both the physical as well as the security aspect.

Shipment was done with registered mail, tracking and signature upon reception. LDC must receive an email with tracking number and the corresponding list of HDD identification numbers.

Each hard drive also had a corresponding status on the OMT (empty, full, moving) and location identified at any time. Updates of the status were done manually at each step.

4 Deinstallation

The aim of this phase is to conclude the experiment. It was scheduled to collect data for as long as possible, still allowing enough time for the OS to remove all equipment on all vehicles and perform the exit interviews with participants.

The only issues to report concern (1) one participant whose vehicle had been vandalized asking again if a reimbursement was possible as the installed equipment was most likely responsible; and (2) there was some discolouring of the paint or wrinkled paint where the antenna was attached, on some vehicles, when removing the antennas.

4.1 De-instrumentation process

4.1.1 Equipment removal

Appointments were taken with the participants and after removal of the equipment, following the deinstallation procedures, a new vehicle condition report was filled out (e.g. no additional scratch or mark should be added by the instrumentation operation) and signed by the deinstallation team and vehicle owner (a copy is kept by both parties). HDDs retrieved from the vehicles were transferred to LCDs.

4.1.2 Participants debriefing

A debriefing interview is also carried out upon decommissioning. An exit questionnaire has been prepared to offer participants the opportunity to provide feedback on the trial. The feedback from these questionnaires is included in D35.1.

In the case of France, participants were also auto-confronted by psychologists from IFSTTAR and LAB, with the aim to discuss relatively recent harsh-braking situations and secondary tasks.

4.2 Timing

Table 4.1: Timeline desintrumentation per OS

OS	DAS de-installation & ramp-down	
	Start date	End date
France	27 March 2017	7 April 2017
Germany	27 March 2017	28 April 2017
Netherlands - Trucks	1 March 2017	26 May 2017
Netherlands - cars[15]	N/A	N/A

[15] Drivers participated in three waves:

- Wave 1: September 2015 - February 2016
- Wave 2: March 2016 – September 2016
- Wave 3: September 2016 – April 2017

Poland	8 May 2017	19 May 2017
Spain	1 February 2017[16] 3 April 2017	10 February 2017 31 May 2017
UK	24 April 2017	9 May 2017

[16] As the rental contract for the first 25 scooters expired on 31 December 2016, it was decided to extend the contract until April 2017 for most but to let go of 7 scooters mainly because of the drop outs and because the rental company needed some scooters. These scooters were deinstalled between February 1st and February 10th. The remainder of the scooters were deinstalled in April started on April 3rd until 31st of May.

5 Data collection in numbers

This chapter provides an overview of the total data collected per OS and vehicle type, as well as the OS final sample characteristics. More specific details on the collected data are provided in SP4 deliverables.

5.1 Final sample characteristics

The sample figures presented hereunder include re-recruitments and secondary drivers.

There was an overrepresentation of male participants and young drivers (≤ 25) were the most challenging age group to recruit. A more detailed analysis of the sample and its representativity is done in SP4 deliverables.

Table 5.1: Sample characteristics per OS and vehicle type

Veh. Type / OS	Vehicles	Participants	Gender		Age			
			Male	Female	20-29	30-39	40-49	50-65
Cars								
France	30	45	47%	53%	9%	27%	31%	33%
Germany	20	30	63%	37%	17%	24%	7%	52%
Netherlands	10	33	55%	45%	9%	30%	27%	33%
Poland	30	31	71%	29%	6%	48%	39%	6%
UK	30	53	49%	51%	15%	28%	19%	38%
Average cars	**120**	**192**	**55%**	**45%**	**11%**	**31%**	**25%**	**33%**
Trucks								
Netherlands	32	48	98%	2%	6%	13%	32%	49%
PTWs								
Spain	40	47	74%	26%	9%	55%	34%	2%
Grand average	**192**	**287**	**66%**	**34%**	**10%**	**32%**	**27%**	**31%**

NOTE : Averages are weighted by the number of participants in each OS. The age category 20-29 includes one 18 year old German participant, and the age category 50-65 includes one 81 year old German participant.

5.1.1 France

			Target	Realized		
Vehicles			= 30	30		
Drivers			≥ 50	45		
Multi-drivers cars	22-65 y/o		≥ 12	13		
Mileage			≥ 10 000 km	Min	Median	Max
				6000	13000	30000
Gender / Age / Vehicle Type Matrix						
Male	22-65 y/o	Overall	≥ 15	21		
		Small cars	≥ 4	12		

		Mid-sized family cars	≥ 4	9
Female	22-65 y/o	Overall	≥ 15	24
		Small cars	≥ 4	13
		Mid-sized family cars	≥ 4	11

5.1.2 Germany

			Target	Realized		
Vehicles			= 20	21		
Drivers			≥ 28	30		
Multi-drivers cars	22-65 y/o		≥ 8	8		
Mileage			≥ 10 000 km	Min	Median	Max
				2,600	7,280	46,800
Gender / Age / Vehicle Type Matrix						
Male	22-65 y/o	Overall	≥ 10	19		
		Small cars	≥ 3	8		
		Mid-sized family cars	≥ 3	11		
Female	22-65 y/o	Overall	≥ 10	11		
		Small cars	≥ 3	7		
		Mid-sized family cars	≥ 3	4		

5.1.3 Netherlands -Trucks

		Target	Realized		
Trucks		= 50	32		
Drivers		≥ 50	47		
Multi-drivers Trucks	22-65 y/o	≥ 12	16		
Mileage[17]		≥ 10 000 km	Min	Median	Max
			N/A	N/A	N/A

5.1.4 Netherlands - Cars

			Target	Realized		
Vehicles			= 10	10		
Drivers			= 30	33		
Multi-drivers cars	22-65 y/o		≥ 12	2		
Mileage			≥ 10 000 km	Min	Median	Max
				15,000	25,000	40,000
Gender / Age / Vehicle Type Matrix						
Male	22-65 y/o					

[17] The mileage per truck participant is unknown since we never asked their mileage (truck drivers drive 40 hours per week for work, they have no idea about their personal mileage).

		Renault Clio[18]	15	18
Female	22-65 y/o			
		Renault Clio	15	15

5.1.5 Poland

			Target	Realized		
Vehicles			= 30	30		
Drivers			≥ 50	31		
Multi-drivers cars	22-65 y/o		≥ 12	10		
Mileage			≥ 10 000 km	Min	Median	Max
Gender / Age / Vehicle Type Matrix						
Male	22-65 y/o	Overall	≥ 15	22		
		Small cars	≥ 4	4		
		Mid-sized family cars	≥ 4	18		
Female	22-65 y/o	Overall	≥ 15	9		
		Small cars	≥ 4	9		
		Mid-sized family cars	≥ 4	0		

5.1.6 Spain

		Target	Realized		
Vehicles		= 40	40		
Drivers		≥ 40	47		
Multi-drivers scooters	22-65 y/o	≥ 0	Impossible due to an insurance clause, only one rider		
Mileage		≥ 10 000 km	Min	Median	Max
			1,000	2,000	15,000
Gender / Age Matrix					
Male	18-25 y/o	≥ 7	0		
	25-45 y/o	≥ 14	32		
	46-70 y/o	≥ 7	3		
Female	18-25 y/o	≥ 6	1		
	25-45 y/o	≥ 6	11		
	46-70 y/o	≥ 0	0		

[18] Only Clios were leased due to budget constraints as Méganes were more expensive to lease.

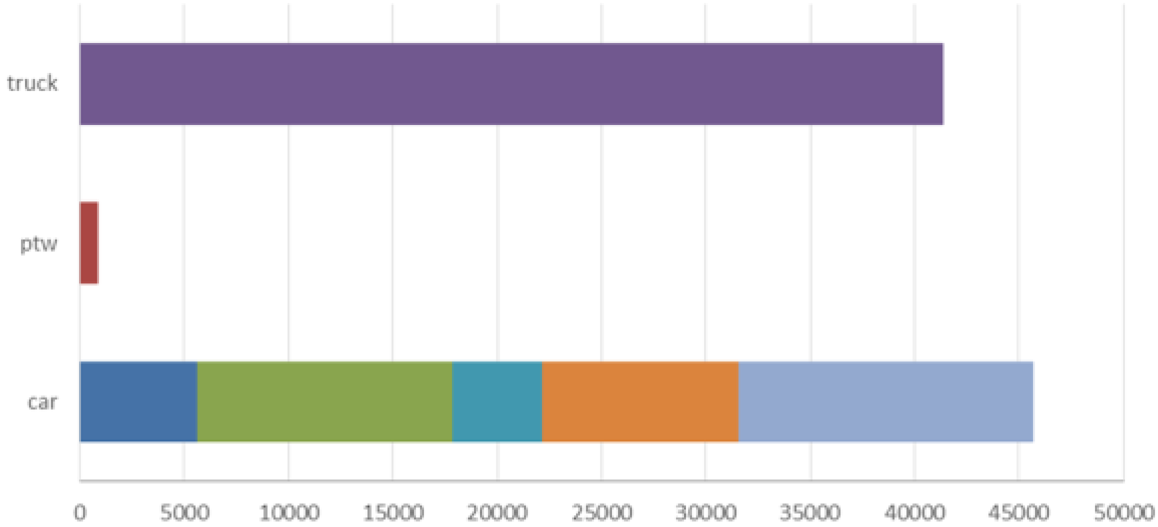
5.1.7 UK

			Target	Realized		
Vehicles			= 30	30		
Drivers			≥ 50	53		
Multi-drivers cars	22-65 y/o		≥ 12	18		
Mileage			≥ 10 000 km	Min	Median	Max
				8,000	16,000	32,000
Gender / Age / Vehicle Type Matrix						
Male	22-65 y/o	Overall	≥ 15	26		
		Small cars	≥ 4	19		
		Mid-sized family cars	≥ 4	7		
Female	22-65 y/o	Overall	≥ 15	27		
		Small cars	≥ 4	21		
		Mid-sized family cars	≥ 4	6		

5.2 Total data collected

When data collection stopped for vehicles to be decommissioned, a total of 87,870 hours of data had been collected (according to the OMT last statistics at the end of May 2017)[19]. Some of the last remaining disks retrieved from the vehicles upon decommissioning still needed to be processed, so the project will only be able to determine by July 2017 how much data is available in the database for further analysis by third parties, within the bounds of legal and ethical restrictions.

[19] This figure does not represent what will eventually be available for further analysis in the database, i.e. after discarding the data where driver ID-ing was not possible, empty records or records that were too short. 100% of the PTW data could be uploaded to UDRIVE database since vehicles were used by only one driver due to insurance. For cars, 94% of the data could be identified and thus was uploaded to UDRIVE database. For trucks, only 33% of the data collected could be used for analysis, due to the face camera sabotage reported in an earlier section of this report (the drivers' schedules provided as a workaround solution to driver IDying was too timeconsuming and project didn't have the resources).



	car	ptw	truck
OS-DE	5618,54		
OS-ES		890,49	
OS-FR	12222,98		
OS-NL			41389,2
OS-NL2	4321,56		
OS-PL	9411,33		
OS-UK	14076,95		

Figure 25: Figures of data collected per OS and vehicle type (in hours)

Considering the number of vehicles, the biggest data collector across vehicle types is understandbly the truck OS seeing that they are driving for their commercial activity. However this is also where the percentage of data actually available for analysis is the lowest after driver ID-ing. As it seems unrealistic to ask fleet managers to allocate equipped trucks to participating drivers only, efforts should be focused on convincing all drivers allocated to equipped trucks to sign in as participants or on briefing them regularly about the study and the switch off button to avoid being recorded. Involving Unions from the beginning is also a must due to their strong influence on drivers.

Among car OSs, UK and France were the biggest collectors, followed by the Dutch Lease OS (considering that they only had 10 vehicles). For the first two, the fact that they didn't experience any major issue with the equipment can be an explanation. Nor did the Dutch car OS, which moreover recruited lease drivers, who use the car primarily for the professional activity.

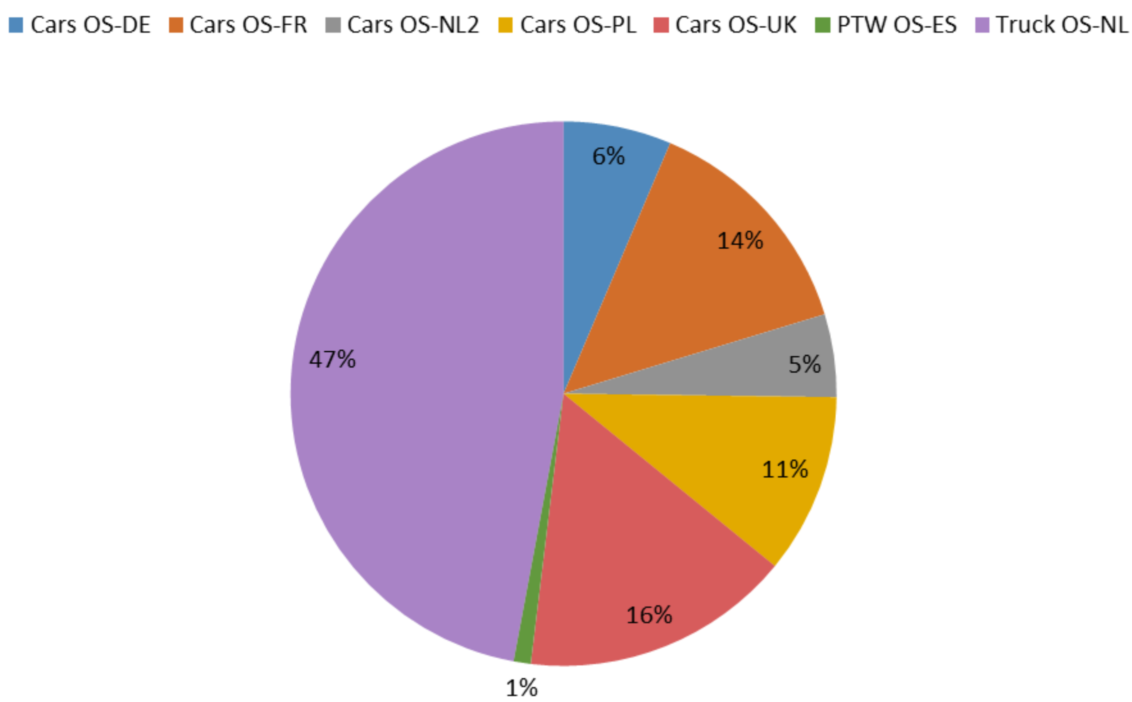


Figure 26: Proportion of data collected per OS

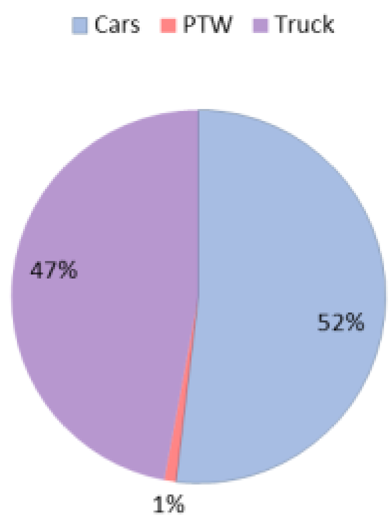


Figure 27: Proportion of data collected per vehicle type

6 Conclusions

Between 18 up to 24 months, 120 cars, 32 trucks and 40 scooters in France, Germany, Poland, The Netherlands, United Kingdom and Spain collected approximately 88,000 hours of vehicle data, GPS and speed data, as well as video data, which are now available for analysis outside of the UDRIVE project, within the bounds of legal and ethical restrictions.

The objectives of UDRIVE Operation Sites (OS) in the project's data collection phase were (1) to finalise the recruitment of drivers and vehicles, (2) to install the data acquisition systems (DAS) in the vehicles, (3) to monitor the participants, their vehicles and the quality of the data collected, as well as (4) transfer the collected data to the local data centres (LDC) before (5) decommissioning all vehicles.

From recruitment to installation, through the data collection, OS operations have not been without a few hiccups:

- Recruitment:
  - Some OS really struggled to reach their target and some shifts of participants to other OSs were necessary;
  - The final sample is not fully in line with the initially defined study plan and OSs had to relax age and gender criteria in some cases in order to reach their target and not delay any further the start of operations;
- Instrumentation:
  - All OSs had to "learn on the job" the distinctions between the piloting equipment and the production one for the actual trial installations. The regular communication flow established between OSs and between SP3 and SP2 proved useful to exchange experiences;
  - On ramping up, OSs had no certainty as to the faultless installation of their whole fleet as they did not receive the first feedback from LDCs before long, had not received enough feedback from the technical pilot and did not have access directly to the data. They relied solely on the OMT but despite positive indicators on the OMT, some issues were only revealed after the LDC pre-processing and thus affected the quality of the data for concerned OSs until the issue(s) could be remedied;
- Data collection
  - Most OSs had to face a couple of drop outs and thus had to re-recruit when finding the last participants was already difficult. Those drop outs were not caused by the study itself, but mostly due to change of vehicle and thus could not have been avoided;
  - Some OSs had more technical issues with the equipment than others and the liaison with the supplier was not smooth; not to mention the long waiting delay when returning DAS's for repair. For future studies, a couple of spare DAS's for each OS is a must and the after-sales support by supplier needs to be clearly defined in a service level agreement, including financial penalties for late response and delivery.

A study such as UDRIVE is a huge endeavour, which requires much time and effort, beforehand, for preparation and recruitment, but also during the trial, whether or not many technical interventions are necessary, as well as monitoring the data quality; thus personnel resources and time necessary to carry out such a study should not be underestimated either. This is why looking at the lessons learnt from UDRIVE is a good place to start for anyone considering to undertake a similar study.

6.1 Main lessons learnt

The lessons learnt presented here are first of all merely a summary of the main ones, as deliverable D35.1 is entirely dedicated to lessons learnt from the data collection and OS operations in UDRIVE, and thus provides more details in relation. Second of all, D35.1 also includes the feedback from the exit questionnaires and thus participants' perspective as well, while the following lessons learnt are strictly from OS operations' perspective.

6.1.1 Recruitment

One of the main lessons learnt regarding recruitment concerns of course the conditions of the study, if as restricted as in UDRIVE regarding the make and model of vehicles, should be pre-defined from planning stage, at the same time as the pilot locations are selected. Indeed the sample criteria have a big impact on the recruitment possibilities if the selected vehicle types are not common in the study region. This, however, might require more investment in getting homologation from different car manufacturers.

An alternative is to foresee enough budget for lease vehicles, which makes it easier to find quickly participants that fit the criteria and for which the incentive amount is less a decisive factor than for private car users. It also allows accommodating more drivers in several consecutive waves of shorter study periods. Recruiting interested young drivers (aged under 25) who fitted the criteria was found particularly difficult. Incentivise them with lease vehicles also seems a better approach.

One of the barriers to recruitment is the duration of the study itself, i.e. the perceived inconvenience for the participant of having one's vehicle immobilised for instrumentation first and consecutive interventions (e.g. for debugging or replacement of equipment as necessary). Hence the importance of the incentive: if not high enough; the ratio monetary benefit / duration of the study won't be positive enough to convince potential participants.

If lease cannot be an option, what is then important to anticipate and secure in advance efficient recruitment channels (per pilot site location) that can deliver enough interested contacts at the time the actual recruitment takes place: e.g. motorists association database, fleet owners or volunteers from own organisation, etc. Other recruitment channels used in UDRIVE included flyers distributed at car dealerships, universities, big stores and supermarkets car parks, as well as advertisements in traditional, online and social media. Maintaining a reserve pool of recruited participants is also advisable as some drop outs during the study are unavoidable, e.g. when participants change car. However when the drop out intervenes at a later stage in the study, in principle the portion of incentive remaining is much less and typically no longer interesting enough to convince a reserve recruit to step in at that point. A drop out budget should be secured for this, so as to be able to re-recruit at all stages in the study.

For PTWs, the OS location needs preferably to be in an area known for its scooter popularity, preferably where the weather is generally nice, if not a high-density urban area where scooters may be a popular way to beat up congestion.

For trucks, the influence of the Unions shouldn't be underestimated and they need to be approached from the start and informed on all aspects of the study, to reassure them on how privacy aspects are to be dealt with, and through them win over drivers more easily. Ideally the truck drivers should receive at least part of the incentive directly (as it is still up the fleet manager to decide, another form of incentive than purely monetary could be imagined).

6.1.2 Instrumentation

The importance of a good briefing interview cannot be underestimated: to provide detailed and transparent information to potential participants and clarify expectations on both sides but also to explain the overall purposes and benefits of study, as it makes people more receptive.

Support visits on site by the project technical team responsible for the installation manual and training should be planned by default and travel budget and resources should be booked in relation from the start, as it has proved efficient for OS struggling with installation issues, especially if such onsite support cannot be arranged with the supplier directly.

The technical solution for pre-processing at Local Data Centres should be ready by the start of operations as some installation issues could only be spot after processing the first batches of data. Spotting those too late in the process means potentially losing a lot of data for analysis.

6.1.3 Data collection

The ethical and legal aspects should not be underestimated and approval from the competent national authorities for data protection should be sought from the very start, as soon as the pilot site locations are determined, in order to avoid delays in the workplan.

The truck data is where we found the biggest discrepancy between collected data and the portion actually available for analysis due to the face camera sabotages that made the driver ID-ing challenging. As it seems unrealistic to ask fleet managers to allocate equipped trucks to participating drivers only, efforts should be focused on convincing all drivers allocated to equipped trucks to sign in as participants or on briefing them regularly about the study and the switch off button to avoid being recorded. Involving Unions from the beginning is also a must due to their strong influence on drivers.

Last but not least, it is important to establish a centralised reserve of spare parts as well as of full DAS's, which can be dispatched among OSs as necessary, so as to reduce fixing delays and minimize data loss in case of any issues with the equipment. Moreover in case of any dependencies on external service providers and suppliers, all parties' rights and obligations need to be clarified and formalized in a contract.

References

This Deliverable is related to the following Deliverables within the project:

- Lai, F., Carsten, O., Schmidt, E., Petzoldt, T., Pereira, M., Alonso, M., Perez, O., Utesch, F. and Baumann, M. (2013) Study Plan. Deliverable 12.1 of the EU FP7 Project UDRIVE (www.udrive.eu)
- Lai, F., Ströbitzer, E., de Goede, M., Krishnakumar, R., Val, C., Mahmod, M., Malasek, J., Martin, O., Welsh, R. and Carsten, O. (2013) Operation Sites description and planning. Deliverable D31.1 of the EU FP7 Project UDRIVE (www.udrive.eu)
- Ströbitzer, E., Lai, F., Winkelbauer, M., Goede, M., Mahmod, M., Martin Perez, O., Krishnakumarn, R. (2013): UDRIVE deliverable 32.1 Participant recruitment procedures of the EU FP7 Project UDRIVE (http://www.udrive.eu)
- Winkelbauer, M., Ströbitzer, E. (2014): UDRIVE Deliverable 32.2 DAS setup, Data collection and transfer procedures of the EU FP7 Project UDRIVE (www.udrive.eu)
- Quintero, K., Val, C., (2016) Overview of OS preparation, sample characteristics and piloting. Deliverable D33.1 of the EU FP7 Project UDRIVE (www.udrive.eu)
- Martin, O., et al (2017) Lessons learnt from OS operations. Deliverable D35.2 of the EU FP7 Project UDRIVE (www.udrive.eu)

List of abbreviations

AAA	Auxiliary Automotive Association
ANDS	Australian Naturalistic Driving Study
CAN	Controller Area Network
CCFA	Comité des Constructeurs Français d'Automobiles (French Automotive Manufacturers Council)
CDC	Central Data Centre
CEESAR	Centre Européen d'Etude de Sécurité et d'Analyse des Risques (European centre of studies on safety and risk analysis)
CF	Compact flash
D	Deliverable
DAS	Data Acquisition System
DLR	Deutsches Zentrum für Luft- und Raumfahrt (German Aerospace Centre)
FIA	Fédération Internationale de l'Automobile
GPS	Global Positioning System
HDD	Hard Disc Drive
IBDiM	Instytut Badawczy Dróg i Mostów (Polish Road and Bridge Research Institute)
IFSTTAR	Institut français des sciences et technologies des transports, de l'aménagement et des réseaux (French institute of science and technology for transport, spatial planning, development and networks)
ID	Identity
IR	Infra-red
LBORO	Loughborough
LDC	Local Data Centre
M2M	Machine to machine
ND	Naturalistic Driving
OBD	On-board diagnostics
OMT	Online Monitoring Tool
OS	Operation Site
PTW	Powered-Two Wheelers
QR-Code	Quick Response Code
SDD	Solid State Drive
SHRP2	Second Strategic Highway Research Program
SIM	Subscriber identity module
SP	Sub-project
TNO	Toegepast Natuurwetenschappelijk Onderzoek (Netherlands Organisation for Applied Scientific Research)
UDRIVE	eUropean naturalistic Driving and riding for Infrastructure and Vehicle safety and Environment
UK	United Kingdom
Volvo FE	F stands for Front steering, E for the "easy" (i.e. very low) access to the driver cabin
Volvo FM	F stands for Front steering, E for the "medium" access (compared to low high and very high)
WP	Work package

List of Figures

List of Tables