UDRIVE

European Naturalistic Driving Study

Overview of the Data Collection

Deliverable 30.1

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Executive Summary

The present document provides an overview of the Data Collection and Operation Sites (OS) efforts to execute the data collection in the context of the UDRIVE project.

This deliverable details the necessary steps and related activities to organise, prepare and carry out the data collection at each OS. It summarizes the difficulties involved at each step and the lessons learnt[1].

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 ~ 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.

The six Operation Sites' objectives were to carry out the Data Collection following the common testing methodology, respect the time plan and provide quality-assured data for analysis.

Before the start of the trial, OS's had to organise themselves and set in place the necessary procedures regarding operational and technical aspects. They also had to implement the necessary preparation steps, e.g. getting the necessary ethical and legal approval from relevant authorities for data collection and participant recruitment, and recruit participants following the sampling methodology.

OS's then put to the test their preparation and processes during a pilot implementation, i.e. a small scale, but representative preliminary installation and data collection. The pilot was done in the same conditions as planned for the real data collection, from participant and vehicle reception, Data Acquisition System installation to a short data collection.

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

Once data collection had started, OSs' objectives were to monitor the vehicles, the drivers and the data quality. They were also responsible to transfer the data to Local Data Centres (LDC) for extraction of the data to the central database for analysis. During this process, the online Monitoring Tool helped OS teams detect and solve technical issues swiftly to ensure data quality and minimize loss of data.

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 main issues encountered during OS operations concern the recruitment and the equipment.

The main recruitment criterion for participation in the study was the make and model of vehicle: Renault Clios[2] and Méganes[3], Volvo Trucks and Piaggio Liberty Scooters were included in order to achieve

[1] There is a dedicated lessons learnt deliverable (D35.1), which provides more extensive details on OS experiences in the UDRIVE study.

homologation agreements and access to vehicle-based data. The project also laid out a sampling strategy, primarily according to driver age and gender.

The channels most commonly used were:

- Internet and social media (including forums for Renault drivers);
- personal references, i.e. internal network of relatives, friends, colleagues and other staff members of the same organisation;
- flyers distribution at car dealerships, parking lots and universities
- fleet owners

In France, the use of the database eased the recruitment effort and allowed for the sample to fit the study plan criteria. Where the vehicles were leased, i.e. the Dutch car OS and the PTWs OS, recruitment was also easier. Moreover, the lease company used in the Dutch car OS (XL Lease) not only made the recruitment easy but also allowed to get a representative distribution of participants (gender and age), in line with the sampling strategy, and the possibility to have three different waves of participants over the whole data collection period.

Nevertheless some OS's struggled to reach their recruitment target and some shifts of participants to other OS's 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 OS's 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.

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

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. Unions should have been approached and informed on all aspects of the study from the early stages, to reassure them on how privacy aspects are to be dealt with, and through them win over drivers more easily.

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. It is therefore important to establish a centralised reserve of spare parts as well as of full DAS's, which can be distributed among OS's 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.

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

[3] Series III, 2008-

Table of contents

1 Introduction

UDRIVE ("European naturalistic Driving and Riding for Infrastructure and Vehicle safety and Environment") is the first large-scale Naturalistic Driving Study in Europe, following the footsteps of SHRP2 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[4] (France, Germany, Poland, The Netherlands, Spain, United Kingdom) over a period of two years.

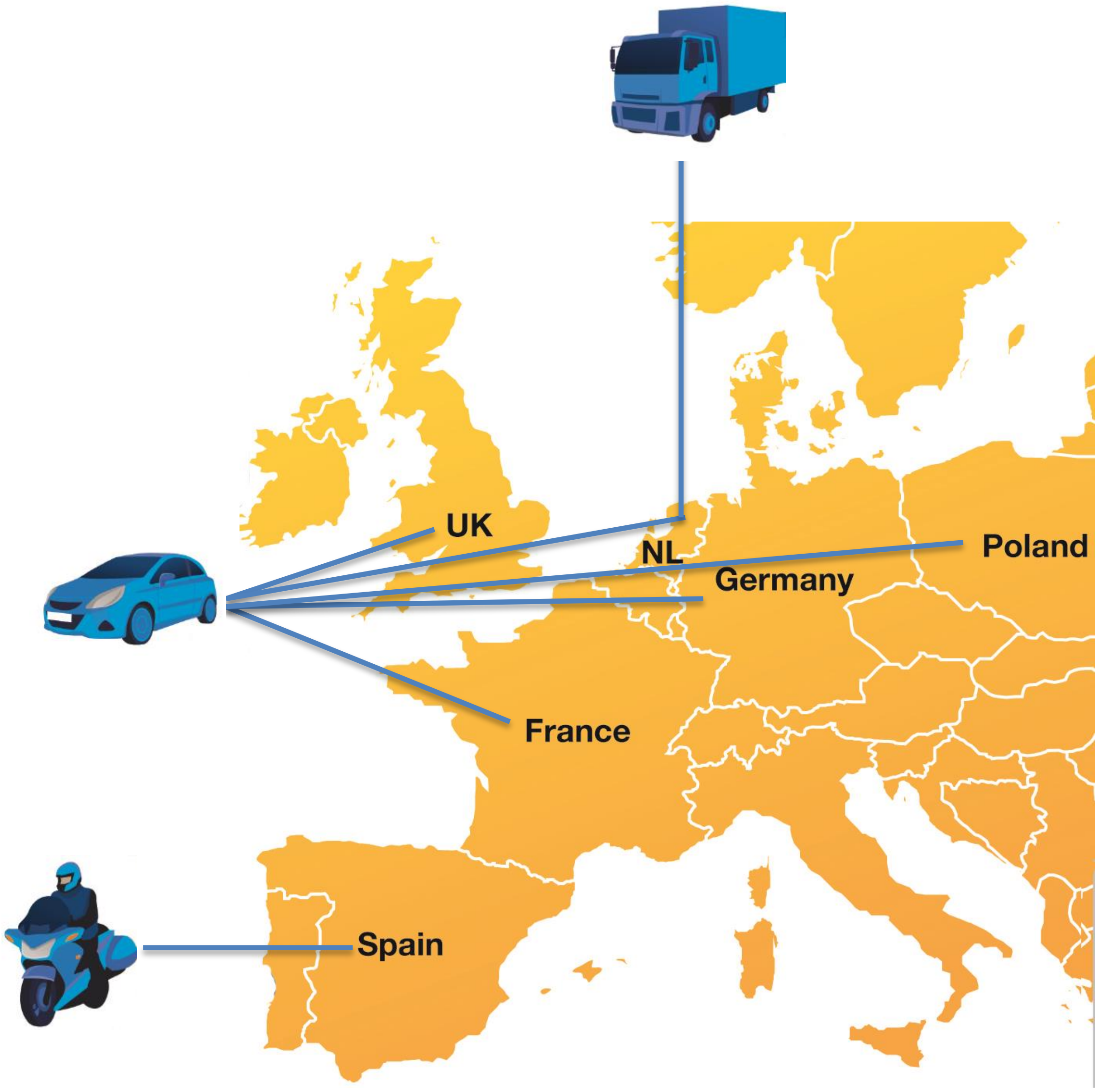

Figure 1: UDRIVE Operation sites and vehicle types

[4] 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.

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 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. UDRIVE also aims to provide access to its database (within the bounds of legal and ethical restrictions) for future research and analysis in various domains worldwide.

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[5]	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	Loughborough and Leeds	Passenger	Operations in two distinct UK regions representing large and small urban

[5] 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.

	and Leeds	universities	cars	areas and rural areas. Relatively high congestion.

The UDRIVE OS's 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 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.

1.2 Relation to the project structure

This deliverable provides an overview of SP3 activities within the UDRIVE study, which purpose was to coordinate and execute the naturalistic driving data collection according to the study design and 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).

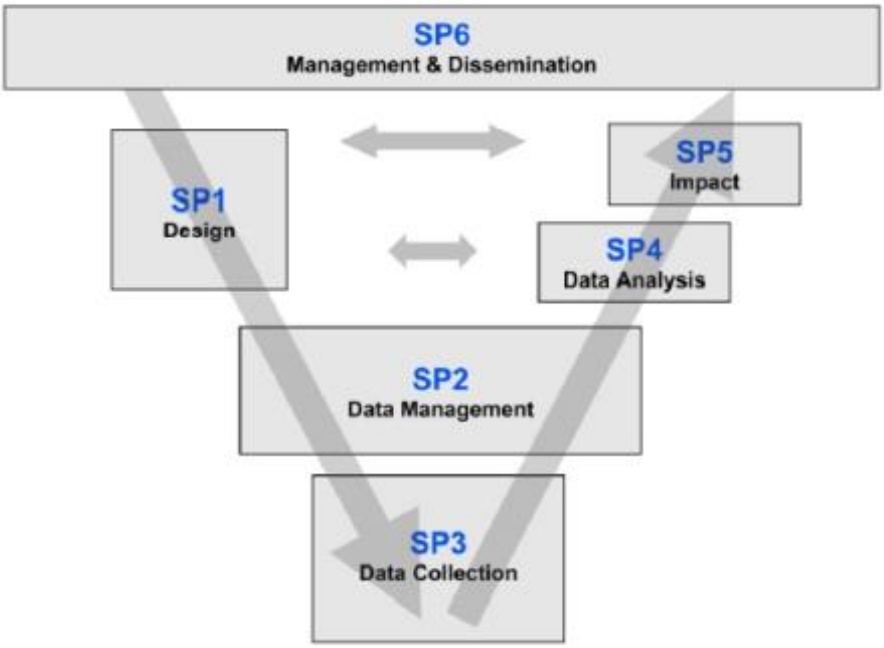

Figure 2: The overall structure of the UDRIVE project

2 Objectives and responsibilities

The objective of SP3 Data Collection is to ensure that the trial carried out in different Operation Sites follow the common testing methodology, respect the time plan and provide quality-assured data for analysis.

Towards this objective, the following tasks were carried out in each OS:

1. Plan and prepare for the trial according to the set guidelines, protocols and technical solutions developed by the project;
2. Recruit target number of participants following the sampling methodology;
3. Get the necessary ethical and legal approval from relevant local authorities;
4. Pilot the data collection operations from organisational, operational and technical points of view
5. Equip the OS fleet with the DAS's and decommission it at the end of trial;
6. Collect data and manage all aspects of operations over 18 to 21 months, i.e. technical and non-technical issues follow-up, including participants;
7. Manage data from data quality assurance to data storage and transfer to Local Data Centres (LDC).

SP3 and each OS work plan was structured accordingly, into 5 work packages (WP):

- WP3.1 OS description and planning
- WP3.2 OS preparation
- WP3.3 OS piloting
- WP3.4 OS operations
- WP3.5 OS conclusions

The leaders of these WPs were responsible for the monitoring of their WP activities across the six OS's and for the related deliverables consolidation. The OS Leaders were responsible for the organisation and operation of their OS in order to fulfil the WP objectives and tasks.

SP3 Leader has acted as a coordination body across all WPs and OS's. SP3 Leader monitored the harmonised execution of the operations across all OS's and the quality of the data, ensuring the information flow between OS's as well as between SP3 and the other SPs. Finally, he/ she reported on SP3 progress and issues to the Coordinator and SP Leaders' group as well as to the Core Group.

2.1 Timeline

A common time plan was specified for all OS's to follow and complete major tasks until the start of the trials. However certain tasks started earlier or finished later in some OS's, depending on the specific challenges met for one particular task or the other, be it recruitment or piloting for instance. There were also delays in the project that impacted on the start or conclusion of certain tasks in SP3.

The resulting timeline for the main tasks carried out in SP3 is specified per OS in table 2.1.

Table 2.1: SP3 timeline per task and per OS

OS	Task									
	OS preparation and adaptation		Participant recruitment		OS piloting		DAS installation and ramp up		DAS deinstallation and ramp down	
	Start date	End date	Start date	End date	Start date	End date	Start date	End date	Start date	End date
France	April 2013	March 2015	April 2015	Sept. 2015	March 2015	Sept. 2015	Sept. 2015	Oct. 2015	March 2017	April 2017
Germany	June 2013	July 2014	Feb 2014	Dec 2016	May 2015	July 2015	Aug. 2015	Dec. 2015	March 2017	April 2017
Netherlands - Trucks	Dec. 2012	Dec. 2013	Jan. 2014	Feb. 2016	Jan. 2014	Nov. 2014	Dec. 2014	Feb. 2016	Feb. 2017	May 2017
Netherlands - cars	Jan. 2015	July 2015	Jan. 2015	May 2015	N/A[6]	N/A	Aug. 2015	Sept. 2015	N/A	N/A
Poland	Nov 2013	May 2015	March 2014	Jan 2016	May 2015	Sept. 2015	Oct. 2015	Feb 2016	May 2017	May 2017
Spain	Jan. 2014	Jun. 2015	Jan. 2015	Oct. 2015	April 2015	May 2015	Oct. 2015	Nov. 2015	Feb. 2017[7] April 2017	Feb. 2017 May 2017
UK	Jan 2013	March 2015	April 2014	May 2015	March 2015	April 2015	June 2015	July 2015	April 2017	May 2017

2.2 Milestones

In order to manage the risks inherent to this type of large-scale data collection, each OS was subject to two GO/NOGO milestones, the first one in M17 (February 2014) and the second one in M19 (April 2014). The two GO/NOGO decisions were respectively based on the completion of OS planning and preparation and the readiness of OS's to start recruitment.

The decisions were based on an agreed list of criteria. OS filled in corresponding checklists. The inputs were discussed and a decision taken by SP3 Leader and the project coordinator.

[6] The Dutch car OS did not do a pilot as they had the experience from the truck pilot. Moreover the vehicles were not de-installed at the end of the data collection as the Lease company was interested in pursuing the data collection beyond the end of UDRIVE.

[7] 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.

2.2.1 First go-nogo decision

All OS's got a positive decision on 5 February 2014, which allowed them to continue their preparation of the recruitment and operations. It was based on the OS description of responsabilities, procedures and preparation plans for recruiting and operations.

2.2.2 Second go-nogo decision

All OS's got a positive decision on 23 April 2014 which allowed them to continue with recruitment and operations preparation. It was mainly focussed on the actual readiness of OS's to start recruitment and operations based on their completion of all preparatory tasks.

3 OS Planning and preparation

3.1 Planning

The planning consisted in identifying the necessary tasks to prepare for operations and data collection, including necessary adaptations at OS level.

During this initial phase, common approaches to the trial operations and data collection as well as a common timeplan for preparation and adaptation activities, piloting and start of operations were defined. OS's described organisation, responsibilities and processes within each OS. These descriptions as well as their strategies for the necessary preparation activities detailed hereunder were included in Deliverable D31.1. The purpose was to ensure harmonization and consistency across the OS's towards data quality assurance.

3.2 Preparation

The main types of preparation and adaptation activities concerned the recruitment, the legal, technical and operational aspects related to the data collection. It envolved the following tasks:

1. For the recruitment:
    a) Prepare questionnaire and briefing documents in the local language
    b) Define recruitment channels
    c) Create a website for participant recruitment
2. For the legal and ethical aspects:
    a) Prepare participant agreement or consent form in local language
    b) Prepare the data protection concept document
    c) Apply for data collection approval by the competent national/ local authority
3. For the technical and operational aspects:
    a) Contract the necessary external garage and/ or certified MobilEye installer
    b) Train technicians and installers for DAS as well as MobilEye calibration
    c) Order SIM cards for data loggers
    d) Acquire local data storage and DAS equipment
    e) Assign a room (with computer) for participant briefing and subjective data questionnaire

These different aspects are described in details in the following chapters.

4 Recruitment

4.1 Preconditions for recruitment

OS preparation for participant recruitment involved developing information and contractual material for participants in the local language, defining possible channels to reach the target group, preparing an online tool for the recruitment questionnaire.

4.1.1 Information material

The project Dissemination Manager designed a leaflet providing general information about UDRIVE and its objectives, to inform stakeholders about the project and facilitate recruitment in the OS's. It was translated into the OS local languages.

Additional information necessary for recruitment was prepared by every OS according to their target sample. This briefing information, aimed at potential participants or fleet companies included an explanation of the DAS, of the expectations on the participant, the compensation to be received and the liaison strategy. The electronic version was used for the recruitment website and also supported the recruitment via email.

4.1.2 Recruitment website

The recruitment website was the backbone of the recruitment process: it provided all information that potential participants might ask for. It also included the web-based version of the participant questionnaire to collect relevant information from potential test subjects. The recruitment website was also used at a later stage for keeping in touch with participants and re-recruitment as necessary.

4.1.3 Participant questionnaire

The questionnaire for recruitment was based on the study plan developed in the project, which defined the required samples and selection criteria. The questionnaire allowed to determine if interested participants met the selection criteria in terms of gender, age, geographic region, vehicle brand and model, average mileage driven).

4.1.4 Participant agreement

The participant agreement was also translated into local languages and adapted to national law. The participant agreement determines all the duties and rights of the participants and includes also the incentive strategy of each OS.

4.1.5 Recruitment channels

Some channels were identified for common use by all OS's, others were used specifically by one or the other OS; finally some channels that proved to be efficient in one OS were re-used by other OS's that encountered more recruitment difficulties and had already used up all options.

The channels most commonly used were:

- Internet and social media (including forums for Renault drivers);
- personal references, i.e. internal network of relatives, friends, colleagues and other staff members of the same organisation;
- flyers distribution at car dealerships, parking lots and universities

- fleet owners

Automobile and riders clubs were also contacted to circulate the call for participation among their members, namely with the help of FIA. Germany even did a radio interview. Some channel used by some OS's, e.g. advertisement in local newspaper, was too expensive for use in Poland for instance.

France had access to the database of private car owners through the Auxiliary Automotive Association (AAA), working with the CCFA-French Automotive Manufactures Council. This database contains the personal information on the potential participants such as name, address, age, brand, model and year of the vehicle.

TNO has contacts with Volvo Netherlands that made connections with fleet owners willing to participate in the project.

The recruitment strategy of each OS, including the procedures and identified channels, is described in deliverable D32.1.

4.2 Recruitment start

4.2.1 Sampling strategy

The main recruitment criterion for participation in the study was the make and model of vehicle: Renault Clios[8] and Méganes[9], 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.

Figure 3: Renault Megane III

Figure 4: Renault Clio III

Figure 5: Renault Clio IV

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

[9] Series III, 2008-

Figure 6 and Figure 7: Piaggio Liberty 125

Figure 8 and Figure 9: Volvo FM

Figure 10 and Figure 11: Volvo FL

4.2.2 Final sample characteristics

The sample figures also include re-recruitments and secondary drivers.

Table 4.1: 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.

4.2.2.1 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		

4.2.2.2 Germany

			Target	Realized		
Vehicles			= 20	20		
Drivers			≥ 28	29		
Multi-drivers cars	22-65 y/o		≥ 8	7		
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	10		
		Small cars	≥ 3	6		
		Mid-sized family cars	≥ 3	4		

4.2.2.3 Netherlands -Trucks

		Target	Realized
Trucks		= 50	32
Drivers		≥ 50	47
Multi-drivers	22-65 y/o	≥ 12	16

Trucks					
Mileage[10]		≥ 10 000 km	Min	Median	Max
			N/A	N/A	N/A

4.2.2.4 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					
		Renault Clio[11]	15	18		
Female	22-65 y/o					
		Renault Clio	15	15		

4.2.2.5 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		

[10] 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).

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

4.2.2.6 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		

4.2.2.7 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		

4.2.3 Recruitment challenges

In France, the use of the database eased the recruitment effort and allowed for the sample to fit the study plan criteria. Where the vehicles were leased, i.e. the Dutch car OS and the PTWs OS, recruitment was also easier. Moreover, the lease company used in the Dutch car OS (XL Lease) not only made the recruitment easy but also allowed to get a representative distribution of participants (gender and age), in line with the sampling strategy, and the possibility to have three different waves of participants over the whole data collection period.

In the UK, the channels used were efficient in bringing the target numbers though they had to relax on demographics criteria laid out in the sampling plan[12] and accept any interested candidate who fell within the required age category and drove close to the required annual mileage. Indeed the respondents were predominantly Renault Clio III female drivers, 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.

Due to the delays in the project and the consequent postponed start of the piloting and operations, some of the originally recruited drivers had lost interest or changed vehicle by the time operations were ready to start. Thus while ready to start instrumenting the vehicles, some OS had to re-recruit additional participants in order to meet the required target.

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

Specific OS's were faced with specific difficulties for different reasons:

4.2.4 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 outside of Braunschweig (participants from Berlin were accepted), Germany had difficulties reaching its target as Renault is not a commonly driven vehicle in the area of Braunschweig.

As it was already difficult to reach 20 vehicles, it was decided to shift 10 participants to the Netherlands and create the Dutch car OS Dutch OS, which leased the cars.

4.2.5 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.

4.2.6 Poland

Poland initial 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, many initially recruited participants had

[12] Considering just primary drivers, the targets for the split by vehicle type and driver gender were not met. However, by including secondary drivers the minima required were met.

dropped out and the manager from the contacted fleet had changed, whom could not be persuaded to participate.

Recruitment efforts had to be restarted and Poland struggled to reach their target when the fleet option had to be dropped and they had to recruit individual participants via internet, personal contacts and flyers dissemination. Renault national club also provided support and another smaller fleet of 5 vehicles (Méganes) could be recruited. However the many technical issues with the pilot trial created additional challenges and delays to the recruitment finalisation.

The recruitment was completed in January 2016; however the full fleet of 30 was never altogether on the road collecting data, due to the continued technical difficulties during operations.

4.2.7 Spain

Initial plans concerning powered two-wheelers were to recruit 40, of which 25 should have been operated in Spain and 15 in Austria. Piaggio Liberty 125 is the most common motorcycle type in Valladolid (Spanish OS location) and BMW R1200GS is the most common one in Austria.

During the DAS development process, it became evident that the device including the top-case and a battery was heavier than the maximum load of the Piaggio Liberty 125 luggage carrier. Hence, the vehicle was changed to a Piaggio Liberty 125 Delivery model, which has only one seat, but a strong luggage rack (often used for mail or food delivery services). This model does not exist in Austria, there are only a couple of vehicles, but a) with the 50ccm engine and b) operated by Austrian Mail Service, which would not allow for a representative sample of subjects. Buying the vehicles and selling them after the study was not possible as only a small share of depreciation could have been charged onto the project, and these vehicles could not be sold in Austria after the project. Leasing them was also impossible as there is no market for these vehicles in Austria. Leasing the vehicles in Spain for use in Austria was not accepted by Piaggio.

Considering all these issues, it was not possible to run a PTW OS in Austria and the decision was taken on 8 May 2015 to shift the 15 PTWs to the Spanish OS.

The recruitment process started on February 2015. An advertisement was published in Cidaut’s internal network and also in a local newspaper. Within two weeks, 51 potential participants had registered their interest. The participants’ selection was done following the sample plan criteria. However the recruitment procedure had to be repeated due to the shift of scooters from Austria and initial participants’ drop outs due to the delays.

The replacement for those participants together with the additional 15 riders made them diverge from the initial gender/age objective. It has been difficult to find women willing to participate in the study for example. 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.

5 Legal and ethical aspects

As personal data was collected in UDRIVE, not only from the test subjects but also from passengers within the vehicle (not applicable to PTW), people and vehicles (number plates) passing by the equipped vehicle, legal and ethical requirements for data privacy were applicable.

Table 5.1: Personal data handled by OS's

Data	Specification
Recruitment data	Personal data for each person applying for participation in this study, thus not only the persons that were selected for participation.
Consent form	The agreement between the participant and the OS.
Driver and vehicle ID	The number used to identify a participant or a vehicle within the project. The OS handled the conversation lists between the IDs and the drivers/vehicles.
Vehicle leasing/fleet agreement	The vehicle agreement between the participant or fleet and the OS. Could also include information about insurance.
Compensation payments	Information about payments to the driver for the participation in the study.
CAN signals	Encrypted data from the vehicle internal data communication, collected from the vehicles. A few signals were exposed on the Online Monitoring Tool (OMT) for failure tracking.
Video	Encrypted video data collected from cameras covering both exterior and interior environment. Cameras' screenshots were exposed on the OMT for failure tracking.
Audio	Encrypted audio data.
GPS	Encrypted full GPS trace for each trip. A few signals were exposed on the OMT for failure tracking.
Other sensors/equipment	Encrypted data from other sensors/equipment.
Vehicle information and diary	Information about the vehicle (such as vehicle registration identifier) and a log showing what actions were performed to maintain the vehicle and the DAS equipment during the study.
Questionnaires	Questionnaires (with potentially personal data) answered by the participants during the study.

Besides the expressed consent from test subjects, permission from the competent data protection authorities had to be obtained, to replace the approval of individuals being recorded by the external cameras without their consent. In Germany and France, these images (pedestrians and licence plates) needed to be blurred to be made unrecognizable, before transferring to Central Data Centre (CDC).

Such permission was also needed to prevent misuse of the data collected relating to possible acts and omissions punishable by the courts or administrative authorities (even suspicion), i.e. (traffic) offences.

Each OS was responsible for seeking ethical and legal approval from the relevant local data protection authorities for data collection and participant recruitment.

5.1 Official approval

5.1.1 France

The French National Commission for Data protection (CNIL)[13], which is an independent French administrative authority, has a mission to ensure that data privacy law is applied to the collection, storage and use of personal data.

Before the start of experimentation, CEESAR had to notify the CNIL and apply to receive permission for data collection and processing (as Local Data Centre). In order to get the approval, they had to provide to CNIL information on the characteristics of the trial implementation, the procedures and measures to ensure data security and confidentiality (storage and access), to ensure that participants could exercise their rights as to their data and the use of one's image (video data, in publications, e.g. internet, reports, presentations).

The decision was received at the beginning of June 2015, with the limitation, though, that only public bodies may work with instantaneous speed data. The postponement of this authorisation caused delays in the recruitment finalisation and installations for the French OS.

IFSTTAR submitted a new request to allow for data transfer and analysis for SAFER (CDC) and other partners that are public bodies or have a public mission. For other partners that are private entities, it was requested to have access to all data except data containing information that could be used to determine traffic offenses; and thus for speed data, only the segments that have to be analyzed (safety-critical events) and those that have to be used as reference segments (baseline segments), i.e. between 45s before and 15s after the segments. The decision of the CNIL approving these terms was received in November 2016.

5.1.2 German OS

Based on experience with another ND project, the procedure followed was to first construct an expert board which consists of 1) data security commissioner for DLR (in German *Datenschutzbeauftragter*), 2) legal department at DLR, 3) external expert company, 4) responsible person from DLR on OS. Then, a data security concept was submitted to that expert board. The concept included issues like e.g. content of recorded data, access to the data and when data would be deleted. Finally, the data security concept needed to be approved by DLR's institute leader.

Regarding ethical issues, in Germany there is no committee to apply for and it was DLR's own responsibility to comply with the rules.

5.1.3 Netherlands

Official ethical approval for the UDRIVE trial was not required, as long as TNO had a documented protocol according to which TNO handles the data in terms of protection and privacy. However, since video data was collected and stored, the project had to be registered at and approved by the institute for personal data protection (CBP[14], now called the Dutch Data Protection Authority or DPA).

Moreover the legal department of TNO worked out contacts between the fleet owners and TNO for clarification of legal issues and liability.

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[13] Commission Nationale de l'Informatique et des Libertés

[14] College Bescherming Persoonsgegevens

5.1.4 Poland

The responsible authority in Poland is the Bureau of the General Inspector for the Protection of Personal Data (http://www.giodo.gov.pl/), which confirmed that there were no legal requirements in Poland at that time requiring such an official approval for UDRIVE study.

5.1.5 Spain

Cidaut contacted the Spanish Data Protection Agency to explain in detail UDRIVE particularities to receive further instructions on how to proceed. Cidaut was asked to register the "database frame", i.e. the variables and data that the Spanish OS was going to register during the project in the Spanish OS, which the Spanish Data Protection Agency reviewed before they gave their formal approval at the beginning of 2015.

5.1.6 UK

The local authority for data protection is the UK's Office of Information Commissioner. Though no formal approval was necessary, a statement of justification for data collection (in particular concerns video and audio recording) and associated data management protocols was submitted to the Office of Information Commissioner to demonstrate efforts made to minimise intrusion of privacy. No comments were received.

5.2 Data protection measures

In UDRIVE, collected data is encrypted in such a way that only authorized parties can access it, i.e. while stored in data acquisition systems and during transit to operation sites, and later LDC/ CDC.

A sign had to be placed in the vehicle informing potential passengers or drivers using the vehicle, who had not signed a participant agreement, that they were being recorded and how they could switch off data record for the trip.

Participants own the collected data and thus have the right at any time to consult the information that concerns them and to ask that the data or certain trips should be deleted.

5.3 Data protection concept

Each OS had also to prepare and submit for approval to the UDRIVE project certification organisation[15] a data protection concept (DPC) document, describing their procedures to comply with the constraints and requirements for the handling of data throughout the project.

The DPC specified the following items in detail:

1. Presentation of type of site/centre and intended data usage
2. Start and end dates for data usage
3. Name of appointed UDRIVE data supervisor and description of organisational structure
4. Overview of personnel to be granted access to data

[15] The certification organisation consisted of a group of project partners (SWOV, ERTICO, SAFER and DLR) during the project. Three members of the certification organisation were appointed to evaluate each application. Decisions were taken with simple majority.

5. Brief analysis of responsibilities of site/centre in context of data protection and privacy issues
6. Detailed description of compliance with regards to protection measures handling and storing participants' data, including subjective data questionnaires and consent forms.
7. Status of the described implementation
8. Risk assessment and response plan in case of infringement of the requirements
9. Documentation of relevant internal routines/guidelines, as well as training for personnel (i.e. on the local implementation of the security precautions, such as the data protection procedures and the analysis environment set-up together with more general information and rules for the UDRIVE data)
10. List of relevant contracts/agreements
11. Analysis of national legal status and any legal issues that must be handled specifically (and how) for the site/centre
12. Approval from national ethics committee, if required.

5.4 Other liability 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.

Finally participants were advised about their liability to report in their tax declaration the income from the incentive money received for participation in the study.

6 Piloting

After validation of the data acquisition system, participant's recruitment phase and piloting phase started in parallel. Consequently to the validation of the pilot implementation, the instrumentation of all participants' vehicles and the actual data collection started.

The objectives of the piloting were to test and validate the data acquisition and all related procedures before the start of actual operations, by implementing a small scale, but representative preliminary installation and data collection. Pilot tests needed to be done in the same way and under similar conditions as planned for the real data collection.

For OS's, it was the opportunity to get to learn how to use the tools developed by SP2, and test their own preparation and processes set in place, from participant and vehicle reception, Data Acquisition System installation to data collection, before ramping-up with actual participants.

The piloting phase envolved three main tasks:

- Define a common methodology or pilot plan, including a checklist of all the tests to be performed from technical, organisational and operational standpoints;
- Implement a pilot at each OS;
- Share and report experiences between OS's to capitalize on lessons learnt.

6.1 Pilot plan

The aim of piloting being to assess that each OS was properly trained and able to carry out OS operations, the pilot plan was based on a precise description of the operations to be performed and procedures to be implemented and validated at each OS.

This preliminary study was divided in several successive steps and OS's could not proceed to the next step before the previous one was fully validated: at least one vehicle should be (1) installed, following DAS installation procedures; (2) used for at least two weeks, with a minimum of 40 different trips, covering at least 1000 kilometres; then (3) de-installed.

OS were to use an OS-owned or rented vehicle for the pilot testing, and recruit volunteers from among e.g. colleagues, friends, etc., who would not necessarily participate in the final experiment. As a last option, the vehicle of a participant already recruited for the study could be used.

The next step was to define prerequisites that each OS had to fulfil before considering piloting, e.g. assigning responsibilities, selecting a proper data transfer operator and installation team; including critical documents that either had to be provided to OS's or developed/ adapted by each OS, e.g. questionnaires, briefing material, instruction manuals, etc.

This resulted in deliverable D33.1, in effect a "handbook" for OS's: the document also comprises recommendations for piloting each step of the OS operation and a thorough checklist to clarify their responsibilities and ensure that no important detail was overlooked.

6.1.1 Prerequisites

Before starting piloting, each OS had to check the following items in order to train themselves on identifying and solving potential problems. Only after such preconditions were met, could they start the pilot:

- Operation Site responsibilities and teams are identified (for liaison with participants, OMT monitoring, hard drives pick up and transfer)
- Documents needed are ready:

        - participant-related ones: briefing information, questionnaire and consent forms (in the local language of each OS); participant badge, including the driver Unique ID and contact information (e.g. hotline), which allowed to identify the participant in the OMT
        - for the OS itself: user manuals and installation guides
        - vehicle-related ones (in the local language of each OS): vehicle condition report to enter the vehicle condition (scuffs, dents, broken, cracked, etc.) on installation, which needed to be signed both by the installation team and the vehicle owner; garage information notice, including a description of the DAS for garage, instructions to disconnect / reconnect the system if necessary in case of maintenance, as well as contact information for the corresponding installation team
    - Online Monitoring Tool (OMT) is configured: the OMT allowed centralized monitoring of the complete operations from each OS, through status reports it got from data loggers though their GSM connection; OS teams interacted with it either for tagging a specific operation (e.g. hard drive exchange) by flashing a QR code, or to monitor progress of their operations and data quality (spotting suspicious behaviour of any DAS or other indicator showing no data record, e.g. video snapshots from the cameras)
        - QR codes to be pasted on cars, data loggers and hard-drives are received
        - Credentials to access the OMT are created
    - Suitable suppliers have been selected for:
        - Data Acquisition System installation team
        - Mobile data transfer: each OS had to contract a suitable mobile operator and acquire the SIM cards to attach to the DAS's so that daily messages could be provided to the OMT on their status and any early signs of DAS failure could be detected[16]
        - Hard drives shipment to LDC
    - Pilot vehicle and participants are selected
    - Suitable facilities to receive participants are prepared

6.2 Pilot implementation

OS performed the necessary procedures for data collection as well as a complete equipment instrumentation and configuration, to validate that this implementation was operational before instrumenting all participants' vehicles and start the actual data collection:

- Registration of the participants
- Reception of the vehicle and instrumentation by DAS installation team
- Online Monitoring Tool (OMT) connection
- Data collection
- Data quality check

[16] It was recommended to try and first obtain a free test SIM card for piloting before contracting the mobile operator.

- Data transfer to LDC
- DAS removal by DAS installation team

Because of SP2 delays, the pilot was officially kicked-off during an SP2-SP3 workshop organized in March 2015 by CEESAR in their premises, including a presentation of all the aforementioned documents and hands-on demonstrations for all technical procedures that OS's had to carry out.

Actual piloting at each OS started after that meeting, a period during which weekly meetings were organised between SP2 and SP3 in order to constantly share experience, report any difficulties and find solutions.

Table 6.1: Piloting timing and characteristics per OS

OS	Vehicle	Participant	Start date	End date
France	3[17]	Employees from CEESAR	March 2015	September 2015
Germany	1	Real participant	May 2015	July 2015
Netherlands[18]	2	Employee from TNO	January 2014	November 2014
Poland	1	Employee from IBDiM[19]	May 2015	September 2015
Spain	1	Employees from CIDAUT	April 2015	May 2015
UK	1	Employee from LBORO University[20]	March 2015	April 2015

6.1 Piloting issues

The main issues encountered during the piloting period concerned e.g. the reception of several participants at the same time, which made the logistics, e.g. regarding the questionnaire completion, somewhat trickier; some participants found the questionnaire to be lengthy, confusing and including redundant questions.

Technical issues that were shared by some of the OS's included:

- The rebooting of data loggers with no apparent reason;
- The OMT status report was not working properly and snap shots were infrequent;
- The delay of the software update (Firmware 1.5 arrived in July 2015) not allowing to perform many tests of the entire system and ghost partitions needing to be removed from the compact flash when reinstalling the software;

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[17] Three different vehicles types were instrumented: Clio III, Clio IV and Mégane III

[18] The Dutch lease car OS did not run a pilot, as they needed to start as soon as pOS'sible and had already experience with the truck pilot.

[19] After the piloting, the pilot participant became a regular project participant.

[20] After the piloting, the pilot participant became a regular project participant.

- Connecting the piloting vehicle to the DAS using QR codes proved to be difficult;
- Discrepancy between the date for the trips in the logbook and the date recorded on the OMT or record folders in the raw HDD;
- Distinction between training and production DAS created issues with the labelling of the cables;

Some specific issues encountered by certain OS's are reported hereunder. During the piloting and data collection phase, regular status meetings were organised between OSs and the SP3 and SP2 Leaders to share those issues and seek advice, or exchange best practice if a solution had been found in the meantime. Most of the issues were solved by the time the instrumentation of the whole OS fleet started; except for Poland which continued troubleshooting some issues while instrumentation and data collection had already started. Despite following all best practice from other OS's and the advice from the supplier self, the Polish OS continued to have technical issues with some DAS's that eventually had to be returned to the supplier for repair.

6.1.1 Germany

The installation took longer than expected. In total four appointments were needed to finish the installation:

- During the first appointment, all cameras and cables were installed except for the data logger and the MobilEye camera. The data logger was not prepared due to missing of lab power cable;
- During the second appointment, the data logger was prepared and installed. However, MobilEye database update took longer than expected and the time was not enough to finish the calibration of MobilEye;
- During the third appointment, the MobilEye software was not able to read system information of the MobilEye. This is because the new EyeCan cable received from SECTRONIC had a problem with its CAN connector. First, the CAN connector was not a standard CAN connector (i.e. bin 1 needed to be changed to bin 7). Second, a mini gender connector was needed to connect EyeCan cable to the CAN N=5B cable. Another difficulty which was faced here is that THE blue and red part of the CAN N=5B cable was labelled incorrectly;
- During the fourth appointment, the installation was finished swapping the blue and red cable in a plug.

6.1.2 Poland

After the pilot vehicle installation, data was collected in May 2015 and after two weeks of recording, the first hard drive was sent to LDC at the end of May 2015. After checking the hard drive, DLR (LDC) provided feedback that video data had been recorded but that the CAN data were not recorded.

SP2 instructed that the MobilEye and CAN cables needed to be modified and recommended stopping further installations until they could test amended version at the UK OS. The supplier SECTRONIC asked to ship back to them the following parts that needed upgrading:

- MobilEye cable
- CAN cable
- drawer N°2 from the TREK (with CAN interface).

Activities were on halt until the missing parts were received to complete the piloting. In September 2015, the Polish OS could resume the piloting but wasn't able to calibrate the MobilEye. A video tutorial of a complete installation was sent by the UK OS and no difference was noted with the procedure already applied by the Polish OS. Finally the Polish installer managed to calibrate the MobilEye by avoiding the CA5b cable.

CEESAR informed the Polish OS that altering in any way the installation kit voids Renault support, which means that the installer would take full responsibility for warranty and homologation, and Renault couldn't be held liable in case of any problem.

4 cars were instrumented in that way and beginning of November 2015, a third HDD from one installed Mégane was sent to LDC (DLR) for checking. The processing revealed that some issues regarding MobilEye data remained but since the OMT showed data being recorded, and while the OS Leader continued to try and troubleshoot remaining issues with the support of other OS's, SP2 Leader and the supplier, it was decided to continue with the remainder of the installations, not to delay ramp up any further.

6.1.3 Spain

The integration of the equipment in the scooter was very difficult due to the reduced physical space, the weight limitations, the hardware and the software. The speed sensor was not working properly in some of the installations and they had to be redone.

6.1.4 UK

The pilot of the HP test was not successful. Several people attempted the test and found it to be confusing primarily since the test operates a left-hand drive vehicle and road infrastructure whereas vehicle in the UK are right-hand drive.

7 Data collection

The first step was the vehicle instrumentation phase, which consisted of the gradual installation of DAS's in the entire fleet for each OS towards ramping up. While some OS's still needed to recruit more participants to reach their target, 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.

Once the whole fleet was installed and collecting data, the main tasks of OS's consisted in maintaining the vehicles and equipment, liaising with participants as necessary and monitoring the data quality.

7.1 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[21].

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.

Figure 12: Typical identification pictures (from a project partner for the sake of example)

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.

[21] 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.

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. The participant also had to fill in a “vehicle questionnaire” to provide information on the vehicle variables

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

7.2 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.

7.3 Vehicle instrumentation

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. Each installation took on average between 4 to 8 hours per vehicle, by a team of two technicians, including the MobileEye certified installer.

Figure 13: 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.

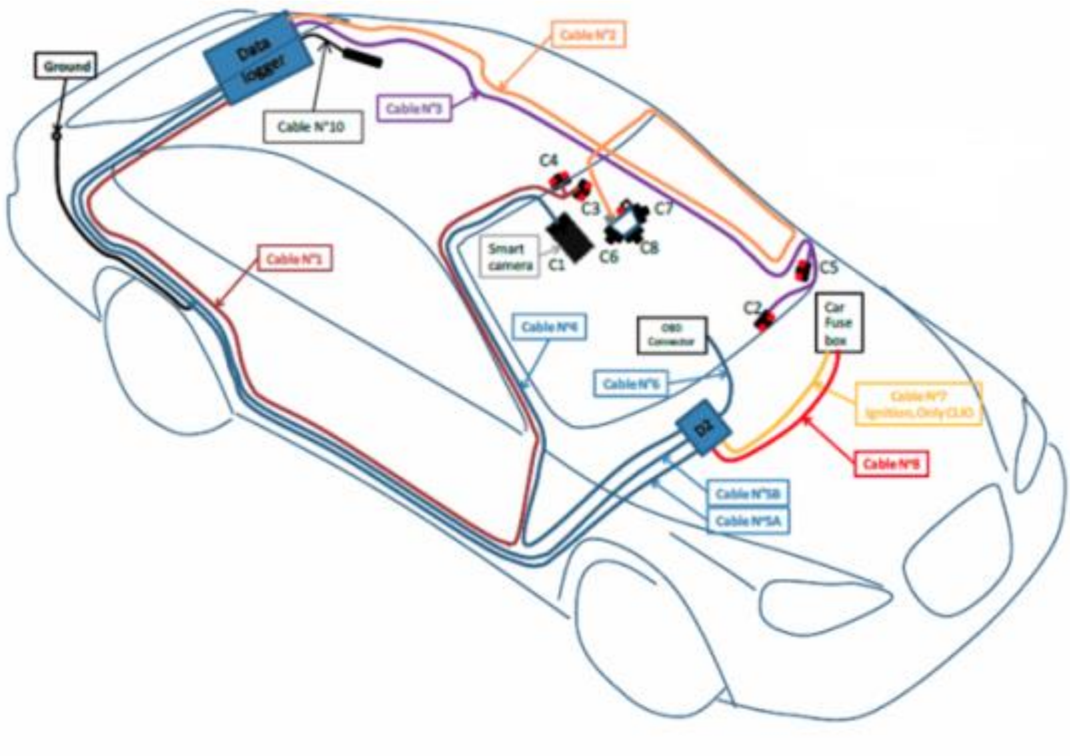

Figure 14: Car installation diagram

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 15 and Figure 16: 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 17: Feet camera

Figure 18 and Figure 19: 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 20: 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 21: 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.

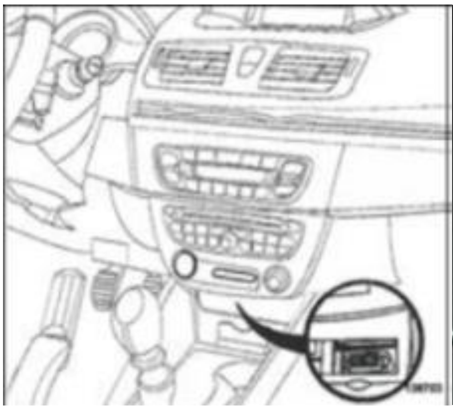
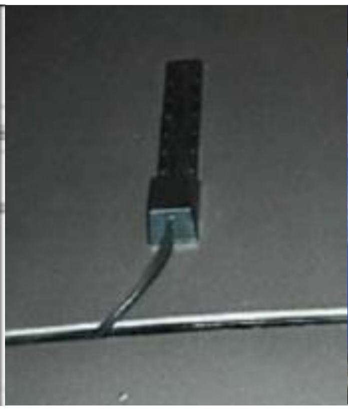


Figure 22, Figure 23 and Figure 24: OBD connector and GPS antenna

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 25 and Figure 26: Data logger and vehicle QR code

7.3.1 PTWs

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 27 and Figure 28: 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 29 and Figure 30: 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 31: Views from the 5 PTW cameras

Figure 32: 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

7.3.2 Installation issues

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.

7.4 Ramp up

The exact timing when the full OS fleet was instrumented and on the road collecting data is included in Table 2.1 and is different for each OS: France had to wait for the approval from CNIL to complete their recruitment while Poland had to solve their piloting issues first. Some OS's completed the instrumentation of their fleet in several phases, such as the Spanish OS that received the lease scooters to equip in two deliveries distant from one month. Others had difficulties recruiting their last few participants and thus fully ramped up later than most OS's, though only for one or two vehicles.

7.5 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.

7.6 Liaison with participants

7.6.1 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.

7.6.2 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.

7.6.3 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.

7.6.4 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.

7.7 Data monitoring

7.7.1 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.

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[22], 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 Central Data Centre (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 OS's, 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.

7.7.2 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)[23] 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.

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

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

Figure 33: DAS Hard drive protection system, relevant for change of hard drive

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.

7.7.3 Data storage and 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.

7.8 Issues during data collection

7.8.1 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.

7.8.2 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.

7.8.3 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.

7.8.4 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.

7.8.5 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.).

7.8.6 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.

7.8.7 Participant 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 7.1: Participant drop outs per OS

OS	Number of drop outs	Replaced YES/ NO	Reasons for dropping out
France	2	NO[24]	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 accident – and were thus replaced with second wave of recruitment
UK	4	NO[25]	Participants sold their vehicles

7.9 De-instrumentation

Appointments were taken with the participants and after removal of the equipment, following the de-installation 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 de-installation team and vehicle owner (a copy is kept by both parties). HDDs retrieved from the vehicles were transferred to LCDs.

A debriefing or exit 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.

Most OS's performed de-installation of their fleet at the end of April or beginning of May, though some OS's started a bit earlier, as contracts with the fleet owners were coming to an end. The Dutch car OS has not de-installed any of their 10 cars as the lease company was interested to extend data collection after the end of the project. The timing per OS for de-installation of their fleet is included in Table 2.1.

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

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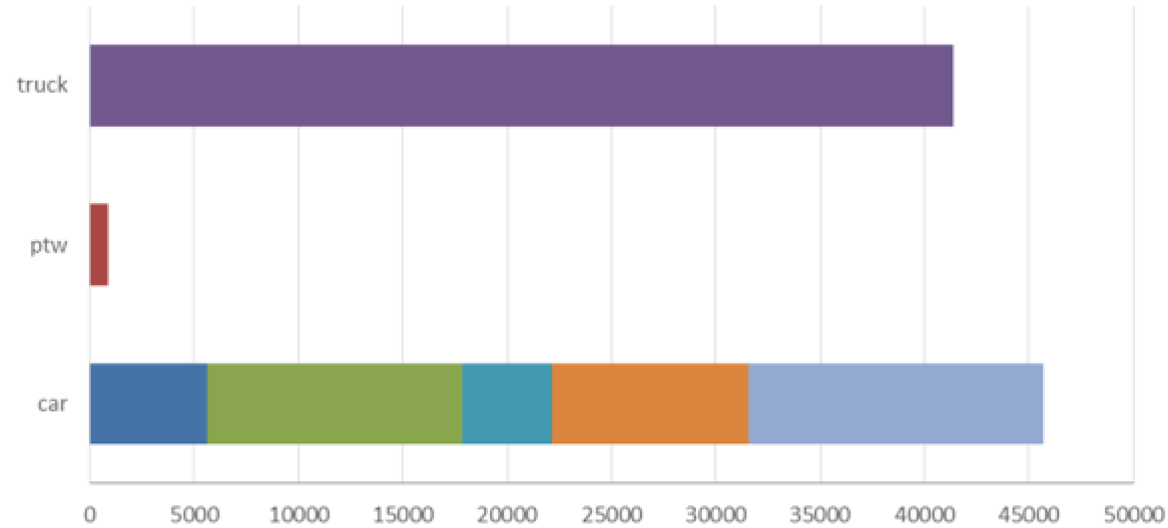
[24] Some of the equipment was used when re-installing the vandalized vehicles since no spare parts were available in the project.

[25] 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.

discolouring of the paint or wrinkled paint where the antenna was attached, on some vehicles, when removing the antennas.

7.10 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)[26]. 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.



	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 34: 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

[26] 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).

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.

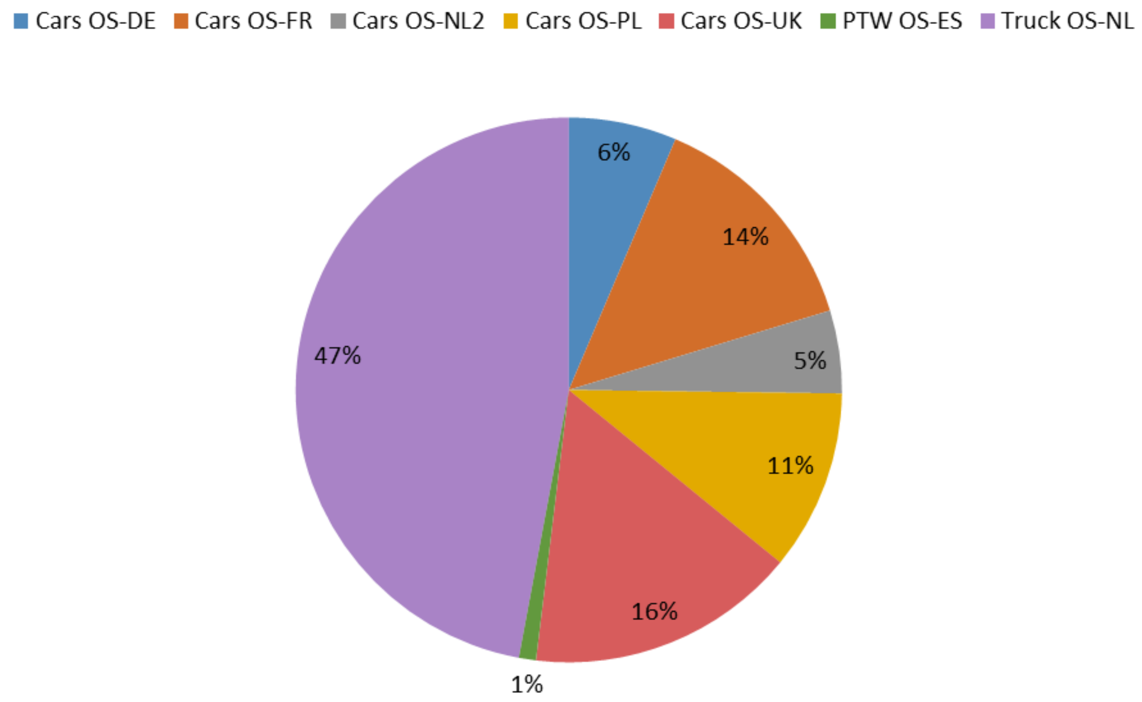


Figure 35: Proportion of data collected per OS

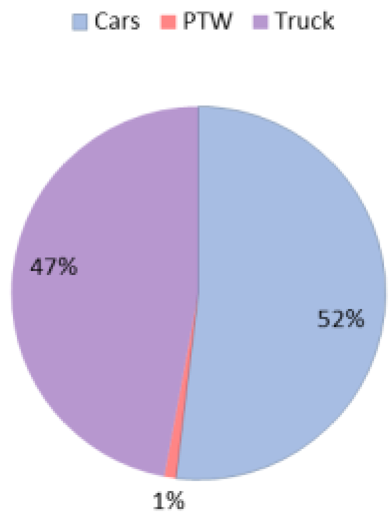


Figure 36: Proportion of data collected per vehicle type

8 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 ~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) were to (1) organise and prepare for the trial; (2) recruit participants; (3) get the ethical and legal approval to collect data; (4) pilot the data collection operations; (5) install the data acquisition systems (DAS) in the vehicles, (6) monitor the participants, their vehicles and the quality of the data collected, throughout the data collection phase before (7) decommissioning all vehicles.

The achievement of these objectives has 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;
- Legal an ethical approval:
  - Each OS was responsible for seeking ethical and legal approval from the relevant local data protection authorities for data collection and participant recruitment. For some OS locations more than others, the process was very slow and time consuming due to risks of misuse of the data collected relating to possible acts and omissions punishable by the courts or administrative authorities (even suspicion), i.e. (traffic) offences. Not only did it take time to receive a decision but the decision was restrictive in terms of partners allowed to access the data for (pre-)processing a further analysis. Much liaison was necessary with the concerned authorities to convince them of the strict measures taken by the project regarding data privacy protection and eventually public bodies were granted full access to the data, while private entities were granted access with restrictions regarding information that could be used to determine traffic offenses, i.e. for speed data, they only received access the segments that have to be analyzed (safety-critical events) and those that have to be used as reference segments (baseline segments), i.e. between 45s before and 15s after the segments.
- Piloting
  - 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;
- Instrumentation:
  - 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.

8.1 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.

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 is 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).

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.

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)
- Castermans, J., et al (2017) Summary of OS operations. Deliverable D34.1 of the EU FP7 Project UDRIVE (www.udrive.eu)
- Martin, O., et al (2017) Lessons learnt from OS operations. Deliverable D35.1 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