FREILOT

Urban Freight Energy Efficiency Pilot

D.FL.4.1 Evaluation methodology and plan

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Table of Contents

Executive Summary

This document describes the methodology to be used in the four FREILOT pilot sites (Bilbao, Helmond, Krakow and Lyon) for the evaluation of the FREILOT services. The aim is to offer to the four pilot sites a common methodology and evaluation plan to provide the same evaluation framework. At the same time another goal is to present the work done to a wider community of urban freight mobility stakeholders in order to first have a discussion and later on acceptance of the FREILOT outcomes.

The first release of this document was prepared in June 2010. The version presented the basic evaluation methodology, including a general data description, general specifications of the data logging and the data management process. Due to the early phase of development, some changes were decided upon in the following months, depending on the final functionality of the services, the final number of trucks/drivers and other environmental conditions in each pilot site. This implies that a second version of the document was prepared. The main modifications in this second release affected the hypotheses and the definition of the indicators taking into account the possibilities offered by the different dataloggers. The evaluation plan was also reviewed, including the combinations of systems in order to analyse the effects of these combinations. The current release (the third one) of the methodology and evaluation plan was prepared taking into account the comments of the project reviewers. The changes in this new version affect mainly the document structure and the evaluation plan. Now the general FREILOT methodology is described in Chapter 3 and Chapter 4 describes how this methodology was applied for the evaluation of each service, including the Research Questions, Hypotheses and the Indicators defined for each service. The last chapters are structured in the same way as the previous versions. Regarding the evaluation plan, it is structured for each pilot sites. Updates related to the adaptation of the data collection periods to the current situation in the pilot sites were also included.

The evaluation of FREILOT services is not a simple task. From the WP4, a general framework is proposed for each service, but due to the different nature of the systems (in-vehicle systems and infrastructure systems) and the diverse dataloggers used, a specific design study and procedures were needed for each service or group of services (e.g. the in-vehicle systems). Taking this consideration in mind, the evaluation methodology and evaluation plan were prepared.

During the first phase of work, an evaluation of other studies with similarities to FREILOT was made in order to have a base of knowledge as a starting point. A total of twelve studies were analysed, most of them are Field Operational Tests (FOT). From this analysis, common procedures and relevant information regarding the configuration of such studies were obtained (see Annex I).

Following the approach of a FOT, FESTA was selected as the general methodology for the preparation of the evaluation. FESTA offers a common methodology for the conduction of FOTs in Europe (FESTA Handbook: the FESTA handbook was created under the 7th Framework Programme as the action to support European FOTs). Although the FREILOT project is a pilot, and this methodology is created to be applied in FOTs, it is commonly applied to other studies as a reference to draw up an evaluation plan and to identify which measures should be taken into account. Following the FESTA guidelines, for defining the FREILOT methodology, four main steps have been followed to define the FREILOT methodology:

- Function Identification and Description.
- Use Cases definitions.
- Identification of Research Questions & Hypotheses.
- Definition of Performance Indicators & Measurements.

The two first steps were covered in the Implementation Plan (D.FL.2.1 Implementation Plan). The following steps are covered in this document.

After the analysis of the services descriptions and the use cases revision, the research questions which guide the evaluation of the FREILOT services were identified. These research questions are mainly focused on the impacts that the services could have on the fuel consumption, pollutant emissions, driving behaviour, traffic efficiency and driver acceptance of the systems. Once this work was carried out, the hypotheses were defined per service. The general hypotheses (e.g. regarding fuel consumption) are the same for all the services and some specific hypotheses are defined per service.

The indicators and measurements were defined per hypothesis. In general, it is possible to identify three main types of data:

- Objective data: data collected with a datalogger during the pilot.
- Subjective data: data collected with questionnaires (for drivers and fleet operators).
- Simulation data: data provided by simulations for Energy Efficient Intersection Control in Helmond and Krakow (used only for a limited number of hypotheses that are not possible to test in real environment) (see Chapter 4.4).

In order to collaborate with the implementation of the datalogger systems (done in WP2 Implementation) the requirements on the data available to be logged in all pilot sites during the experiment were specified. This work was done in a close collaboration with the partners responsible for the implementation. Each system has its own data logging features and characteristics so, the procedures to control the data flow will differ among them. The data management and data collection scheme are also included in this document to give a general overview of the tasks involved: the data files definitions, local storage servers which are storing the data logged in the pilot sites and the mechanisms to retrieve the data from pilot sites to local databases. It is important to arrange a common data collection scheme to facilitate the work in all the data acquisition scenarios.

In parallel with these activities, the evaluation plan was defined. Taking into account the conditions of the pilot sites (number of trucks per service, driver characteristics, technical implementations, etc…) the different experimental designs per pilot site and service were defined, fixing the combinations of systems, the months/periods of the baseline (collection of data with the system inactive) and experimental line (collection of data with the system active). The definition of these designs and the baseline period is of vital importance to compare and show the benefits of the FREILOT services.

1. Introduction

The FREILOT project targets a reduction of fuel consumption and CO_2 emissions in urban freight transport through a holistic and integrated treatment of traffic management, fleet management, the delivery vehicle and the driver. The main goal of the pilot is to demonstrate in four pilot sites (Bilbao, Helmond, Krakow and Lyon) that up to 25% reduction of fuel consumption and CO_2 emissions in urban areas is achievable using FREILOT services.

The deployment of the FREILOT results to network level must be done by defining in each region of the city which system will be the primary one saving fuel while the other systems will have a secondary role. When the truck is near the DSB places, the most savings will be due to the DSB system, while when the truck is crossing the principal arterial of the city the EEIC will have the primary role. At the same time, outside of the city center, where no EEIC systems are installed, the EDS and the ASL will collaborate in reducing the fuel consumption. The deployment of the services to network level must be done then by defining spatial regions where each system will be the primary responsible for fuel reduction, weighting in this way the fuel reduction of each system working alone and obtaining the final fuel reduction.

According to the results of the FREILOT project for the EDS, a 15% saving can be achieved in urban zones, but always depending on the initial performance of the driver and their behavior (following or not the advices). As commented in the evaluation results, the saving in the case of the in-vehicle systems are highly driver-dependent, thus a unique value is difficult to provide. Building a use case, where the initial performance of the driver is low, this 15% of fuel consumption reduction can be achieved in the whole urban area. Taking into account the local savings of the 13% in the case of the EEIC and secondary fuel savings of the other systems, the initial value of 25% could be achieved by a low performance driver using all systems in some specific locations of the city.
WP4 'Evaluation' is responsible for a common and effective evaluation among the pilot sites developing a common methodology for all pilot sites and analising the data collected during the pilot in order to obtain results from the real environment. The work done in the Evaluation is closely related with the activities of the other WPs (see next figure), providing the data requirements to the Implementation WP and interchanging information about the preparation of the different pilot sites (e.g. number of trucks installed, timing of installations, specifications of systems, etc…), receiving the data from the WP3 Operation and providing the results to the WP5 Dissemination and WP6 Deployment Enablers. In WP6 the generalization of the results provided by the evaluation will be done in order to define the business cases.

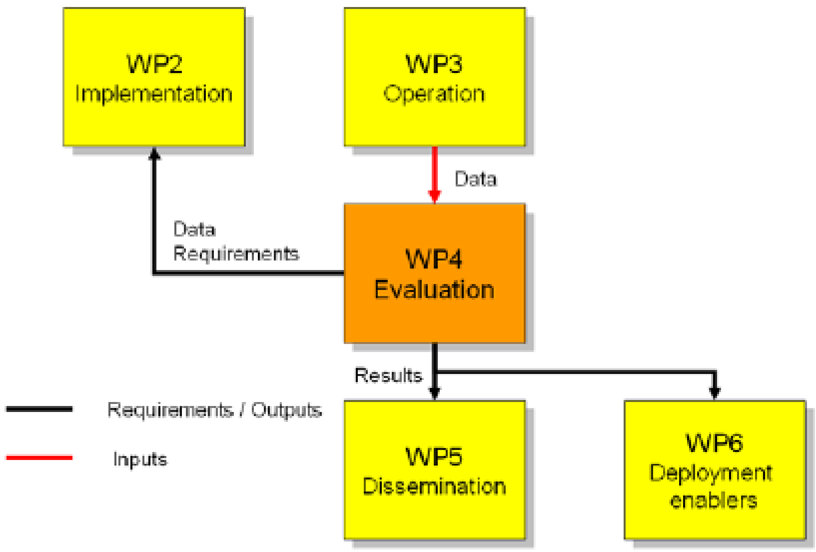

Figure 1 Relationship between Evaluation and other WPs.

This document, Evaluation Methodology and Plan, is the first deliverable provided for WP4. This deliverable describes:

- the methodology to be used in the FREILOT pilot sites for the evaluation of the FREILOT services and

- the evaluation plan to be followed in the different pilot sites.

The first version of this document was produced in an early phase of the project and some decisions still had to be taken. The second release continues the specification of the methodology taking into account the specific pilot conditions. Now, in this third release, structural changes and an update of the evaluation plan are included. Below the structure of this document is briefly presented.

The FESTA handbook has provided the best practices to follow for the evaluation of FOTs. In Chapter 2 a general description of this methodology is included in order to explain the steps to be followed in the definition of the FREILOT evaluation. Taking FESTA as a reference, the specific methodology developed for the FREILOT project was defined in Chapter 3, describing the pilot site conditions, the impacts of FREILOT services usage to be considered in the evaluation, the general hypotheses and a general overview of the indicators and measurements considered in FREILOT.

How this methology was applied per service is described in Chapter 4, in which the specific Research Questions, Hypotheses and Indicators are presented per service, including a brief description of the functionality and the use cases (A detailed description of the service functionalities can be found in D.FL.2.1 Implementation Plan).

The last chapters of the document describe the data management process (Chapter 5), the procedure for the evaluation of fuel consumption and emissions (Chapter 6) and the evaluation plan per pilot site (Chapter 7).,

Finally, in Chapter 8 the main conclusions after this work and the next steps for the evaluation of the systems are included.

In the annexes, some additional information is provided:

- Annex I: State of the art and the main characteristics of the studies reviewed are presented.
- Annex II: Questionnaires prepared for the drivers and the fleet operators are included.
- Annex III: CVIS questionnaire adapted to the FREILOT project.
- Annex IV: Table with the list of measurements proposed in the first version of this document is included. This table summarize all the data needed for the evaluation of the different hypotheses proposed.
- Annex V: Table of figures.
- Annex VI: List of tables.
- Annex VII: Abreviations and definitions.

2. FESTA methodology description

Taking into account the similarities of the FREILOT pilot with a FOT from the point of view of evaluation and the interest of the consortium to be aligned with the current initiatives and standards in Europe, the FESTA methodology was selected to be applied as a guideline for the definition of the FREILOT Methodology and Evaluation Plan. A FOT ("Field Operational Test") is defined in the FESTA Handbook (2008) as "a study undertaken to evaluate a function, or functions, under normal operating conditions in environments typically encountered by the host vehicle(s) using quasi-experimental methods". Then it is possible to compare the effects that the function has on traffic with a baseline condition when the function does not work. In case of FREILOT, it is possible to compare the effect of systems and services (Acceleration Limiter, Delivery Space Booking, Eco Driving Support,Energy Efficient Intersection Control and Adaptive Speed Limiter) in a study taking into account the specific conditions of the pilot sites where the study is carried out.

FESTA was created under the 7th Framework Programme as the action to support FOTs. Although the FREILOT project is a pilot, the FESTA methodology was taken as a reference to draw up an evaluation plan and to identify which behavioural measures should be taken into account.

The FESTA methodology has been developed because there was a need to offer guidelines and a common methodology for the conduction of FOTs in Europe (FESTA Handbook). This methodology provides aspects as for example the needs for analysis or the integration of the acquired data.

The final aim of a FOT is to evaluate different functions in order to address specific research questions related to different topics (environment, traffic efficiency or acceptance). To achieve this general objective the first step is to identify functions. After this, it is necessary to define statistically testable hypotheses and to find measurements to test these hypotheses.

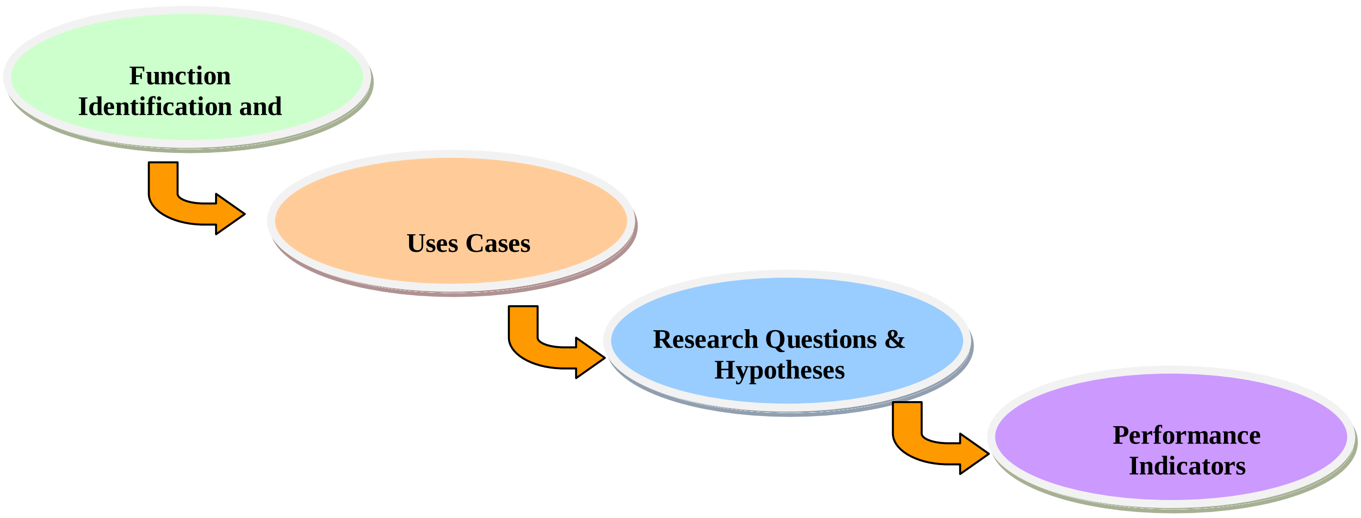

Figure 2 First steps considered to follow an FOT (based on FESTA Handbook)

The process defined in FESTA was followed during the first phase of the FREILOT project: from function identification and description to the identification of performance indicators and specification of the data to be logged. During the process, a strong interaction with the other WPs was established, especially with WP2: Implementation (see D.FL.2.1 Implementation Plan) and WP6: Deployment enablers (see D.FL.6.1 Business model) in order to align the technical implementation of the services (including data logger equipment) and the indicators used in the business models with the evaluation of the services. The technical implementation of the systems and data loggers put some restrictions on the evaluation, especially regarding the data acquisition (which data could be recorded, which format, in which way, etc…), so along the methodology definition process some modifications were made in this document.

The next sub-chapters summarize the process followed in the different steps of the FESTA methodology.

2.1. Function Identification and Description

In order to start the definition of the methodology it is necessary to have a complete description of the selected functions. This information can to be divided into two parts:

- Functional Classification: contains all relevant specifications of the system, provided by the vendor.
- Description of limitations, boundary circumstances and extra information that will be useful to understand how the function works. When boundary circumstances are mentioned, they refer to the circumstances under which the function will operate, what type of data needs to be recorded during the FOT, where the FOT will be developed etc. (Infrastructure requirements, driver requirements, road context, traffic context, environmental restrictions and other limitations.)

The detailed description of the services to be tested in FREILOT was included in the D.FL.2.1 Implementation plan. In this document a brief description of the different services is included in chapters 4.1.1, 4.2.1, 4.3.1, 4.4.1 and 4.5.1.

2.2. Use Cases

The use cases put the systems and functions at a suitable level of abstraction in order to group technology-independent functionalities and answer more holistic research questions described later.

The definition of a use case is a target condition in which a system is expected to behave according to a specified function. A specific use case is a system and driver state, where “system” includes the road and traffic environment. Use cases are very general descriptions, and provide a tool for people with different backgrounds.

Then, the situations are defined as a combination of characteristics of a use case. Situations can be derived from use cases compiling a reasonable permutation of the use case characteristics.

In this document a summary of the main use cases to be tested for the different services are included in chapters 4.1.2~~4.1.2~~, 4.2.2~~4.2.2~~, 4.3.2~~4.3.2~~, 4.4.2~~4.4.2~~ and 4.5.2~~4.5.2~~. A complete explanation of the different use cases can be found in D.FL.2.1 Implementation Plan.

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2.3. Research Question & Hypotheses

A research question (RQ) is a statement that identifies the event to be studied; therefore the RQ is the question that you are trying to answer when you do research on a topic, in this case, about a FOT. The Research Questions (RQ) should focus mainly on impacts although there are other questions than can be asked.

Once the research questions are proposed, hypotheses can be derived from them. In this process the general research questions are expressed as more specific and statistically testable hypotheses. Hypotheses are more detailed predictions about the nature and direction of the relationship between two variables, for example, between Energy Efficient Intersection Control and delivery time. These hypotheses are statements that can be proved or disproved.

Finally, the hypotheses are linked with measurements and indicators for quantitative analysis. Sometimes, the hypotheses include an indicator which needs to be measured, e.g. a concrete hypothesis like “The Energy Efficient Intersection Control will decrease the delivery time”. In this case, it is obvious that delivery time is a direct measurement. In other cases, it will be important to identify surrogate measurements or indicators.

The central part of this document are chapters 3 and 4 describing the Research Questions identified in the framework of the FREILOT project and the different hypotheses identified per service (4.1.4, 4.2.4, 4.3.4, 4.4.4 and 4.5.4).

2.4. Performance Indicators

Regarding the data logging systems, FESTA proposes guidelines and recommendations for selecting adequate data logging systems and how to handle data in a FOT study. In general it covers aspects such as data acquisition, data storage, and data analysis tools.

Performance indicators (PIs) are quantitative or qualitative measurements, agreed on beforehand, expressed as a percentage, index, rate or other value, which is monitored at regular or irregular intervals and can be compared with one or more criteria.

For PIs measured via rating scales and questionnaires, focus groups, interviews, etc., the “denominator” would be the time and circumstances of administrating the measuring instruments, for example before the test, after having experienced the system, and so on.

PIs are very diverse in nature. There are global PIs as well as detailed PIs, there are observed and self-reported PIs, there are PIs calculated from continuous and from discrete data, and so on. An example for a rather global PI based on continuous log data would be the mean speed on motorways, whereas an example of a PI based on discrete, self-reported data would be the level of perceived usability of a function.

Some PIs can be based on either self-reported, discrete measures or on log data like, for example, the rate of use of a system. The participants can be asked how often they use a function, but the actual function activation and the different settings chosen by the driver can also be logged from the system.

All PIs are based on measurements, which are combined and/or aggregated in certain ways, and which are normalised in order to allow comparisons.

For FREILOT, an extended analysis was done in order to define the indicators and the data to be logged. Chapters 4.1.4~~4.1.4~~, 4.2.5, 4.3.5, 4.4.5, 4.5.5 and 6 include the indicators per hypothesis and service and the different data acquisition scenarios identified in FREILOT, with the data format associated.

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3. FREILOT Methodology: General Approach

For the FREILOT Project four cities in different countries (Krakow – Poland; Bilbao – Spain; Helmond – Netherlands; Lyon - France) were selected. The purpose of the pilot is to carry out the evaluation of the effects of the services selected (Acceleration Limiter, Delivery Space Booking, Eco Driving Support, Energy Efficient Intersection Control, Adaptive Speed Limiter) in terms of fuel saving and energy efficiency.

These systems will be installed in trucks that make their delivery routes mainly in the urban area of the cities mentioned above.

Once the systems are installed and tested in the trucks of the fleet operators who collaborate with the FREILOT project, the systems are turned on and off according to the experimental design included in the Evaluation Plan (see Chapter 7).

Implementation of services in different cities is based on the actual need these cities have. Therefore not all services are going to be evaluated in all pilot sites. As an example, Delivery Space Booking (DSB) is not needed in Helmond as the city has no problems with this aspect of urban deliveries. Only in Lyon all the services are going to be tested.The following table shows a global image of the systems that will be implemented and evaluated in each pilot site/city. (Table 1).

		PILOT SITES			
		BILBAO	LYON	KRAKOW	HELMOND
SYSTEMS	AL	X	X		X
	DSB	X	X		
	EDS	X	X	X	X
	EEIC		X	X	X
	ASL	X	X		X

Table 1 Systems to evaluate per pilot sites

1. The **Acceleration Limiter (AL)** system will be evaluated in Bilbao, Lyon and Helmond. The system functionality will be the same in all pilot sites.

2. The **Delivery Space Booking (DSB)** service will be assessed simultaneously in Bilbao and Lyon. The technical implementation of the service is not the same for Bilbao and Lyon and the functionalities are not exactly the same (see chapter 4.2 and sections 1.6.1 and 1.6.2 in D.FL. 2.1 Implementation Plan). This will allow for comparision of the systems from both cost as well as benefit point of views.

3. The **Eco Driving Support (EDS)** system will be evaluated in all pilot sites: Bilbao, Lyon, Krakow and Helmond. The system functionality will be the same in all pilot sites.

4. The **Energy Efficient Intersection Control (EEIC)** service will be assessed simultaneously in Lyon, Krakow and Helmond, but in different conditions (depending on the use case). In Krakow, Isolated Control will be implemented for a specific fleet and Isolated Control will be simulated for all HGV (Heavy Goods Vehicles).

   In Lyon, a Green Wave for a specific fleet will be implemented and evaluated and a Green Wave for all HGV.

   And last, in Helmond Adaptive Control for a specific fleet will be implemented. The Adaptive Control for all HGV will be evaluated through simulations.

5. The **Adaptive Speed Limiter (ASL)** system will be assessed in Bilbao, Lyon and Helmond. The system functionality will be the same in all pilot sites.

The current number of trucks with the FREILOT trucks per system and test site is summarized in the next table:

Site	EEIC	ASL	AL	EDS	DSB	Total vehicles per site*
Bilbao	-	3	3	1	124****	127
Helmond	11	2	2	4	-	14
Krakow	10 **	-	-	5	-	15
Lyon	3 ***	4	9	9	7	25
Total vehicles per system	24	9	14	19	131	152

Table 2 Number of trucks per system and pilot site

*** Several vehicles are testing a combination of systems, see annex in Implementation plan.***

***** Currently 2 trucks participating in the pilot of EEIC, three trucks to be added as well as five buses.***

****** Number does not include green wave solution. several of the equipped trucks will pass the avenue Jean Jaures and record data. Today it is not confirmed how many but it is expected to be around five.***

******* The trucks were added in three phases: at the beginning of the project 35 trucks were confirmed and, 60 trucks more were included after January 2011 in the project and in a third phase 29 vehicles more were included in April 2011.***

As one of the main objectives of the FREILOT pilot is to include additional fleet operators and/or trucks (Objective 3) the number of vehicles used in the pilot could be expected to increase. This is also important for achieving sustainable after-project life (Objective 2), where some of the services, e.g. Delivery Space Booking are dependent on a broad user base (large number of fleet operators and/or trucks). This however can be somewhat contradictory to achieving quantifiable results (Objective 1). Taking all of these aspect in consideration (increasing the number of fleets/trucks, after-project life and evaluation) it is clear that compromises need to be made between the different objectives and partners. Therefore, a close cooperation between partners responsible for different parts is in place, one example is the compromise made for including 30 new fleet operators (65 more trucks) in the Bilbao Delivery Space Booking scheme in the second phase and 29 additional vehicles in a third phase.

In addition, the total number of truck drivers has not been finalised yet, as many fleet operators taking part in the pilot do not use fixed associations between drivers and trucks.

According to the approach of the Evaluation Plan, the systems will be evaluated individually to answer the hypotheses (see Chapter 7) and analyse the effect of each individual system. Some combination of systems in the same truck are planned to see the effect of the combinations. Taking into account the technical restrictions for the installations of services and the number of trucks, the combinations of services installed in each truck are summarized in the next table:

HELMOND	
FREILOT Services Combination	Truck ID
AL	H14
EDS	H18,H19
EEIC	H01, H03, H06, H10 Fire brigade & Ambulances: H30, H31, H32, H33
EEIC +ASL	H15
EEIC + EDS	H17
AL + ASL + EEIC + EDS	H16
LYON	
FREILOT Services Combination	Truck ID

AL	L22, L23, L24, L25, L27, L31
ASL	L30
AL+ASL	L31
ASL+EEIC	L28
AL+ EEIC	L29
AL+ASL+EEIC	L29
DSB	L38, L39, L40, L41, L42, L43, L44
EDS	L16, L18, L19, L32, L33, L34, L35, L36
EEIC	L45
BILBAO	
FREILOT Services Combination	Truck ID
DSB	**95 trucks**
ASL	B06
EDS	B04
AL+ASL+EDS	B05, B04
KRAKOW	
FREILOT Services Combination	Truck ID
EDS EEIC	K01, K02, K03, K04, K05 K06, K07

Table 3 System combinations per trucks and pilot sites

Different combinations of services have been proposed for analyzing the added-value of each system when the truck is already equipped with other systems. If the consumption reduction of the SL and AL are 10% and 15% respectively, the reduction of the combination of systems (SL+AL) will not be 25%. In this direction, 10 trucks have been equipped with different systems and 3 periods have been defined. In each period a new system will be added to the truck in order to calculate the extra reduction of this new system when other systems were already installed. Due to the low number of trucks and systems, many combinations (and single systems) will be tested only by one truck in each city, and for a period of 3 months. For a detailed explanation of the combinations see Chapter 7 Evaluation Plan.

In addition to the evaluation of the individual systems, a general comparison will be made among the data collected in trucks from different pilot sites. In this way it is possible to check whether the effects are similar for the different pilot sites, taking into account the general differences among the cities in terms of:

- Implementation: the implementation of the DSB is not the same in Bilbao and Lyon and the EEIC systems in Lyon and Helmond/Krakov are different. Different use cases are tested for EEIC in the different cities.
- Legislation: there are different legislation in the pilot sites that affects the service implementation (e.g. Delivery Space Booking in Lyon and Bilbao) and as consequence, in some cases the use of the service.
- Environment conditions: mainly different weather conditions and traffic conditions.

A more extensive description of each pilot site's technical set up is included in the D.FL.2.1 Implementation plan and the respective prototype descriptions (D.FL.2.4 Helmond Prototype for example).

3.1. Impacts of FREILOT services usage

Three different evaluation goals are used on the impact of the FREILOT service usage: impact on the environment and fuel consumption, impact on driving behaviour and impact on traffic efficiency. The research questions are summarized as follows:

3.1.1. Impacts on the environment and fuel consumption

FREILOT services are expected to increase energy efficiency in road goods transport in urban areas with a reduction of 25% of fuel consumption, CO_2 emissions.

RQ1: Achieve an in-depth understanding of the effect the FREILOT services have on energy efficiency (fuel consumption and fuel economy).

RQ2: Establish if the FREILOT services have a positive influence on the CO_2 emissions.

RQ3: Establish if the FREILOT services have a positive influence on other pollutants.

3.1.2. Impacts on driving behaviour

These research questions focus on extrapolating the results observed in the study to predict how FREILOT services influence driver behaviour.

RQ4: Determine if the driver changes his driving after the FREILOT services/systems usage.

RQ5: Determinate if the driver changes his behaviour after stopping to use FREILOT services.

RQ6: Determine how the FREILOT services promote a more eco-friendly driving style through the driver's acceleration, braking and gear changing behaviour.

3.1.3. Impacts on traffic efficiency

It is particularly interesting to collect information on the traffic efficiency impact when FREILOT services are used. Three general questions are included:

RQ7: Determinate if the use of the FREILOT services will optimise the driver delivery time and promote travel time benefits for specific fleets (traffic efficiency).

RQ8: Determine how the FREILOT services influence the traffic flow.

RQ9: Determine the impact of FREILOT services on noise levels.

3.1.4. Driver acceptance/perceptions of FREILOT services

Driver's acceptance of the FREILOT services and human factors are very important in the overall benefits of the FREILOT project.

RQ10: Assess driver acceptance and perception of the FREILOT services.

RQ11: Determine the acceptance of customers and drivers of a modified journey duration/fuel consumption trade-off.

3.1.5. Implications of measured impacts

This section defines the research questions about the implications on policy and the identification of missing legislation or if it is necessary to establish changes in the actual legislation.

- Laws, directives & enforcements
- Public authority implications

These implications are going to be evaluated in WP6 (not WP4). This research question was included in this document in collaboration with WP6 partners, as D4.1 summarizes the main evaluation objectives for FREILOT.

RQ12: What is the impact on legislation of the FREILOT services and are they accepted by Public authorities because these services have direct effects on performance, pollutants and noise.

3.1.6. Impacts on Safety

Main objectives from FREILOT has not included from the beginning the impacts on safety, but, during the project development it was clear that some of the services (not all) could have beneficial impacts on this field. So, in the last revision of the methodology performed during the project, it was decided to consider the analyses of possible impacts on safety of the services SL, ASL and EEIC. This decision was taken when all the services was already collecting data (after July 2012) when all baseline periods were already finished. This fact implied that it was difficult to add new useful measuremnts and indicators in terms of safety analyses and without influencing the study (as baselines were already finished, it was possible to have measurements with the services but not the same ones without them in order to compare and obtain quantitative benerfits in terms of safety). In parallel, in agreement with WP6 and trying to provide them some additional information, in the subjective questionnaires, some questions about the perception of the drivers on safety were already included previously and this information will help to do these analyses.

In general, with the measurements already defined, it seems possible to perform a general analyse of these effects for some of the services, though a specific reseach question was included:

RQ13: what are the impacts of FREILOT services on safety.

3.2. Impacts of FREILOT by service

The FREILOT services under test are expected to reduce the fuel consumptions and CO_2 emissions. Furthermore the use of these services is expected to change perceptions and lead to the acceptance of the FREILOT services as well as to improve the traffic flow compared to the current situation. In this case, it is possible to group different research questions by service:

Function/Impact	Energy Efficient Intersection Control	Acceleration Limiter & Adaptive Speed Limiter	Eco Driving Support	Delivery Space Booking
Effect on energy efficiency	RQ1_1	RQ1_2	RQ1_3	RQ1_4

Reduction of CO_2	RQ2_1	RQ2_2	RQ2_3	RQ2_4
Reduction of other pollutants	RQ3_1	RQ3_2	RQ3_3	RQ3_4
Changes in the driving behaviour after FREILOT services/systems usage	RQ4_1	RQ4_2	RQ4_3	RQ4_4
Changes in the driving behaviour after stopping to use FREILOT services/systems	RQ5_1	RQ5_2	--	--
Promotion of more eco-friendly driving	RQ6_1	RQ6_2	RQ6_3	--
Improvement of traffic efficiency (Improvement of travel time)	RQ7_1	--	--	RQ7_4
Positive impact on traffic flow	RQ8_1	--	--	RQ8_4
Positive impact on noise level	--	--	--	--
Positive acceptance and perceptions on FREILOT services/systems by drivers	RQ10_1	RQ10_2	RQ10_3	RQ10_4
Positive impact on legislation and acceptation by Public authority	RQ12_1	RQ12_2	RQ12_3	RQ12_4
Positive acceptance by customer and drivers of a modified journey duration / fuel consumption trade-off	RQ11_1	RQ11_2	RQ11_3	RQ11_4
Positive impact on safety	RQ13_1	RQ13_2	--	--

Table 4 Research Questions by service

**** RQx_y: x is the number associated to the general research question (see sub-chapter 3.1) and y is the number associated to the service: EEIC →1; AL & ASL → 2; EDS →3; DSB →4***

At this point it is relevant to indicate that not all the possible impacts per service are considered in this table. The table only includes these impacts that will be evaluated within the FREILOT project.

Regarding the RQ addressing the impacts on noise, a specific research question by service was not fixed. When the impacts to be analyzed were fixed, it was not clear how the noise could be measured for the services guarantying the quality of the measurements. During the pilot the possibility of doing tests in laboratory is going to be analysed.

3.3. FREILOT Hypotheses

Taking into account the research questions presented above several hypotheses are established for each FREILOT service. These hypotheses try to find the answer for the research questions that have been stated in sub-chapter 3.1.2 and 3.1.3.

- RQ1, RQ2 & RQ3: Research questions about the impact on environment and fuel consumption benefits
- RQ4, RQ5 & RQ6: Research questions about impact on driving behaviour
- RQ7, RQ8 & RQ9: Research questions about impact on traffic efficiency, traffic flow and noise levels.
- RQ10 & RQ11: Research questions about driver acceptance or perception of FREILOT services
- RQ12: Implications of measured impacts.
- RQ13: Reseearch questions about impacts on safety.

For each service a table summarizing the research question, the area and the measurement method is given below. The area is identified with the next abbreviations: E&FC for Environment & Fuel Consumption, DB for Driving Behaviour, TE for Traffic Efficiency and DA for Driver Acceptance. Moreover every hypothesis is identified by two letters and a number.

For the different services, three main hypotheses were defined regarding reduction of fuel consumption, reduction of CO_2 and reduction of other pollutants. Though fuel consumption and CO_2 emissions is in direct relation (e.g. a reduction of fuel consumption implies a reduction on CO_2 emissions), two different hypothesis were created because formally each hypothesis should reference to only one element.

3.4. Indicators & Measurements

Indicators are quantitative or qualitative measurements, agreed on beforehand, expressed as a percentage, index, rate or other value, which is monitored at regular or irregular intervals and can be compared with one or more criteria (FESTA Handbook). The indicators will allow to verify the hypotheses.

In the chapter 4, the hypotheses for each system are identified and for each hypothesis the method for testing it is indicated (direct/questionnaire/simulation). Some indicators/measurements are defined for each FREILOT service and for each hypothesis. These indicators will be used for testing (true/false) each hypothesis for each service. In this section, the indicators and measurements for testing each hypothesis of each system will be presented.

In addition in Annex IV the first tables prepared during the process of the methodology definition including the first approach of the measurements needed for the hypothesis evaluation are included. These first tables were reviewed with the feedback from the data loggers technical implementation and taking into account which data will be recorded and in which format. The results of this revision are the final tables with indicators and measurements included in this chapter.

For each service, the information needed for evaluating them is presented classified in three groups:

- General information.
- Performance indicators.
- Subjective measurements.

The subjective measurements will be collected using different questionnaires. For the preparation of these questionnaires, for each hypothesis and service, a list of possible items was identified and for the final questionnaire a selection of them was transformed into questions. In this chapter, the items proposed for the creation of questionnaires are included and in the annex I, the complete questionnaires are included. For Delivery Space Booking, a specific questionnaire developed in the European Project CVIS is going to be used in order to obtain additional information and, at the end, to have the possibility to compare the results of FREILOT and CVIS (for DSB) (see in Annex III the adaptation of the CVIS questionnaire to be used in FREILOT).

Finally, in the chapter 6.Fuel Consumption and EmissionsFuel Consumption and Emissions a description can be found on how the emissions and fuel consumption will be calculated.

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3.5. Methods

As FREILOT is a pilot, the main method used for testing is real environment tests where data will be collected from the infrastructure, the truck and the driver (their subjective impressions). In addition, for the evaluation of EEIC a traffic simulation will be performed as it is the service with more impact in the network. The results of the simulations will be used in order to complement the results obtained in the real environment covering more complex scenarios (different degrees of penetration in the intersections and trucks) in which, the global impact on the network (not only the impact on the trucks using the system) can be analyses.

The integration of these results in the evaluation will be done in terms of hypotheses. That means, in addition to the hypotheses to be tested with real environment data and subjective data, for the EEIC a set of hypothesis were defined trying to cover the main results of the simulation.

4. FREILOT Services Evaluation

This chapter describes the services that will be evaluated in the four pilot sites, a brief description of their functionality and the uses cases for each of them. More detailed information can be found in the D.FL.2.1 Implementation Plan.

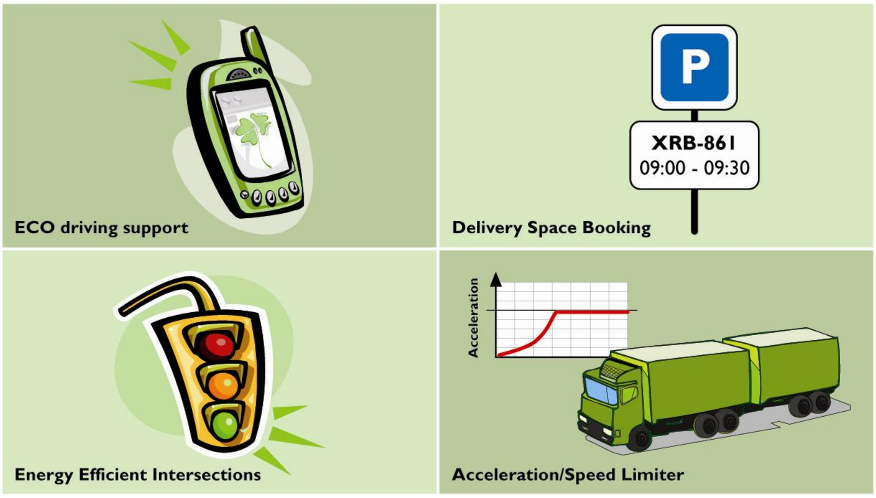

Figure 3 FREILOT services

4.1. Acceleration Limiter

4.1.1. Functionality

The Acceleration Limiter service limits the engine acceleration to a certain level in order to optimize the fuel consumption in relation to a mobility trade-off. The function is made to optimize a route profile to be travelled by a specific truck type.

An acceleration limitation map and related parameters are adjusted using an off-board tool which automatically calculates the optimized set-up of parameters; the acceleration map is then downloaded to the vehicle engine management system and thus the service is activated.

4.1.2. Use Cases

The following use cases are identified:

- Define Mission
- Calculate optimal acceleration map
- Update vehicle acceleration map
- Limit acceleration

These use cases are described in more detail in the D.FL.2.1 Implementation Plan.

Research Questions

RQ1_2: Achieve an in-depth understanding of the benefits of the Acceleration Limiter, if it has an effect on energy efficiency (fuel consumption and fuel economy).

RQ2_2: Establish if the Acceleration Limiter has a positive influence on the CO_2 emissions.

RQ3_2: Establish if the Acceleration Limiter has a positive influence on other pollutants.

RQ4_2: Determine if the driver changes his driving after the Acceleration Limiter usage.

RQ5_2: Determine if the driver changes his behaviour after stopping to use the Acceleration Limiter.

RQ6_2: Determine how the Acceleration Limiter promote a more eco-friendly driving style through the driver acceleration, braking and gear changing behaviour.

RQ8_2: Determine how the Acceleration Limiter services have influence on the traffic flow.

RQ10_2: Assess driver acceptance and perception of the Acceleration Limiter service.

RQ11_2: Determine the acceptance by customer and drivers of a modified journey duration/fuel consumption trade-off.

RQ12_2: What is the impact on legislation of the FREILOT services and are they accepted by Public authorities because these services have direct effects on performance, pollutants and noise.

RQ13_2: What is the impact on safety

4.1.3. Hypotheses

Seventeen hypotheses are proposed for the Acceleration Limiter System. Most of them are related to the acceptance and perception of the drivers about the system (e.g. risk perceptions). Although the primary questionnaire seeks to evaluate the perceptions and opinions of drivers, also a questionnaire for fleet owners will be designed. Some measurements could determine if the Acceleration Limiter service will reduce the fuel consumption or capacity of acceleration on flat road. It could be possible to evaluate if the driver accelerates less when using the system.

Acceleration Limiter				
Hypothesis	RQ	Area	ID	Measure
Using the Acceleration Limiter service, fuel consumption will decrease	RQ1_2	E&F C	AL1	Direct
Using the Acceleration Limiter service, load capacity will not change	RQ8_2	TE	AL2	Direct
Using the Acceleration Limiter service, the driver will notice decreased capacity of acceleration on a flat road	RQ6_2, RQ4_2	DB	AL3	Questionnaire
Using the Acceleration Limiter service, the exterior noise level will decrease	RQ2	E&F C	AL4	Tests in Laboratory (To Be Confirmed)
Acceleration Limiter usage will decrease CO_2 emissions	RQ2_2	E&F C	AL5	Direct
Acceleration Limiter usage will decrease emissions of	RQ3_2	E&F	AL6	Direct

other pollutants		C		
The driver will accelerate less with the use of the Acceleration Limiter	RQ4_2, RQ13_2	DB	AL7	Direct
The Acceleration Limiter service is appreciated by drivers	RQ10_2	DA	AL9	Questionnaire
Drivers will perceive that the Acceleration Limiter service is reliable	RQ10_2	DA	AL10	Questionnaire
Drivers will find the Acceleration Limiter is useful when driving	RQ10_2	DA	AL11	Questionnaire
Drivers will find the Acceleration Limiter is easy to use	RQ10_2	DA	AL12	Questionnaire
Drivers' perceived stress will decrease with the acceleration limiter usage	RQ10_2, RQ13_2	DA	AL13	Questionnaire
Perceived risk of accidents will decrease with the acceleration limiter usage	RQ10_2, RQ13_2	DA	AL14	Questionnaire
According to the drivers' perception the acceleration limiter system will improve the freight transport image in urban areas	RQ10_2	DA	AL15	Questionnaire
Drivers will trust the acceleration limiter system	RQ10_2	DA	AL16	Questionnaire
The drivers will accept an increase in journey duration as a trade-off to decreased fuel consumption	RQ11_2	DA	AL17	Questionnaire

Table 5 Hypotheses Acceleration Limiter

The measure of noise is not possible in a real environment. As a possible solution for the noise, a test in a laboratory could be done. This possibility is to be confirmed.

4.1.4. Indicators & Measurements.

Following the indicators and measurements collected during the pilot for the Acceleration Limiter are presented. As it was explained in chapter 3.43.4, three different types of information are going to be collected:

- General information
- Objective data
- Subjective data

The general information collected are the characteristics of the truck, the driver characterization and the type of journey the truck does every day. This information collection has as a main objective to have a good knowledge of the conditions of the system use regarding who is using the system, in which type of vehicle it is installed and the activity this vehicle do.

The objective data is going to be used for the generation of the indicators used for the evaluation and also to obtain information about the conditions of the system use.

The subjective data, collected using questionnaires, provides directly the indicators for the evaluation of some of the hypothesis.

4.1.4.1. General information.

- Number of trucks with Acceleration Limiter.
- Characteristics of each truck
    - Manufacturer.
    - Model.

  - Year of manufacturing.
  - Maximum load of the vehicle.
- Data from driver:
  - Nationality.
  - Age.
  - Male/female.
  - Driver experience (- at start of pilot: Less than one year, 1-2- years, 3-5 years, 5-10 years, 10-15 years, etc.)
- Characteristics of journey.
  - Origin.
  - Destination.
  - Total distance.
  - Total distance in urban areas.

4.1.4.2. Performance Indicators.

The following table presents the list of performance indicators for the **Acceleration Limiter** system related to each hypothesis, the research questions where the hypotheses are coming from are also included. These indicators will be calculated taking into account the data collected in each pilot site. The list of data measured (Input data) is presented in chapter 5.2.15.2.1.

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Service	Research Question	Hypothesis	Exogenous factors	Indicators	Input data	Time units of measure	Comments
AL	RQ1_2	AL1 Using Acceleration Limiter service fuel consumption will decrease	peak time/off peak time day of the week	fuel consumption / km	veh id / driver id / route id time x 3 states and date zone id Distance x 3 states MovingFuel and totalFuel Fuel x 3 states	Zone entry / zone exit	
AL	RQ8_2	AL2 Using Acceleration Limiter service load capacity will not change	peak time/off peak time day of the week	Variation of max weight	veh id / driver id / route id time and date Weight	Zone entry / zone exit	
AL	RQ6_2	AL3 Using Acceleration Limiter service driver will notice decreased capacity of acceleration on flat road					Capacity of acceleration not measurable in daily pilots, only measurable by VOLVO, but if we are limiting acceleration it is obvious that capacity of acceleration will decrease. The interesting question

							is to know how the driver feel about this (unsafe, stress,...)
AL	RQ2_2	AL5 Acceleration Limiter usage will decrease the CO_2 emissions and other pollutants	peak time/off peak time day of the week	CO_2 emissions (directly proportional to fuel consumption) per km	veh id / driver id / route id time x 3 states and date zone id Distance x 3 states MovingFuel and totalFuel Fuel x 3 states	Zone entry / zone exit	
AL	RQ3_2	AL6 Acceleration Limiter usage will decrease emissions of other pollutants					For other pollutants instantaneous information is needed (velocity, acceleration)*
AL	RQ4_2	AL7 The driver will accelerate less with the usage of the acceleration system					We don't have information about acceleration, neither instant speed for calculating it ourselves*

Table 6 Measurement summary of Acceleration Limiter

*Due to the used on-board datalogger it is not possible to collect all the data needed to evaluate some of the hypotheses. After this revision, a modification of the questionnaires was done in order to get information for a subjective evaluation of these topics (see Annex II).

4.1.4.3. Subjective measurements

The subjective data for evaluating the Acceleration Limiter service will be collected through questionnaires prepared for the drivers of the truck. The hypotheses that will be tested with questionnaires are included in Table 5.

This was a first proposal where a pool of items try to answer the different hypotheses. Therefore, some items ask the same in different ways but at the end, only some of them were chosen to compose the final version of the questionnaire.

The items needed to analyse the different hypotheses are provided in the following table (in the Annex II the questionnaires are included):

AL8	**Using the Acceleration Limiter service, the driver will note decreased capacity of acceleration on flat road**	**RQ4_2**	**Questionnaire**
• "Using the Acceleration Limiter service, I decrease capacity of acceleration on flat road"			

AL9	**The Acceleration Limiter service is appreciated by drivers**	**RQ10_2**	**Questionnaire**
• "I really appreciate the Acceleration Limiter service" • "After using Acceleration Limiter I like the service" • "I think that using the Acceleration Limiter increases my productivity" • "I think that using the Acceleration Limiter service decreases the travel times" • "I think that using the Acceleration Limiter service increases the efficacy of my work"			
AL10	**Drivers will perceive that the Acceleration Limiter service is reliable**	**RQ10_2**	**Questionnaire**
• "I perceive Acceleration Limiter is a reliable service" • "I think the Acceleration Limiter is effective to not exceed the speed limitations" • "I believe the Acceleration Limiter service works properly"			
AL11	**Drivers will find the Acceleration Limiter is useful when driving**	**RQ10_2**	**Questionnaire**
• "I find that the Acceleration Limiter service is useful when driving" • "I consider Acceleration Limiter makes easier my urban driving easier" • "I believe I have the indispensable knowledge to utilize the Acceleration Limiter service"			
AL12	**Drivers will think the Acceleration Limiter is easy to use**	**RQ10_2**	**Questionnaire**
• "I find the Acceleration Limiter service is easy to use" • "I think it easy to understand how the Acceleration Limiter service works" • "I have difficulties to understand the Acceleration Limiter service" • "It is easy to indentify the functionality of the Acceleration Limiter service"			
AL13	**Drivers' stress perception will decrease with the acceleration limiter usage**	**RQ10_2**	**Questionnaire**
• "The more I use the Acceleration Limiter service, the easier I find the urban driving " • "I perceive that I am less stressed when I use the Acceleration Limiter" • "The more I use the Acceleration Limiter service, the more stressed I feel" • "I feel calmer with the use of Acceleration Limiter service" • "The more I use the Acceleration Limiter service, the more apprehensive I become about it"			
AL14	**Perceived risk of accidents will decrease with the acceleration limiter usage**	**RQ10_2**	**Questionnaire**
• "Using the Acceleration Limiter service, I consider my driving is becoming safer" • "My perceived risk of accidents is lower since I use the Acceleration Limiter service"			

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- "I think I have had less number of accidents with the use of Acceleration Limiter service"
- "I think the number of accidents is independent of the use of the Acceleration Limiter service"
- "I am confident in my ability to drive the truck safely with the Acceleration Limiter service"

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<tr><td>AL15</td><td>According to the driver perception the acceleration limiter system will improve freight transport image in urban areas</td><td>RQ10_2</td><td>Questionnaire</td></tr>
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- "According my perception, the Acceleration Limiter service improves the freight transport image in urban areas"
- "I believe the urban congestion has increased with the usage of the Acceleration Limiter service"

</td></tr>
<tr><td>AL16</td><td>Drivers will trust the acceleration limiter system</td><td>RQ10_2</td><td>Questionnaire</td></tr>
<tr><td colspan="4">

- "I trust the Acceleration Limiter service"
- "I am confident using Acceleration Limiter service"

</td></tr>
<tr><td>AL17</td><td>The drivers will accept increase in journey duration as a trade off to decreased fuel consumption</td><td>RQ11_2</td><td>Questionnaire</td></tr>
<tr><td colspan="4">

- "I accept increase in journey duration as a trade off to decreased fuel consumption"

</td></tr>
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Table 7 Initial proposed items for developing questionnaires (AL)

4.2. Delivery Space Booking

4.2.1. Functionality

The Delivery Space Booking feature allows an operator or / and his drivers to book a delivery space in advance, in order to make sure that the driver can benefit from a free public space once he arrives to an unloading or loading point.

Two different approaches will be tested in the project: in Lyon, the driver will be able to manage the system (booking, cancellations, rescheduling) using onboard equipment, in Bilbao, no action will be possible from within the truck. Nevertheless, a specific device placed next to each space will allow drivers to reserve a suitable parking, if they have not booked yet.

4.2.2. Use Cases

The main use cases for the delivery space booking are:

- Request a reservation
- Confirm a reservation
- Cancel a reservation
- Check an existing reservation
- Send alerts to enforcement personnel
- Get reservation status
- Send arrival / departure notification

Additionally, in Lyon, these use case will be tested:

- All previous use cases, from within the truck
- Update Estimated Time of Arrival

These use cases are described in more detail in the D.FL.2.1 Implementation Plan.

4.2.3. Research Questions

RQ1_4: Achieve an in-depth understanding of the benefits the Delivery Space Booking has, if it has an effect on energy efficiency (fuel consumption and fuel economy).

RQ2_4: Establish if the Delivery Space Booking has a positive influence on the CO_2 emissions.

RQ3_4: Establish if the FREILOT services have a positive influence on other pollutants.

RQ4_4: Determine if the driver changes his driving after the Delivery Space Booking usage.

RQ7_4: Determine if the use of the Delivery Space Booking will optimise the delivery time and promote travel time benefits for specific fleets (traffic efficiency).

RQ8_4: Determine how the Delivery Space Booking influences on the traffic flow.

RQ9_4: Determine the impact of Delivery Space Booking on noise levels.

RQ10_4: Assess driver acceptance and perception of the Delivery Space Booking service.

RQ11_4: Positive acceptance by costumer and drivers of a modified journey duration/fuel consumption trade off.

RQ12_4: What is the impact on legislation of the Delivery Space Booking service and is it accepted by Public authorities because these services have direct effects on performance, pollutants and noise.

4.2.4. Hypotheses

The hypotheses for the Delivery Space Booking service are summarised below. Most of them are related to the acceptance and perception of the drivers. Moreover some measurements could determine if the delivery space booking reduces the length and time of delivery journeys or if the service decreases the fuel consumption or the CO_2 emissions. Assessing the effect on double lane parking is another objective to measure with the hypotheses for this service.

Delivery Space Booking				
Hypothesis	RQ	Area	ID	Measure
Delivery space booking reduces the lengths of delivery journeys	RQ8_4,	E&FC, TE	DSB1	Direct

Delivery space booking reduces the time of delivery journeys	RQ7_4, RQ8_4	E&FC, TE	DSB2	Direct
Delivery Space Booking service decreases the fuel consumption	RQ1_4	E&FC	DSB3	Direct
Delivery Space Booking decreases the CO_2 emissions	RQ2_4	E&FC	DSB4	Direct
Delivery Space Booking decreases the emission of other pollutants	RQ2_4	E&FC	DSB5	Direct
Drivers decrease double lane parking with the Delivery Space Booking	RQ3_4, RQ8_4	DB,TE	DSB6	Direct
Delivery space booking avoids the need for searching for free space	RQ10_4	DA	DSB7	Questionnaire
Drivers will perceive delivery conditions to be safer while performing delivery operations in a dedicated delivery space	RQ10_4	DA	DSB8	Questionnaire
Drivers will perceive that delivery space booking facilitate their delivery operations	RQ10_4	DA	DSB9	Questionnaire
The Delivery space booking service is appreciated by drivers	RQ10_4	DA	DSB10	Questionnaire
Drivers will perceive that the delivery space booking service is reliable	RQ10_4	DA	DSB11	Questionnaire
The Delivery space booking service will not disturb the driver in his driving task	RQ10_4	DA	DSB12	Questionnaire
Drivers will find the delivery space booking system easy to use	RQ10_4	DA	DSB13	Questionnaire
Drivers' stress perception will decrease with the delivery space booking usage	RQ10_4	DA	DSB14	Questionnaire
Perceived risk of accidents will decrease with the delivery space booking usage	RQ10_4	DA	DSB15	Questionnaire
According to the drivers' perception the delivery space booking system will improve the freight transport image in urban areas	RQ10_4	DA	DSB16	Questionnaire
Drivers will trust the delivery space booking service	RQ10_4	DA	DSB17	Questionnaire
Drivers consider that there is more space available with the delivery space booking usage	RQ10_4	DA	DSB18	Questionnaire
The rest of the drivers will appreciate the delivery space booking system because they will find it easier to drive in the city without double lane parking and trucks parked on the pavement	RQ10_4	TE, DA	DSB19	Questionnaire
The traffic flow benefits from the delivery space booking (the rest of the drivers are not waiting for double parked vehicles, less congestion)	RQ8_4	E&FC, TE	DSB20	Questionnaire
Drivers receive less tickets (fines) because double lane parking is avoided	RQ8_4	DB	DSB21	Questionnaire

Table 8 Hypotheses Delivery Space Booking

4.2.5. Indicators & Measurements.

This chapter summarizes the data collected for the Delivery Space Booking service. The type and purpose of the data collected is the same for all the services (see chapter 4.1.4~~4.1.4~~).

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4.2.5.1. General information.

The general information identified for evaluating Delivery Space Booking regarding the characteristics of each truck, the data from the driver and the characteristics of the journey is the same as the identified for the Acceleration Limiter (see the list in chapter 4.1.4.1). In addition, the following general information will be collected for DSB:

- Use of DSB:
    - Number of trucks using the DSB.
    - Number of reservations per day.
    - Number of stops per day.
    - Duration of each stop.
    - Number of times a space was occupied by an unauthorized vehicle.

4.2.5.2. Performance Indicators.

The following table presents the list of performance indicators for the **Delivery Space Booking** system related to each hypothesis, the research questions where the hypotheses are coming from is also included. These indicators will be calculated taking into account the data measured in each pilot site, the list of data measured (Input data) is presented in chapter 5.2.2.

Service	Research Question	Hypothesis	Exogenous factors	Indicators	Input data	Time units of measure	Comments
DSB	RQ8_4	DSB1 Delivery space booking reduces the lengths of delivery journeys	- type of journey (number of delivery stops...) -meteorology (rain, snow...) - time slot - day of the week - holidays	journey lengths average	- GPS data - reservation data - Road network - rain and temperature per day (Meteociel.com) - date of holidays or other events	One GPS point each 2 seconds	The length of a journey depends on too many exogenous factors. It is very difficult to appreciate the real impact of DSB on lengths of delivery journeys. Moreover, the journeys are not regular.
DSB	RQ7_4, RQ8_4	DSB2 Delivery space booking reduces the time of delivery journeys	- type of journey (number of delivery stops...) -meteorology (rain, snow...) - time slot - day of the week - holidays	journey time average	- GPS data - reservation data - Road network - rain and temperature per day (Meteociel.com) - date of holidays or other events	One GPS point each 2 seconds	Same comments as for lengths of delivery journeys
DSB	RQ1_4	DSB3 Delivery Space Booking service decreases the	- time slot - day of the week - holidays	fuel weight: (g/zone)	- GPS data - reservation data - Road network	One GPS point each 2 seconds	If DSB has an impact on fuel consumption near a DSB stop, the fuel

		fuel consumption			- date of holidays or other events		consumption of a journey decreases according to the number of DSB in the city.
DSB	RQ2_4	DSB4 Delivery Space Booking decreases the CO2 emissions	- time slot - day of the week - holidays	CO_2 weight: (g/zone)	- GPS data - reservation data - Road network - date of holidays or other events	One GPS point each 2 seconds	Same comments as fuel consumption
DSB	RQ2_4	DSB5 Delivery Space Booking decreases the emission of other pollutants	- time slot - day of the week - holidays	gas weight: (g/zone)	- GPS data - Road network - date of holidays or other	One GPS point each 2 seconds	Same comments as fuel consumption
DSB	RQ3_4, RQ8_4	DSB6 Drivers decrease number of violations (like the double lane stops) with the Delivery Space Booking usage	- meteorology (rain, snow...) - time slot - day of the week - holidays - traffic flow	Number of infractions per type of vehicles	- Counting of violations (see Bilbao work) - reservation data	Per hour	

Table 9 Measurement summary of Delivery Space Booking

4.2.5.3. Subjective measurements.

The subjective data for evaluating the Delivery Space Booking service will be collected through questionnaires prepared for the drivers of the truck and the fleet managers. The hypotheses considered for the creation of the questionnaires could be found in Table 8 (measure=questionnaire).

Added to the questionnaires prepared in the framework of the FREILOT project, one of the questionnaires used in the EU project CVIS was adapted in order to obtain additional information and, at the end, to have the possibility to compare the results obtained in both projects regarding Delivery Space Booking. The adaptation of the CVIS questionnaire can be found in Annex III.

The proposal of items to analyze the different hypotheses is provided in the following table (in the Annex II the questionnaires are included):

DSB7	**Delivery space booking avoids the need of searching for free spaces**	**RQ10_4**	**Questionnaire**
• "The Delivery Space Booking service facilitates my delivery task because I don't need to look for free spaces"			

DSB8	**Drivers will perceive delivery conditions safer while delivering operations in a dedicated delivery space**	**RQ10_4**	**Questionnaire**
• "My safety has increased since I used the Delivery Space Booking service"			
DSB9	**Drivers will perceive that delivery space booking facilitates their delivery operations**	**RQ10_4**	**Questionnaire**
• "I think the Delivery Space Booking service facilitates my delivery operations"			
DSB10	**Delivery space booking service is appreciated by drivers**	**RQ10_4**	**Questionnaire**
• "I really appreciate the Delivery Space Booking service" • "After using Delivery Space Booking I like the service" • "I think that using the Delivery Space Booking service increases my productivity" • "I think that using the Delivery Space Booking service optimizes the travel times" • "I think that using the Delivery Space Booking service optimizes the delivery times" • "I think that using the Delivery Space Booking service increases the efficacy of my work" • "I appreciate Delivery Space Booking service because it helps me to reduce fuel consumption" • "I like the Delivery Space Booking because it makes the driving task easier"			
DSB11	**Drivers will perceive that delivery space booking service is reliable**	**RQ10_4**	**Questionnaire**
• "I perceive Delivery Space Booking service is a reliable service" • "I think the Delivery Space Booking service is effective to reduce double lane stops" • "I believe the Delivery Space Booking service is effective to reduce the delivery times" • "I believe that the advices provide by the Delivery Space Booking service are adequate" • "I believe the Delivery Space Booking service works properly"			
DSB12	**Delivery space booking service will not disturb driver in his driving task**	**RQ10_4**	**Questionnaire**
• "I think the Delivery Space Booking service does not disturb me in my driving task "			
DSB13	**Drivers will find the delivery space booking system easy to use**	**RQ10_4**	**Questionnaire**
• "I find the Delivery Space Booking service is easy to use"			
DSB14	**Drivers' stress perception will decrease with the delivery space booking usage**	**RQ10_4**	**Questionnaire**

<table>
<tr><td colspan="4">

“The more I use the Delivery Space Booking service, the easier I find the urban driving is easier”
“The more I use the Delivery Space Booking service, the less stressed I feel”
“The more I use the Delivery Space Booking service, the more stressed I feel ”
“The more I use the Delivery Space Booking service, the more apprehensive I feel about it”

</td></tr>
<tr><td>DSB15</td><td>Perceived risk of accidents will decrease with the delivery space booking usage</td><td>RQ10_4</td><td>Questionnaire</td></tr>
<tr><td colspan="4">

“I perceive the risk of accidents is lower since I use the Delivery Space Booking service”
“Using the Delivery Space Booking service, I consider the driving is safer”
“I think the number of accidents is independent of the use of the Delivery Space Booking service”
“I am confident in my ability to drive the truck safely with the Delivery Space Booking service”

</td></tr>
<tr><td>DSB16</td><td>According to the driver perception the delivery space booking system will improve of freight transport image in urban areas</td><td>RQ10_4</td><td>Questionnaire</td></tr>
<tr><td colspan="4">

“The freight transport image in urban areas is improved with the usage of Delivery Space Booking service”
“I believe the urban congestion has increased with the usage of the Delivery Space Booking service”
“I consider the Delivery Space Booking service improves the freight image in urban areas because decrease the number of double lane stops”
“I think the Delivery Space Booking service improves the freight transport image in urban areas since it is used to reduce the fuel consumption”

</td></tr>
<tr><td>DSB17</td><td>Drivers will trust the delivery space booking service</td><td>RQ10_4</td><td>Questionnaire</td></tr>
<tr><td colspan="4">

“I trust the Delivery Space Booking service”
“I am confident using Delivery Space Booking service”

</td></tr>
<tr><td>DSB18</td><td>Drivers consider that there are more availability space with the delivery space booking usage</td><td>RQ10_4</td><td>Questionnaire</td></tr>
<tr><td colspan="4">

“I find that there are more availability spaces with the Delivery Space Booking service usage”
“I think it is easier to find a free space since I used the Delivery Space Booking service”

</td></tr>
</table>

DSB19	**The rest of the drivers will appreciate the delivery space booking system because they will find easier to drive in the city without double lines and trucks parked on the pavement resulting in less stress**	**RQ10_4**	**Questionnaire**
• "I believe the rest of the drivers appreciate the Delivery Space Booking service because they will find it easier to drive in the city without double lines and trucks parked on the pavement resulting in less stress"			
DSB20	**The traffic flow gets benefits from the delivery space booking (the rest of the drivers do not hold up because of double lines, less congestions)**	**RQ8_4**	**Questionnaire & Direct observation**
• "I think the traffic flow gets benefits from the Delivery Space Booking service (the rest of the drivers do not hold up because of double lines, less congestions…"			
DSB21	**Less tickets (fines) because of avoided double line parking**	**RQ8_4**	**Direct (ask data to the police o to the companies)**
• "I have less tickets/fines because of avoided double-parkings since I starting using Delivery Space Booking service "			

Table 10 Initial proposal items for developing questionnaires (DSB)

4.3. Eco Driving Support

4.3.1. Functionality

The Eco Driving Support service aims to help the driver to improve his driving style to minimize the fuel consumption by giving real-time advice during the trip; the service gives continuous feedback to the driver on how to improve:

- Engine speed at shift-up in the start and acceleration phase
- Accelerator position in the start and acceleration phase
- Engine speed when cruising at steady speed
- Max vehicle speed in the start-stop phase
- The percentage of coasting in the deceleration phase

The system also gives the fleet operator the possibility to evaluate the truck driver's performance though an off-board analysis tool.

4.3.2. Use Cases

The main use cases identified are the following ones:

- Set configuration.
- Get real-time advice: the following advices can be given:
    - Late shift-up in start and acceleration section

  - Accelerator pedal pushed too far
  - Late shift up in steady running section
  - Low percentage of coasting in deceleration section
  - Parking brake set but engine still running
- Upload trip result.
- Get trip evaluation.

These use cases are described in more detail in the D.FL.2.1 Implementation Plan.

4.3.3. Research Questions

RQ1_3: Achieve an in-depth understanding of the effects the Eco Driving Support has on energy efficiency (fuel consumption and fuel economy).

RQ2_3: Establish if the Eco Driving Support has a positive influence on the CO_2 emissions

RQ3_3: Establish if the Eco Driving Support have a positive influence on other pollutants.

RQ4_3: Determine if the driver changes his driving after the Eco Driving Support usage.

RQ6_3: Determine how the Eco Driving Support promotes a more eco-friendly driving style through the driver acceleration, braking and gear changing behaviour.

RQ10_3: Assess driver acceptance and perceptions about the Eco Driving Support service.

RQ11_3: Assess positive acceptance by costumer and drivers of a modified journey duration/fuel consumption trade off.

RQ12_3: What is the impact on legislation of the Eco Driving Support and are they accepted by Public authorities because these services have direct effects on performance, pollutants and noise.

4.3.4. Hypotheses

Thirteen hypotheses are proposed for Eco Driving Support. The majority is related to the acceptance and perception of the service by the drivers. Furthermore some measures could determine if the Eco Driving Support system will increase the time of delivery or decrease the average speed of the truck. Other questions that are assessed with the hypotheses are related to the reduction of fuel consumption or the possibility that the usage of Eco Driving Support disturbs the surrounding traffic.

Eco Driving Support				
Hypotheses	RQ	Area	ID	Measure
Following the advice from the Eco Driving Support service will lead to decreased fuel consumption	RQ1_3	E&FC	EDS1	Direct
Following the advice from the Eco Driving Support service CO_2 emissions will decrease	RQ2_3	E&FC	EDS2	Direct

Following the advice from the Eco Driving Support service emission of other pollutants will decrease	RQ2_3	E&FC	EDS3	Direct
Following the advice from the Eco Driving Support service harsh acceleration and braking will be reduced	RQ4_3 RQ6_3	DB	EDS4	Direct
In stressful situations drivers will have difficulties to follow the instructions	RQ3_3	DB	EDS5	Questionnaire
The Eco Driving Support service is appreciated by drivers	RQ10_3	DA	EDS6	Questionnaire
Drivers will perceive that Eco Driving Support as reliable	RQ10_3	DA	EDS7	Questionnaire
Drivers will find the Eco Driving Support useful when driving	RQ10_3	DA	EDS8	Questionnaire
Drivers will find the Eco Driving Support is easy to use	RQ10_3	DA	EDS9	Questionnaire
Drivers' stress perception will increase with the Eco Driving Support usage	RQ10_3	DA	EDS10	Questionnaire
Perceived risk of accidents will decrease with the Eco Driving Support usage	RQ10_3	DA	EDS11	Questionnaire
According to the drivers' perception the Eco Driving Support system will improve the freight transport image in urban areas	RQ10_3	DA	EDS12	Questionnaire
Drivers will trust the Eco Driving Support system to give good advice	RQ10_3	DA	EDS13	Questionnaire

Table 11 Hypotheses Eco Driving Support

4.3.5. Indicators & Measurements.

The different indicators and measurements to be collected for the evaluation of Eco Driving Support are explained in this chapter.

4.3.5.1. General information.

IIn this case, the general information needed is the same as the information needed for the evaluation of the Acceleration Limiter (see chapter 4.1.4.1~~4.1.4.1~~).

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4.3.5.2. Performance Indicators.

The following table presents the list of performance indicators for the **Eco Driving Support** system related to each hypothesis, the research questions where the hypotheses are coming from is also included. These indicators will be calculated taking into account the data measured in each pilot site, the list of data measured (Input data) is presented in chapter 5.2.1.

Service	Research Question	Hypothesis	Exogenous factors	Indicators	Input data	Time units of measure	Comments
EDS	RQ1_3	EDS1 Following the advice from the EDS service fuel consumption	peak time/off peak time day of the week	fuel consumption / km	veh id / driver id / route id time and date Distance	end of each cycle	

		will decrease			Fuel Target Fuel Consumption Global driver		
EDS	RQ2_3	EDS2 Following the advice from the Eco Driving support service CO_2 emissions will decrease.	peak time/off peak time day of the week	CO_2 emissions (directly proportional to fuel consumption) per km	veh id / driver id / route id time and date Distance Fuel Target Fuel Consumption Global driver	end of each cycle	
EDS	RQ2_3	EDS3 Following the advice from the Eco Driving Support service harsh acceleration and braking will reduce					We don't have information about acceleration, neither instant speed for calculating it ourselves (here we will have the EDS score in %)*
EDS	RQ4_3 RQ6_3	EDS4 Following the advice from the Eco Driving Support service harsh acceleration and braking will reduce	peak time/off peak time day of the week	Global score	veh id / driver id / route id time and date Global driver	end of each cycle	

Table 12 Measurement summary of Eco Driving Support

* The datalogger used for this service is the same used for the Acceleration Limiter. it is not possible to collect all the data needed to evaluate some of the questions (same explanation as for AL. See chapter 4.1.4.2).

4.3.5.3. Subjective measurements.

The subjective data for evaluating the Eco Driving Support service will be collected through questionnaires for the drivers of the trucks.

The hypotheses that will be tested with questionnaires are included in Table 11.

The items to analyze for the different hypotheses are provided in the following table (in annex II the questionnaires are included).

EDS5	**In stressful situations drivers will have difficulties to follow the instructions**	**RQ10_3**	**Questionnaire**
• “I have difficulties to follow the instructions of Eco-driving support in stressful situations”			

EDS6	**Eco-Driving Support service is appreciated by drivers**	**RQ10_3**	**Questionnaire**
• “I really appreciate the Eco-driving support service” • “After using Eco-driving support I like the service” • “I think that using the Eco-driving support increases my productivity” • “I think that using the Eco-driving support service optimizes the travel times” • “I think that using the Eco-driving support service increases the efficiency of my work” • “I appreciate Eco-driving support service because it helps me to reduce fuel consumption” • “I don’t like the Eco-driving support because it makes the driving task more difficult”			
EDS7	**Drivers will perceive that Eco-driving support is reliable**	**RQ10_3**	**Questionnaire**
• “I perceive Eco-driving support is a reliable service” • “I think the Eco-driving is effective to reduce the fuel consumption and the pollutants” • “I believe that the advices provide by the Eco-driving support are adequate” • “I believe the Eco-driving support service works properly”			
EDS8	**Drivers will find the Eco-driving support useful when driving**	**RQ10_3**	**Questionnaire**
• “I find the Eco-driving support is useful when driving” • “The use of Eco-driving support services makes urban driving easier” • “I believe I have the indispensable knowledge to utilize the Eco-driving support service”			
EDS9	**Drivers will find the Eco-driving support is easy to use**	**RQ10_3**	**Questionnaire**
• “I find the Eco-driving support is easy to use” • “It is easy to understand how the Eco-driving support works” • “I have difficulties to understand the Eco-driving support” • “It is easy to indentify the functionality of the Eco-driving support”			
EDS10	**Drivers’ stress perception will increase with the Eco-driving support usage**	**RQ10_3**	**Questionnaire**
• “The more I use the Eco-driving support, the easier I find the urban driving” • “The more I use the Eco-driving support, the less stressed I feel” • “The more I use the Eco-driving support, the more stressed I feel” • “The more I use the Eco-driving support service, the more apprehensive I feel about it”			
EDS11	**Perceived risk of accidents will decrease with the Eco-driving support usage**	**RQ10_3**	**Questionnaire**
• “Using the Eco-driving support, I consider my driving is safer” • “My perceived risk of accidents is lower since I use the Eco-driving support”			

• "The number of accidents has decreased with the use of Eco-driving support" • "I think the number of accidents is independent of the use of the Eco-driving support" • "I am confident in my ability to drive the truck safely with the Eco-driving support"			
EDS12	**According to the driver perception the Eco-driving support system will improve of freight transport image in urban areas**	**RQ10_3**	**Questionnaire**
• "The freight transport image in urban areas is improved with the usage of Eco-driving support" • "I believe the urban congestion has increased with the usage of the Eco-driving support" • "I think the Eco-driving support improves the freight transport image in urban areas taking into account that its use reduce the CO2 emissions and other pollutants			
EDS13	**Drivers will trust the Eco-driving support system to give good advice**	**RQ10_3**	**Questionnaire**
• "I trust the Eco-driving support service" • "I am confident using Eco-driving support"			

Table 13 Initial proposal items for developing questionnaires (EDS)

4.4. Energy Efficient Intersection Control

4.4.1. Functionality

The Energy Efficient Intersection Control application provides priority to Heavy Goods Vehicles (HGV) at controlled intersections. If possible the traffic light towards which the vehicle is driving will become green sooner, or the current green phase will be extended to allow the vehicle to pass without stopping. Depending on the detection mechanism priority is provided to all HVGs or to the FREILOT vehicles only.

4.4.2. Use Cases

The following use cases will be implemented:

- Energy Efficient Intersection Control with FREILOT scheme member detection
    - Request priority
    - Speed Advice
    - Retrieve Logging
- Energy Efficient Intersection Control with coordination system (Lyon).
    - Coordination for green wave
    - Retrieve Logging
    - FREILOT Embedded System

The next table summarizes and describes the specific use cases implemented in each pilot site and the description.

Use case	Pilot site	Description

IC_SF	Krakow	Isolated control, priority for specific identified fleets (SF = Specific Fleet). Isolated control is on an intersection by intersection basis (no coordination). Control strategies are determined by local (loop) detectors. The priority in this use case is for specific actively detected vehicles.
IC_HGV	Krakow Simulation	Isolated control, priority for all vehicles over a specified length As the previous use case, but now there is priority for all long vehicles.
GW_SF	Lyon	Green wave, optimised for specific identified fleets Green wave systems use coordination on a corridor. The coordination is fixed for a measured (by a limited number of (loop) detectors) traffic situation.
GW_HGV	Lyon	Green wave, optimised for all vehicles over a specified length
AC_SF	Helmond	Adaptive control, optimised for specific indentified fleets Adaptive control is a form of flexible network control, where coordination depends on the actual traffic demand. With higher volumes on the main corridor, coordination will occur as an emergent phenomenon.
AC_HGV	Helmond Simulation	Adaptive control, optimised for all vehicles over a specified length.

Table 14 Use cases Intersection Control

4.4.3. Research Questions

RQ1_1: Achieve an in-depth understanding of the benefits of the Energy Efficient Intersection Control has on energy efficiency (fuel consumption and fuel economy).

RQ2_1: Establish if the Energy Efficient Intersection Control has a positive influence on the CO_2 emissions.

RQ3_1: Establish if the Energy Efficient Intersection Control has a positive influence on other pollutants.

RQ4_1: Determine if the driver changes his driving after the use of Energy Efficient Intersection Control.

RQ5_1: Determine if the driver changes his behaviour after stopping to use Energy Efficient Intersection Control.

RQ6_1: Determine how the Energy Efficient Intersection Control promotes a more eco-friendly driving style through the driver acceleration, braking and gear changing behaviour.

RQ7_1: Determine if the use of the Energy Efficient Intersection Control will optimise the driver delivery time and promote travel time benefits for specific fleets (traffic efficiency).

RQ8_1: Determine how the Energy Efficient Intersection Control influences the traffic flow.

RQ10_1: Assess driver acceptance and perceptions about the Energy Efficient Intersection Control service.

RQ11_1: Positive acceptance by custumer and drivers of a modified journey duration/fuel consumption trade off.

RQ12_1: What is th impact on legislation of the Energy Efficiency Intersection Control and is it accepted by Public authorities because it has direct effects on performance, pollutants and noise.

RQ13_1: What is the impact on safety

4.4.4. Energy Efficient Intersection Control Hypotheses

Thirty-eight hypotheses are proposed for Intersection Control Service. Most of them are related to the reduction of fuel consumption or the possibility that the use of Intersection Control disturbs the surrounding traffic. Other questions that will be assessed with the hypotheses are related to the acceptance and perception of the system by the drivers.

These hypotheses are provided taking each possible use case of the service into account (see Table 14). The following table shows all hypotheses related to Energy Efficient Intersection Control.

Energy Efficient Intersection Control				
Hypothesis	RQ	Area	ID	Measure
Overall estimated fuel consumption in use case IC_SF will be lower than reference (default non-prioritised control)	RQ1_1	E&FC	IC1	Direct
Measured fuel consumption in the specific fleet in use case IC_SF will be 10% lower than reference (default non-prioritised control)	RQ1_1	E&FC	IC2	Direct
Overall estimated fuel consumption in use case GW_SF will be lower than reference (default non-prioritised control)	RQ1_1	E&FC	IC3	Direct
Measured fuel consumption in the specific fleet in use case GW_SF will be 10% lower than reference (default non-prioritised control)	RQ1_1	E&FC	IC4	Direct
Overall estimated fuel consumption in use case AC_SF will be lower than reference (default non-prioritised control)	RQ1_1	E&FC	IC5	Direct
Measured fuel consumption in the specific fleet in use case AC_SF will be 12% lower than reference (default non-prioritised control)	RQ1_1	E&FC	IC6	Direct
Overall estimated fuel consumption in use case IC_HGV will be 5% lower than reference case (default non-prioritised control)	RQ1_1	E&FC	IC7	Simulation
Overall estimated fuel consumption in use case GW_HGV will be 5% lower than reference case (default non-prioritised control)	RQ1_1	E&FC	IC8	Direct
Overall estimated fuel consumption in use case AC_HGV	RQ1_1	E&FC	IC9	Simulation

will be 5% lower than reference case (default non-prioritised control)				
Estimated fuel consumption of HGV's in use case IC_HGV will be 9% lower than reference case (default non-prioritised control)	RQ1_1	E&FC	IC10	Simulation
Estimated fuel consumption of HGV's in use case GW_HGV will be 7% lower than reference case (default non-prioritised control)	RQ1_1	E&FC	IC11	Direct
Estimated fuel consumption of HGV's in use case AC_HGV will be 8% lower than reference case (default non-prioritised control)	RQ1_1	E&FC	IC12	Simulation
Average cycle times on the intersections will increase no more than 12% in use case IC_SF	RQ8_1	TE	IC13	Direct
Average cycle times on the intersections will increase no more than 15% in use case GW_SF	RQ8_1	TE	IC14	Direct
Average cycle times on the intersections will increase no more than 10% in use case AC_SF	RQ8_1	TE	IC15	Direct
Average cycle times on the intersections will increase no more than 20% in use case IC_HGV	RQ8_1	TE	IC16	Simulation
Average cycle times on the intersections will increase no more than 15% in use case GW_HGV	RQ8_1	TE	IC17	Direct
Average cycle times on the intersections will increase no more than 18% in use case AC_HGV	RQ8_1	TE	IC18	Simulation
FREILOT member truck travel times will decrease by 20% in use case IC_SF	RQ7_1	TE	IC19	Direct
FREILOT member truck travel times will decrease by 20% in use case GW_SF	RQ7_1	TE	IC20	Direct
FREILOT member truck travel times will decrease by 20% in use case AC_SF	RQ7_1	TE	IC21	Direct
Increase in travel times on crossing routes will be lower than 5% in use case IC_SF	RQ8_1	TE	IC22	Direct
Increase in travel times on crossing routes will be lower than 5% in use case GW_SF	RQ8_1	TE	IC23	Direct
Increase in travel times on crossing routes will be lower than 5% in use case AC_SF	RQ8_1	TE	IC24	Direct
Travel times on main routes will improve by 5% in use case IC_HGV	RQ7_1	TE	IC25	Simulation
Travel times on main routes will improve by 5% in use case GW_HGV	RQ7_1	TE	IC26	Direct
Travel times on main routes will improve by 8% in use case AC_HGV	RQ7_1	TE	IC27	Simulation
Increase in travel times on crossing routes will be lower than 20% in use case IC_HGV	RQ7_1	TE	IC28	Simulation
Increase in travel times on crossing routes will be lower than 8% in use case GW_HGV	RQ7_1	TE	IC29	Direct
Increase in travel times on crossing routes will be lower than 10% in use case AC_HGV	RQ7_1	TE	IC30	Simulation

Energy Efficient Intersection Control service is appreciated by drivers	RQ10_1	DA	IC31	Questionnaire
Drivers will perceive that Energy Efficient Intersection Control service is reliable	RQ10_1	DA	IC32	Questionnaire
Drivers will find the Energy Efficient Intersection Control service is useful when driving	RQ10_1	DA	IC33	Questionnaire
Drivers will think the Energy Efficient Intersection Control service is easy to use	RQ10_1	DA	IC34	Questionnaire
Drivers stress perception will decrease with the Energy Efficient Intersection Control service usage	RQ10_1, RQ13_1	DA	IC35	Questionnaire
Perceived risk of accidents will decrease with the Energy Efficient Intersection Control service usage	RQ10_1, RQ13_1	DA	IC36	Questionnaire
According to the driver perception the Energy Efficient Intersection Control service will improve the freight transport image in urban areas	RQ10_1	DA	IC37	Questionnaire
Drivers will trust the Energy Efficient Intersection Control service	RQ10_1	DA	IC38	Questionnaire

Table 15 Hypotheses Energy Efficient Intersection Control

In some cases direct measurement of the effect of a hypothesis has too much impact on the daily traffic. We have not too much vehicles for understanding high penetration scenarios. Therefore the data for the hypotheses where a large number of vehicles get priority are gathered via simulation. For both Helmond and Krakow a VISSIM simulation model exists, which allows to observe what will happen when every large vehicle would get priority.

4.4.5. Indicators & Measurements.

The indicators and measurements to be collected for the evaluation of Energy Efficiency Intersection Control are described in this chapter.

4.4.5.1. General information.

Added to the general data to be collected for all the systems (see chapter 4.1.4.1) for the EEIC the following general data will be collected:

- Use of Energy Efficient Intersection Control:
    - Number of trucks using the Energy Efficient Intersection Control.
    - Number of times that a truck in the project passes through the Energy Efficient Intersection Control daily.

4.4.5.2. Performance Indicators.

The following table presents the list of performance indicators for the **Energy Efficient Intersection Control** system related to each hypothesis, the research questions where the hypotheses are coming from is also included. These indicators will be calculated taking into account the data measured in each pilot site, the list of data measured (Input data) is presented in chapter 5.2.5.

Research Question	Hypothesis	Exogenous factors	Indicators	Input data	Time units of measure

RQ1_1	EEIC1, EEIC3, EEIC5	peak time/off peak time day of the week	Estimated fuel consumption	Driver ID, Truck ID, GPS position, Intersection ID, Mode of operation, Priority state, Time until green, Advised Speed, State of traffic lights, Traffic Intensity	1 second
RQ1_1	EEIC2, EEIC4, EEIC6, EEIC7, EEIC8, EEIC9	peak time/off peak time day of the week	Estimated fuel consumption	Driver ID, Truck ID, GPS position, Intersection ID, Mode of operation, Priority state, Time until green, Advised Speed, State of traffic lights, Traffic Intensity	1 second
RQ1_1	EEIC10, EEIC11, EEIC12	peak time/off peak time day of the week	Estimated fuel consumption	Driver ID, Truck ID, GPS position, Intersection ID, Mode of operation, Priority state, Time until green, Advised Speed, State of traffic lights, Traffic Intensity	1 second
RQ8_1	EEIC13, EEIC14, EEIC15, EEIC16, EEIC 17, EEIC18	peak time/off peak time day of the week	Cycle time	Intersection ID, Mode of operation, Priority state, Time until green, Advised Speed, State of traffic lights, Traffic Intensity	1 second
RQ8_1	EEIC19, EEIC20, EEIC21	peak time/off peak time day of the week	Waiting time after vehicle detection	Intersection ID, Mode of operation, State of traffic lights, State of detectors, Traffic Intensity	1 second
RQ8_1	EEIC22, EEIC23, EEIC24	peak time/off peak time day of the week	Waiting time after vehicle detection	Intersection ID, Mode of operation, State of traffic lights, State of detectors, Traffic Intensity	1 second
RQ8_1	EEIC25, EEIC26, EEIC27	peak time/off peak time day of the week	Waiting time after vehicle detection	Intersection ID, Mode of operation, State of traffic lights, State of detectors, Traffic Intensity	1 second
RQ8_1	EEIC28, EEIC29, EEIC30	peak time/off peak time day of the week	Waiting time after vehicle detection	Intersection ID, Mode of operation, State of traffic lights, State of detectors, Traffic Intensity	1 second

Table 16 Measurement summary of Energy Efficient Intersection Control

4.4.5.3. Subjective measurements.

The subjective data for evaluating the Energy Efficient Intersection Control service will be collected through questionnaires prepared for the drivers of the truck. The hypotheses that will be tested with questionnaires are summarized in Table 15.

The items to analyse for the different hypotheses are provided in the following table. For the preparation of the questionnaires a selection of these items was performed and the final questionnaires are provided in annex II.

EEIC31	**Energy Efficient Intersection Control service is appreciated by drivers**	**RQ10_1**	**Questionnaire**
▪ "I really appreciate the Energy Efficient Intersection Control service" ▪ "After using Energy Efficient Intersection Control I like the service" ▪ "I think that using the Energy Efficient Intersection Control service increases my productivity" ▪ "I think that using the Energy Efficient Intersection Control service decreases the travel times" ▪ "I think that using the Energy Efficient Intersection Control service increases the			

efficiency of my work”			
EEIC32	**Drivers will perceive that Energy Efficient Intersection Control service as reliable**	**RQ10_1**	**Questionnaire**
▪ “I perceive Energy Efficient Intersection Control as a reliable service” ▪ “I think the Energy Efficient Intersection Control is effective to manage the traffic in the road intersections” ▪ “I believe the Energy Efficient Intersection Control service works properly”			
EEIC33	**Drivers will find the Energy Efficient Intersection Control service is useful when driving**	**RQ10_1**	**Questionnaire**
▪ “I find the Energy Efficient Intersection Control service is useful when driving” ▪ “The use of Energy Efficient Intersection Control services makes urban driving easier” ▪ “I believe I have the indispensable knowledge to utilize the Energy Efficient Intersection Control service”			
EEIC34	**Drivers will find the Energy Efficient Intersection Control service easy to use**	**RQ10_1**	**Questionnaire**
▪ “I find the Energy Efficient Intersection Control service is easy to use” ▪ “It is easy to understand how the Energy Efficient Intersection Control service works” ▪ “I have difficulties to understand the Energy Efficient Intersection Control service” ▪ “It is easy to indentify the functionalities of the Energy Efficient Intersection Control service”			
EEIC35	**Drivers stress perception will decrease with the Energy Efficient Intersection Control service usage**	**RQ10_1**	**Questionnaire**
▪ “The more I use the Energy Efficient Intersection Control service, the easier I find the urban driving” ▪ “More I use the Energy Efficient Intersection Control service, I feel less stressed” ▪ “More I use the Energy Efficient Intersection Control service, I feel more stressed” ▪ “The more I use the Energy Efficient Intersection Control service, the more apprehensive I feel about it”			
EEIC36	**Perceived risk of accidents will decrease with the Energy Efficient Intersection Control service usage**	**RQ10_1**	**Questionnaire**
▪ “Using the Energy Efficient Intersection Control service, I consider my driving is safer” ▪ “My perceived risk of accidents is lower since I use the Energy Efficient Intersection Control service” ▪ “The number of accidents has decreased with the use of Energy Efficient Intersection Control service” ▪ “I think the number of accidents is independent of the use of the Energy Efficient Intersection Control service”			

▪ "I am confident in my ability to drive the truck safely with the Energy Efficient Intersection Control service"			
EEIC37	**According to the driver perception the Energy Efficient Intersection Control service will improve of freight transport image in urban areas**	**RQ10_1**	**Questionnaire**
▪ "The freight transport image in urban areas is improved with the usage of Energy Efficient Intersection Control service" ▪ "I believe the urban congestion has decreased with the usage of the Energy Efficient Intersection Control service" ▪ "I consider the length of traffic queues in road intersections are smaller with the usage of Energy Efficient Intersection Control service"			
EEIC38	**Drivers will trust the Energy Efficient Intersection Control service**	**RQ10_1**	**Questionnaire**
▪ "I trust the Energy Efficient Intersection Control service" ▪ "I am confident of using Energy Efficient Intersection Control service"			

Table 17 Initial proposal items for developing questionnaires (EEIC)

4.5. Adaptive Speed Limiter

4.5.1. Functionality

The Adaptive Speed Limiter service limits the vehicle speed in certain predefined zones in a city. Vehicle position is determined by GPS. When the vehicle enters a speed zone a message is sent to the driver asking him to accept the predefined speed limitation.

4.5.2. Use Cases

The main use cases identified are the following ones:

- Define Speed Limitation Zones.
- Upload Speed Limitation Zones.
- Zone detection.
- Acceptation of speed limitation.

These use cases are described in more detail in the D.FL.2.1 Implementation Plan.

4.5.3. Research Questions

RQ1_2: Achieve an in-depth understanding of the benefits of the Adaptive Speed Limiter, if it has an effect on energy efficiency (fuel consumption and fuel economy).

RQ2_2: Establish if the Adaptive Speed Limiter has a positive influence on the CO_2 emissions.

RQ3_2: Establish if the Adaptive Speed Limiter has a positive influence on other pollutants.

RQ4_2: Determine if the driver changes his driving after the Adaptive Speed Limiter usage.

RQ5_2: Determine if the driver changes his behaviour after stopping to use the Adaptive Speed Limiter.

RQ6_2: Determine how the Adaptive Speed Limiter promotes a more eco-friendly driving style through the driver's acceleration, braking and gear changing behaviour.

RQ8_2: Determine how the Adaptive Speed Limiter services have influence on the traffic flow.

RQ10_2: Assess driver acceptance and perception of the Adaptive Speed Limiter service.

RQ11_2: Determine the acceptance by customer and drivers of a modified journey duration/fuel consumption trade-off.

RQ12_2: What is the impact on legislation of the Adaptative Speed Limiter and is they accepted by Public authorities because this service have direct effects on performance, pollutants and noise.

RQ13_2: What is the impact on safety

4.5.4. Hypotheses

Sixteen hypotheses are proposed for the Adaptive Speed Limiter Service. Again most of them are related to the acceptance and perception of the drivers about the system. Furthermore some measurements could determine if the Adaptive Speed Limiter system will increase the time of delivery or decrease the average speed of the truck. Other questions that could be assessed with the hypotheses are related to the reduction of fuel consumption or the possibility that the use of the Adaptive Speed Limiter disturbs the surrounding traffic.

Adaptive Speed Limiter				
Hypotheses	RQ	Area	ID	Measure
Using the Adaptive Speed Limiter service, the time of delivery will increase	RQ8_2	TE	SL1	Direct
Use of the Adaptive Speed Limiter service reduces fuel consumption	RQ1_2	E& FC	SL2	Direct
The average speed of the truck will decrease with the use of the Adaptive Speed Limiter	RQ4_2, RQ13_2	DB	SL4	Direct
Driver braking behaviour will change after stopping to use the Adaptive Speed Limiter	RQ5_2	DB	SL5	Direct
Driver braking behaviour will change with the use of the Adaptive Speed Limiter	RQ6_2, RQ13_2	DB	SL6	Direct
Using the Adaptive Speed Limiter service, the driver will accept/acknowledge speed limit recommendations from	RQ10_2	DA	SL7	Questionnaire

the system				
Using the Adaptive Speed Limiter service, the driver will not be disturbed in his driving task	RQ10_2, RQ13_2	DA	SL8	Questionnaire
The Adaptive Speed Limiter service is appreciated by drivers	RQ10_2	DA	SL9	Questionnaire
Drivers will perceive that the Adaptive Speed Limiter service is reliable	RQ10_2	DA	SL10	Questionnaire
Drivers will find that the Adaptive Speed Limiter is useful when driving	RQ10_2	DA	SL11	Questionnaire
Drivers will find the Adaptive Speed Limiter is easy to use	RQ10_2	DA	SL12	Questionnaire
Drivers' stress perception will decrease with the Adaptive Speed Limiter usage	RQ10_2, RQ13_2	DA	SL13	Questionnaire
Perceived risk of accidents will decrease with the Adaptive Speed Limiter usage	RQ10_2, RQ13_2	DA	SL14	Questionnaire
According to the driver's perception, the Adaptive Speed Limiter system will improve the freight transport image in urban areas	RQ10_2	DA	SL15	Questionnaire
Drivers will trust the Adaptive Speed Limiter system	RQ10_2	DA	SL16	Questionnaire

Table 18 Hypotheses Adaptive Speed Limiter

4.5.5. Indicators & Measurements.

The indicators and measurements to be collected for the evaluation of Adaptive Speed Limiter are summarized in this chapter.

4.5.5.1. General information.

Added to the data collected for the other services (see chapter 4.1.4.1~~4.1.4.1~~), is important to collect how many times and how long the truck enters speed limited zones.

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4.5.5.2. Performance Indicators.

The following table presents the list of performance indicators for the **Adaptive Speed Limiter** system related to each hypothesis, the research questions where the hypotheses are coming from is also included. These indicators will be calculated taking into account the data measured in each pilot site, the list of data measured (Input data) is presented in chapter 5.2.1.

Service	Research Question	Hypothesis	Exogenous factors	Indicators	Input data	Time units of measure	Comments
ASL	RQ8_2	ASL1 Using Adaptive Speed Limiter service, the time of delivery will increase	peak time/off peak time day of the week	average delivery time	veh id / driver id / route id time x 3 states and date zone id Distance x 3 states	Zone entry / zone exit / 2 min	

					Number of deliveries (Weight)		
ASL	RQ1_2	ASL2 Using Adaptive Speed Limiter service reduces fuel consumption	peak time/off peak time day of the week	fuel consumption / km	veh id / driver id / route id time x 3 states and date zone id Distance x 3 states MovingFuel and totalFuel Fuel x 3 states	Zone entry / zone exit	
ASL	RQ9_2	ASL3 A truck using Adaptive Speed Limiter service will not disturb surrounding traffic	surrounding traffic				1.- It is not possible to obtain data from surrounding traffic
ASL	RQ4_2	ASL4 Average speed of the truck will be decrease with the use of the Adaptive Speed Limiter	peak time/off peak time day of the week	average speed	veh id / driver id / route id time x 3 states and date zone id Distance x 3 states	Zone entry / zone exit	
ASL	RQ5_2	ASL5 Driver braking behaviour will change with/after the use of the Adaptive Speed Limiter	peak time/off peak time day of the week	number of times the driver use the break per km	veh id / driver id / route id time x 3 states and date zone id Distance x 3 states Number of deliveries (Weight) Break count Stop Count	Zone entry / zone exit / 2 min	
ASL	RQ6_2	ASL6 Driver braking behaviour will change with/after the use of the Adaptive Speed Limiter	peak time/off peak time day of the week	number of times the driver use the break per km	veh id / driver id / route id time x 3 states and date zone id Distance x 3 states Number of deliveries (Weight) Break count Stop Count	Zone entry / zone exit / 2 min	

Table 19 Measurement summary of the Adaptive Speed Limiter service

4.5.5.3. Subjective measurements.

The subjective data for the evaluation of the Adaptive Speed Limiter service will be collected through questionnaires for the drivers of the truck.

The hypotheses that will be tested with questionnaires are summarized in Table 18.

The items to analyse for the different hypotheses are provided in the following table. In the annex II, the final questionnaires prepared for the evaluation of the different research questions are included.

<table>
<tr><td>ASL7</td><td>Using the Adaptive Speed Limiter service, the driver will accept/acknowledge speed limit recommendations from the system</td><td>RQ10_2</td><td>Questionnaire</td></tr>
<tr><td colspan="4">“I think the speed limitation provided by the Adaptive Speed Limiter service is acceptable”
“I accept/acknowledge speed limit recommendations from the Adaptive Speed Limiter service”</td></tr>
<tr><td>ASL8</td><td>Using the Adaptive Speed Limiter service, the driver will be not be disturbed in his driving task</td><td>RQ10_2</td><td>Questionnaire</td></tr>
<tr><td colspan="4">“Using the Adaptive Speed Limiter service, I am not disturbed in my driving task”
“The use of the Adaptive Speed Limiter service annoys me while driving”
“The use of the Adaptive Speed Limiter makes me difficult to drive”
“Adaptive Speed Limiter service disturbs me when I drive”
“The use of The Adaptive Speed Limiter service helps me in the driving task”
“The use of the Adaptive Speed Limiter makes me easy to drive”</td></tr>
<tr><td>ASL9</td><td>The Adaptive Speed Limiter service is appreciated by drivers</td><td>RQ10_2</td><td>Questionnaire</td></tr>
<tr><td colspan="4">“I really appreciate the Adaptive Speed Limiter service”
“After using Adaptive Speed Limiter I like the service”
“I think that using the Adaptive Speed Limiter increases my productivity”
“I think that using the Adaptive Speed Limiter service decreases travel time”
“I think that using the Adaptive Speed Limiter service increases the efficiency of my work”</td></tr>
<tr><td>ASL10</td><td>Drivers will perceive that Adaptive Speed Limiter service is reliable</td><td>RQ10_2</td><td>Questionnaire</td></tr>
<tr><td colspan="4">“I perceive Adaptive Speed Limiter is a reliable service”
“I think the Adaptive Speed Limiter is effective to not exceed the speed limitations”
“I believe the Adaptive Speed Limiter service works properly”</td></tr>
<tr><td>ASL11</td><td>Drivers will find the Adaptive Speed Limiter is useful when driving</td><td>RQ10_2</td><td>Questionnaire</td></tr>
</table>

<table>
<tr><td colspan="4">• “I find the Adaptive Speed Limiter service useful when driving”
• “The use of Adaptive Speed Limiter services makes urban driving easier”
• “I believe I have the indispensable knowledge to utilize the Adaptive Speed Limiter service”</td></tr>
<tr><td>ASL12</td><td>Drivers will find the Adaptive Speed Limiter is easy to use</td><td>RQ10_2</td><td>Questionnaire</td></tr>
<tr><td colspan="4">• “I find the Adaptive Speed Limiter service is easy to use”
• “It is easy to understand how the Adaptive Speed Limiter service works”
• “I have difficulties to understand the Adaptive Speed Limiter service”
• “It is easy to indentify the functionality of the Adaptive Speed Limiter service”</td></tr>
<tr><td>ASL13</td><td>Drivers’ stress perception will decrease with the Adaptive Speed Limiter usage</td><td>RQ10_2</td><td>Questionnaire</td></tr>
<tr><td colspan="4">• “The more I use the Adaptative Speed Limiter, the easier I find the urban driving”
• “The more I use the Adaptative Speed Limiter, I feel less stressed”
• “The more I use the Adaptative Speed Limiter, the more stressed I feel”
• “The more I use the Adaptative Speed Limiter, the more apprehensive I feel about it”</td></tr>
<tr><td>ASL14</td><td>Perceived risk of accidents will decrease with the Adaptive Speed Limiter usage</td><td>RQ10_2</td><td>Questionnaire</td></tr>
<tr><td colspan="4">• “Using the Adaptative Speed Limiter, I consider my driving is safer”
• “My perceived risk of accidents is lower since I use the Adaptative Speed Limiter”
• “The number of accidents has decreased with the use of Adaptative Speed Limiter”
• “I think the number of accidents is independent of the use of the Adaptative Speed Limiter”
• “I am confident in my ability to drive the truck safely with the Adaptative Speed Limiter”</td></tr>
<tr><td>ASL15</td><td>According to the driver perception, the Adaptive Speed Limiter system will improve the freight transport image in urban areas</td><td>RQ10_2</td><td>Questionnaire</td></tr>
<tr><td colspan="4">• “The freight transport image in urban areas is improved with the usage of Adaptive Speed Limiter service”
• “I believe the urban congestion has increased with the usage of the Adaptive Speed Limiter service”</td></tr>
<tr><td>ASL16</td><td>Drivers will trust the Adaptive Speed Limiter system</td><td>RQ10_2</td><td>Questionnaire</td></tr>
<tr><td colspan="4">• “I trust the Adaptive Speed Limiter service”
• “I am confident using Adaptive Speed Limiter service”</td></tr>
</table>

Table 20 Initial proposal items for developing questionnaires (ASL)

5. Data Management.

This chapter describes the procedures for data management that are going to be followed in FREILOT, including the requirements and the format of the data. The first part describes the data collection scheme, an overall description of the process that defines how the data is going to be retrieved from the different pilot sites and stored in the CTAG back up database and in the local storage systems managed by the evaluation partners.

In the next sections, the different data acquisition scenarios where the data collection scheme has to be adapted are introduced too. There are different data acquisition scenarios due to the combination of the different services and pilot sites working during the FREILOT pilot. It is important to note that each scenario has its own features (data list available, data files definition) and data logging systems so the data acquisition processes may differ among them. In this section the data list registered and the data files generated including the measures per scenario are included.

Finally, regarding that some final adjustments are still to be done, a preliminary description of the global back up database located in CTAG is included.

5.1. Data collection schema

A common data collection scheme is needed to retrieve and store all data coming from the Bilbao, Lyon, Helmond and Krakow pilot sites to the evaluation partners databases (including CTAG back-up database). An overall vision of this scheme is presented below:

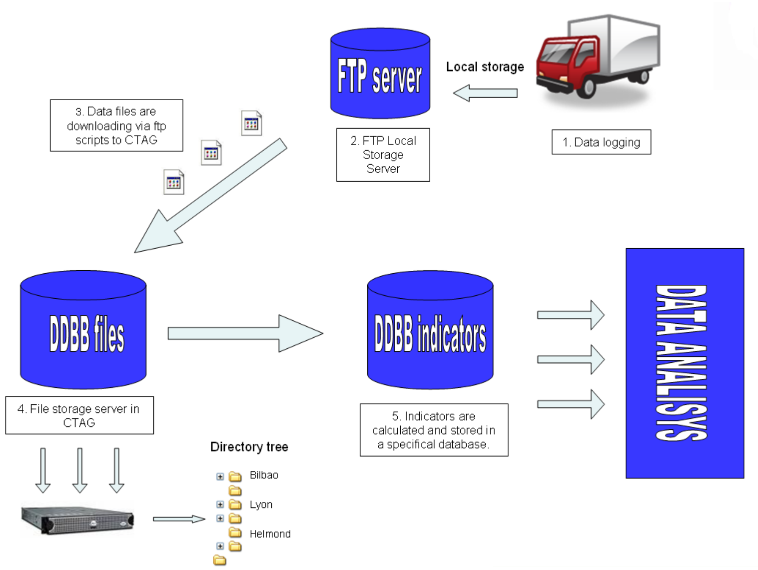

Figure 4 Data management scheme

The data logged from the data logger devices during the 12 months pilot are stored locally in the FTP servers managed and supervised by the pilot site leaders. It's important to note that the work of the DAS systems is different depending on the pilot site and service so the data collection scheme may differ in each location.

Periodically the data files are going to be downloaded by CTAG and the evaluation partners. This process has to be done automatically so the development of automated downloading scripts is needed to facilitate this task. After the file collection, the rest of the evaluation process will start:

- Data processing.
- Performance indicators calculation.
- Hypothesis testing.
- Global assessment.

5.2. Data acquisition scenarios

During the process for the definition of the data acquisition system, three main tasks were carried out:

1. Preparation of the data list with the measurements that can be provided by each data logger system. Different data loggers will be used depending on the scenario (see D.FL.2.1.Implementation Plan).
2. Definition of the different file formats where the logs are saved. Main issues in this task are the naming of the files (to avoid duplicate names), file format (text files) and data arrangement inside these files (this is an important point for the evaluation tools development).
3. Data storage scheme. This task is focussed at the identification of the data servers that will store the files locally and the downloading scripts development to automate the data retrieval from the data sources (pilot sites) to the CTAG database.

These tasks have to be sorted out with the partners in charge of the implementation work package and in the four pilot sites where the five FREILOT functionalities were installed. Five acquisition scenarios were defined taking into account the data-loggers installed and the data management process involved in the systems per test site. The 5 data acquisition scenarios are listed below:

1. **SCENARIO1:**
   - **Acceleration Limiter**, **Eco Driving Support, Adaptive Speed Limiter** in Bilbao.
   - **Acceleration Limiter**, **Eco Driving Support, Adaptive Speed Limiter** in Lyon
   - **Acceleration Limiter**, **Eco Driving Support, Adaptive Speed Limiter** in Helmond
   - **Eco Driving Support** in Krakow.
2. **SCENARIO2:**
   - **Delivery Space Booking** in Bilbao.
3. **SCENARIO3:**
   - **Delivery Space Booking** in Lyon
4. **SCENARIO4:**
   - **Energy Efficient Intersection Control** in Helmond and Krakow.
5. **SCENARIO5:**
   - **Energy Efficient Intersection Control** in Lyon.

The next table summarizes the five existing scenarios per pilot site and system:

System **Pilot site**	**AL**	**DSB**	**EDS**	**EEIC**	**ASL**
Lyon	Scenario 1	Scenario 3	Scenario 1	Scenario 5	Scenario 1
Helmond	Scenario 1		Scenario 1	Scenario 4	Scenario 1
Krakow			Scenario 1	Scenario 4	
Bilbao	Scenario 1	Scenario 2	Scenario 1		Scenario 1

Table 21 Summary of data acquisition scenarios

5.2.1. Scenario 1: AL, EDS, ASL in MADRID, HELMOND, LYON and KRAKOW

This section involves the measures logged in trucks in which the Volvo systems are implemented. The file definitions, naming, and file storage server issues are also described.

5.2.1.1. List of measurements logged.

The Volvo systems have their own data acquisition system, the system takes a snapshot of the data when an event occurs directly from the truck network or periodically (2 min). The first task was the selection of measurements and events needed to perform the Adaptive Speed Limiter, Acceleration Limiter and Eco Drive Support evaluation and performance indicators calculation.

In the tables below the common measurements are described (registered for all the four in-vehicle systems), and then separately the measurements belonging to each system in particular. The data features, units and events which trigger the measurement logging, are also shown in the tables:

Common measures	Description	RANGE	UNITS	Trigger
TruckID	ID of truck	-	numerical code	periodic(2 min) driver login/logout zone entry/exit
DriverID	ID of driver	-	alphanumerical code	periodic(2 min) driver login/logout zone entry/exit
VehicleTotalWeight	Current load	0,0 to 119713,243245	kg	periodic(2 min) zone entry/exit driver login/logout
LOV.Vehicle.Distance	Distance driven by the truck	0-500.000	m	periodic(2 min) zone entry/exit driver login/logout
LOV.Vehicle.Fuel	Total fuel used	0,00 – 10.000.000	l	periodic(2 min) zone entry/exit driver login/logout
BrakeCounter	Brake switch counter	-	numerical register	periodic(2 min) zone entry/exit driver login/logout
VehicleStopCounter	Stop counter	-	numerical register	periodic(2 min) zone entry/exit driver login/logout
LOV.vehicle.moving.time	Total time when vehicle is moving	1 – 4.294.967.295	s	zone entry/exit driver login/logout
LOV.Vehicle.Moving.fuel	Fuel used when vehicle is moving	0,00 – 10.000.000	l	zone entry/exit driver login/logout
Speed	Speed	-	Km/h	periodic(2 min)
Tracking	**Description**		**UNITS**	**Trigger**
Position	GPS Position	-	GPS coordinates, ex: 43.262217; -2.929084; 2.97	periodic(2 min)
Heading			Deg	periodic(2 min)
DateTime	Timestamp	-	YYYY-MM-DD HH:MM:SS	periodic(2 min) zone entry/exit driver login/logout

Table 22 Common measurements list registered in all Volvo systems

The next tables summarise the characteristics of the measurements registered per system:

Adaptive Speed Limiter	Description	RANGE	UNITS	Trigger
SL.Counter	Number of times the system has been activated	0-10.000	numerical register	zone entry/exit
SL.Value	Value of the current speed limitation	0-100	km/h	zone entry/exit
SL.Active.Time	Duration while vehicle in state SL Function Active	1 - 4.294.967.295	S	zone entry/exit
SL.Active.Fuel	Vehicle fuel while in state SL Function Active	0,00 – 10.000.000	l	zone entry/exit
SL.Active.Distance	Vehicle distance while in state SL Function Active	0-500.000	m	zone entry/exit
SL.Limiting.Time	Vehicle distance while in state Speed Limitation Active	1 - 4.294.967.295	s	zone entry/exit
SL.Limiting.Fuel	Vehicle fuel while in state Speed Limitation Active	0,00 – 10.000.000	l	zone entry/exit
SL.Limiting.Distance	Vehicle distance while in state Speed Limitation Active	0-500.000	m	zone entry/exit
SL.Overriding.Counter	Number of times the system has been overridden	0-10.000	numerical register	zone entry/exit
SL.Overriding.Time	Duration while in state Speed Limitation Overridden	1 - 4.294.967.295	s	zone entry/exit
SL.Overriding.Fuel	Vehicle fuel while in state Speed Limitation Overridden	0,00 – 10.000.000	l	zone entry/exit
SL.Overriding.Distance	Vehicle distance while in state Speed Limitation Overridden	0-500.000	m	zone entry/exit

Table 23 Measurement list registered in the Adaptive Speed Limiter system

Acceleration Limiter	Description	RANGE	UNITS	Trigger
AL.MapX.Active.Count (X=0,1,2)	Count of AL activations for map No.X	0-10.000	numerical register	driver logout, periodic 1 hour if X=0 zone entry/exit if X=1,2
AL.MapX.Active.Fuel (X=0,1,2)	AL active fuel for map No.X	0.00 - 10.000.000	l	1 hour if X=0
AL.MapX.Active.Time (X=0,1,2)	AL active time for map No.X	1 - 4.294.967.295	s	zone entry/exit if X=1,2
AL.MapX.Active.Distance (X=0,1,2)	AL active distance for map No.X	0-500.000	m	1 hour if X=0
AL.MapX.Limiting.Count (X=0,1,2)	Count of AL limitations for map No.X	0-10.000	numerical register	zone entry/exit if X=1,2
AL.MapX.Limiting.Fuel (X=0,1,2)	AL limiting fuel for map No.X	0.00 - 10.000.000	l	1 hour if X=0
AL.MapX.Limiting.Time (X=0,1,2)	AL limiting time for map No.X	1 - 4.294.967.295	s	zone entry/exit if X=1,2
AL.MapX.Limiting.Distance (X=0,1,2)	AL limiting distance for map No.X	0-500.000	m	1 hour if X=0
AL.MapX.Overriding.Count (X=0,1,2)	Count of AL overridden for map No.X	0-10.000	numerical register	zone entry/exit if X=1,2
AL.MapX.Overriding.Fuel (X=0,1,2)	AL overridden fuel for map No.X	0.00 - 10.000.000	l	1 hour if X=0
AL.MapX.Overriding.Time (X=0,1,2)	AL overridden time for map No.X	1 - 4.294.967.295	s	zone entry/exit if X=1,2
AL.MapX.Overriding.Distance (X=0,1,2)	AL overridden distance for map No.X	0-500.000	m	1 hour if X=0

Table 24 Measurement list registered in the Accelerator Limiter system

Eco Driver Support	Description	RANGE	UNITS	Trigger
EDS.StartTime	Cycle beginning			end of cycle
EDS.TotalTime	Cycle duration			end of cycle
EDS.TotalDistance	total distance drive during the previous run	0-500.000	m	end of cycle
EDS.AverageSpeed	average speed (tot dist/ tot time) during previous run		Km/h	end of cycle
EDS.AccPedDrv	Accelerator pedal driver score	0-100	%	end of cycle
EDS.AccSftDrv	Acceleration shifting driver score	0-100	%	end of cycle
EDS.StdSftDrv	Steady shifting driver score	0-100	%	end of cycle
EDS.CstRatDrv	Coasting ratio driver score	0-100	%	end of cycle
EDS.GlobalDrv	Global score (4 previous scores sum-up)	0-100	numerical register	end of cycle
EDS.FuelConso	Actual comsumption	0 - 10.000.000	L/100km	end of cycle
EDS.FuelTarget	Fuel estimation if all advices followed		L/100km	end of cycle
EDS.Idle.Fuel	Fuel consumption during Idle phase	0- 10.000.000	L	end of cycle
EDS.Idle.Time	Idle phase duration	1 - 4294967295	s	end of cycle
EDS.Accel.Distance	Distance during acceleration phase	0-500.000	m	end of cycle
EDS.Accel.Fuel	Fuel consumption during acceleration phase	0- 10.000.000	l	end of cycle
EDS.Steady.Distance	Distance during steady phase	0-500.000	m	end of cycle

EDS.Steady.Fuel	Fuel consumption during steady phase	0- 10.000.000	l	end of cycle
EDS.DecelDistance	Distance during deceleration phase	0-500.000	m	end of cycle
EDS.Decel.Fuel	Fuel consumption during deceleration phase	0- 10.000.000	l	end of cycle

Table 25 Measurement list registered in the Eco drive support system

5.2.1.2. File definitions

All the logs generated during the experiment have to be collected in data files periodically. For Scenario 1 it has been decided that the files will be generated daily per truck and system. To avoid duplicate names, a common file name pattern has been defined. This standard name is proposed for all the services involved in FREILOT (to get an easier development of the data management tool). The definition of the file name is the following:

- "yyyy-mm-dd hh_mm_ss_IDCity_x_IDSystem_y_IDTruck_platenumber_IDDriver_driverid_IDCompany_company.txt"

Where:

- "yyyy-mm-dd hh_mm_ss" : references the date and hour.
- "x" : city ID: 2→Bilbao, 3→Lyon,4→Helmond,5→Krakow.
- "y" : system ID: 1→EEIC, 2→ASL, 3→AL, 4→EDS, 5→DSB.

Depending on the data logging system selected for each system and the information available per pilot site, some fields won't be present in the file name. In case of the Volvo systems the pattern name will be as follows:

- "yyyy-mm-dd_IDCity_x_IDSystem_y_IDTruck_platenumber_ IDCompany_companyname.txt"

For example in Lyon, on 2010-09-28 a log file name of the EDS on a truck belonging to the company NANUK looks like this:

- "2010-09-28_IDCity_3_IDSystem_4_IDTruck_9800CDF_IDCompany_NANUK.txt"

An example of text file logged from Volvo systems (values are dummy) is presented below:

```
date: 2010-05-14 15:23:08
truckId: H4D4685FDHUCHJXW45
driverId: SERGE_DUPONT
trigger: ZONE_EXIT
zoneId: 68

SL.Value: 50
SL.Active.Time: 16584695
SL.Active.Fuel: 0.896425
SL.Active.Distance: 589
SL.Limiting.Time: 49563258
SL.Limiting.Fuel: 0.58564
...
```

Figure 5 Example of a data file from Volvo data logger

5.2.1.3. Local Data Server

In order to share and retrieve the data files generated in all pilot sites a definition of the servers which will store all the data collected is needed. The desirable solution is using FTP servers in all pilot sites. In the next figure the scheme of the Volvo local data management is shown:

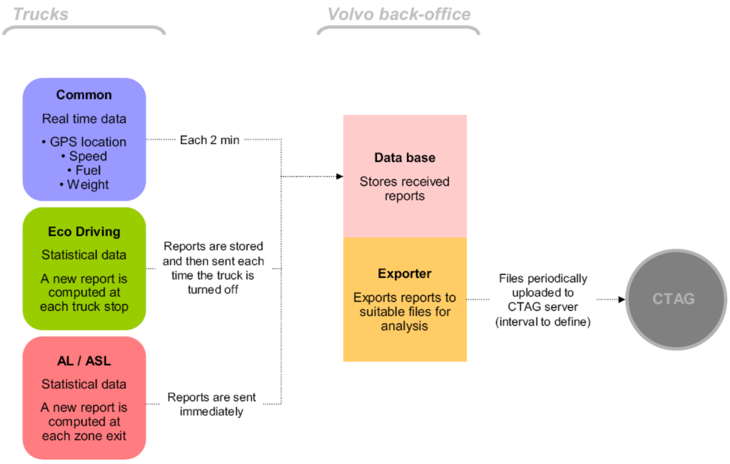

Figure 6 Data logging scheme and data retrieval with Volvo systems.

The data reports from trucks are uploaded to the Volvo back office and are exported to suitable files for analysis. Later the data files can be retrieved from the Volvo server periodically. This period can be variable and has to be supported by the downloading scripts.

5.2.2.Scenario 2: Delivery Space Booking in Bilbao

For the DSB in Bilbao the data is logged from each truck once per day taking advantage of a Blackberry's GPS system. The driver logs in to the Blackberry's system before starting the journey and then the GPS data is collected for the whole journey. Files are sent via GPRS to the Bilbao local FTP server.

Added to the data collected by the GPS system, in order to estimate the impacts of DSB systems on both traffic flows and driver's parking behaviour, a data collection method was proposed based on both automatic and manual data collection.

5.2.2.1. Data list recorded

The data recorded per truck and day using the GPS data loggers is described in the next table:

Delivery Space Booking	RANGE	UNITS	Logging frequency
GPS date and time	-	YYYY-MM-DD HH:MM:SS	0.5 Hz
GPS position	-	GPS coordinates	0.5 Hz
GPS Speed	-	Km/h	0.5 Hz
GPS number of satellites	-		0.5 Hz
GPS signal level	-	dB	0.5 Hz

Table 26 List of data registered by DSB system in Bilbao

In Bilbao, four DSB areas are taken into account. However, only three of them are equipped with automatic traffic counting sensors. These sensors are installed at streets near the intersections, in order to estimate the traffic intensity in each road, direct or indirectly. Indeed, not all the streets are equipped with sensors, but only a subset of them. In order to obtain the traffic in the unequipped streets, it is possible to estimate them by addition and/or subtraction of the flows of the adjacent streets that are equipped.

The manual data collection has been carried out using two types of questionnaire for the baseline and an improved questionnaire derived from that of Lyon in the case of the pilot. The baseline data collection would take place during 6 weeks whereas for the pilot we propose to collect data of 3 complete weeks.

The procedure can be summarised as follows. In Bilbao, the counting operator is observing a big area which includes at least one crossroad and more than three street sections. In this context, an accurate observation vehicle by vehicle is not possible. For this reason, two different procedures were tested. In the first, each hour, the number of vehicles was recorded, by type of vehicle and type of infraction. Moreover, the main incidents were also noted. In the second, a more accurate observation was required, in order to note each infraction, its average duration and the involved vehicles. The main incidents are noted in the same way as in the first procedure. In both cases, the first five minutes of each hour, the traffic at the corresponding crossroads is observed and noted. The first questionnaire was in general well filled in, whereas the second was often not filled in completely. In the pilot, a new procedure was proposed. The related data collection procedure needs to collect, each 15 minutes, the number of vehicles in infraction, by vehicle type and type of infraction. The traffic is not counted but the exceptional events are also recorded if needed.

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5.2.2.2. File definitions

The data files in Bilbao will contain the data recorded per truck and delivery route (one truck can follow different routes per day). The names of the files are defined following the next pattern:

- “yyyy-mm-dd hh_mm_ss_IDCity_x_IDSystem_y_IDTruck_z_IDDriver_w_IDCompany_j_n_m.txt”

  Where:

  - “x” : city ID: Bilbao 2.
  - “y”: system ID: DSB 5.
  - ”z”: truck ID: plate number of the truck.
  - “w”: driver ID: login of the driver.
  - “j”: company Id: name of the company which owns the truck.
  - “n” “m”: files are fragmented because of size problems, “n” references the particular part from the total number of parts “m”.

For example, in Bilbao using the DSB during a day, the file being the first part of a total of six, the name is as follows.

- “2010-07-22 07_49_08_IDCity_2_IDSystem_5_IDTruck_0624BCN_IDDriver_perez_IDCompany_DHL_1_6.txt”

An example of data file recorded in Bilbao is presented in the next figure:

```
date and time;latitude;longitude;altitude;speed;sats_number;signal_level
22/07/2010-11:13:13;43.20555;-2.708956;2.75;143.0;3;-72;
22/07/2010-11:13:15;43.205524;-2.708979;0.00;143.0;3;-72;
22/07/2010-11:13:17;43.205524;-2.708979;0.00;143.0;3;-72;
22/07/2010-11:13:19;43.205524;-2.708979;0.00;143.0;3;-72;
22/07/2010-11:13:22;43.205591;-2.708988;0.00;128.0;4;-72;
22/07/2010-11:13:24;43.205607;-2.70898;0.00;122.0;5;-72;
22/07/2010-11:13:26;43.205618;-2.709;0.00;118.0;5;-72;
22/07/2010-11:13:28;43.205649;-2.708979;0.00;114.0;5;-72;
22/07/2010-11:13:30;43.205672;-2.708975;3.19;114.0;5;-75;
22/07/2010-11:13:32;43.205706;-2.708952;4.33;113.0;5;-72;
22/07/2010-11:13:34;43.205718;-2.708959;4.11;114.0;4;-71;
22/07/2010-11:13:36;43.205732;-2.708954;2.75;110.0;3;-71;
22/07/2010-11:13:39;43.205744;-2.708937;0.00;110.0;3;-71;
22/07/2010-11:13:41;43.205738;-2.708956;0.00;109.0;4;-71;
```

Figure 7 Example of file registered in Bilbao with the DSB data logger.

5.2.2.3. Local Data Server

The data file server selected in order to store the files locally and facilitate file sharing, is a FTP server. CTAG and evaluation partners can retrieve the files uploaded during the experiment.

5.2.3.Scenario 3: Delivery Space Booking in Lyon.

Delivery Space Booking in Lyon will use the same data collection scheme for non Volvo trucks as it has been implemented in Bilbao, this is data logging based on GPS measurements from mobile devices in non Volvo trucks. Data files will contain the data from each truck per day. The data list, data files definition and naming is equal to the Bilbao case.

5.2.3.1. Data list recorded

The data list features will be the same as in Bilbao (see Table 26).

In Lyon there are not traffic sensors installed near the DSB areas so, in order to obtain data to study these impacts, a manual method has been developed from Bilbao's baseline feedbacks (Bilbao DSB pilot site started in advance). After determining the advantages and disadvantages of the procedure used in Bilbao, and the impossibility to automatically measurement of the traffic flows in the two DSB areas, we propose an « only manual » data collection method. This method is able to collect more detailed qualitative data but needs more human resources to ensure its accuracy.

The data collection procedure is organised as follows. Because the road sections are small, each vehicle can be well identified and checked while parking. For this reason, for each vehicle, the arriving hour, the place of parking, the type of vehicle, the purpose of parking and the hour of departure, among others, are recorded. The streets are small, and from these data the type of infraction can be identified. Moreover, a second procedure for traffic counting is used. In this procedure, the number of vehicles on the section are recorded each 10 minutes.

5.2.3.2. File definitions

The file name pattern proposed for Lyon files for the DSB system is described below:

- "yyyy-mm-dd hh_mm_ss_IDCity_x_IDSystem_y_IDTruck_z_IDDriver_w_IDCompany_j.txt"

The different fields will contain the same information as has been shown in the previous sections. Files will be registered per truck and day.

5.2.3.3. Local Data Server

The data will be uploaded to a FTP server in order to give an easy access for data retrieval to the evaluation partners which can access to the server and download the data files in his system.

5.2.4.Scenario 4: Intersection Control in HELMOND and KRAKOW

Intersection Control has two DAS units which will register data: a vehicle unit collecting GPS data and sending it to the road side unit when the vehicle is in radio range of an intersection, and a road side unit collecting data related to the traffic light controller status on intersections. The road side unit stores the truck and intersection logs and compresses the data into one file. These files are retrieved to the Peek headquarters where CTAG and the rest of evaluation partners will be able to download them later.

5.2.4.1. List of measurements logged.

In the tables below the measurements registered in this case are presented. The first table gathers the info coming from the truck logs and the second table contains the logs from the intersection infrastructure.

Intersection Control Truck Logs	RANGE	UNITS	Logging Frequency
GPS date and time	-	YYYY-MM-DD HH:MM:SS	1 Hz
GPS position	-	GPS coordinates	1 Hz
GPS heading	-	degrees	1 Hz
GPS Speed	-	Km/h	1 Hz
Priority message received:	-		1 Hz
intersection id	-	numerical register	1 Hz
priority state	-	numerical register	1 Hz
distance to the stop line	-	m	1 Hz
time until green (if applicable)	-	s	1 Hz
advised speed (if any)	-	km/h	1 Hz

Table 27 List of truck logs registered in Energy Efficient Intersection Control system

Energy Efficient Intersection Control Road side Logs	RANGE	UNITS	Logging Frequency
state of traffic lights for all directions (including pedestrians)	-	-	1 Hz
state of any pending priority requests	-	-	1 Hz

Table 28 List of road side logs registered in Energy Efficient Intersection Control system

5.2.4.2. File definitions

There will be two files containing the data logged with the Energy Efficient Intersection Control system. The file name pattern is the same as in the previous scenario with the in-vehicle systems (see section 5.2.1.2). Some variations depending on the particularities of each DAS were introduced. In this case, there are two files per intersection, one of them containing the data logs coming from all the trucks which have been crossing the intersection during the day and the other with information about the traffic controller state per day. Then these two files are compressed into another one. The name proposed for these three files are the followings:

- “yyyy-mm-dd_IDCity_x_IDSystem_y_IDIntersection_xx.gz”. For the compressed file being:
  - “yyyy-mm-dd” the date where the file is created.
  - “x” : city ID: 2→Bilbao, 3→Lyon,4→Helmond,5→Krakow.
  - “y” : system ID: 1→EEIC, 2→ASL, 3→AL, 4→EDS, 5→DSB.
  - “xx” is the intersection ID. It could be an alphanumerical code, not defined yet.

  Example of name for Lyon: “2010-10-15_IDCity_3_IDSystem_1_IDIntersection_A1.gz”
- “yyyy-mm-dd_IDCity_x_IDSystem_y_IDIntersection_xx_TruckLogs.txt”. For the file containing the truck logs. An example of file name in Lyon could be:

  “2010-10-15_IDCity_3_IDSystem_1_IDIntersection_A1_TruckLogs.txt”
- “yyyy-mm-dd_IDCity_x_IDSystem_y_IDIntersection_xx_IntersectionLogs.txt”. Containing the infrastructure logs.

  For example: “2010-10-15_IDCity_3_IDSystem_1_IDIntersection_A1_IntersectionLogs.txt”.

5.2.4.3. Local Data Server

As in the 5.2.1.3 section the desirable solution to store and share data from the pilot sites (Helmond and Krakow) is a FTP server. The development of the downloading scripts can be adapted easily if this solution is used in all the pilot sites. The data retrieval has to be done periodically to store the files in the CTAG back up database and in the evaluation partner storage systems.

5.2.5.Scenario 5: Energy Efficient Intersection Control in Lyon

In the Lyon pilot site the data provided by the Energy Efficient Intersection Control data loggers is recorded on trucks per day. There are two different pilot sites for priority, each which their own mode of operation:

1. Green wave
2. Priority control with cooperative system

In both pilot sites the trucks will register the data logs only when they enter in the pilot area. For the green wave pilot site, FREILOT trucks will detect that they are entering in the pilot zone using GPS positioning.

5.2.5.1. Data list recorded

The data recorded depends on the intersection where the data has been logged. In the intersection with the green wave mode the data list is composed of the GPS measurements recorded each second, this list is shown in the following table (next page):

Energy Efficient Intersection Control Green Wave mode	RANGE	UNITS	Logging Frequency
GPS date and time	-	YYYY-MM-DD HH:MM:SS	1 Hz
GPS position	-	GPS coordinates	1 Hz
GPS heading	-	degrees	1 Hz
GPS Speed	-	Km/h	1 Hz
Priority message received:	-		1 Hz
city id	-	numerical register	
intersection id	-	numerical register	1 Hz
priority state	0 no priority 1 intersection priority -1unknown	numerical register	1 Hz
distance to the stop line	-1 if distance unknown	m	1 Hz
time until green (if applicable)	-1 if time unknown	s	1 Hz
advised speed (if any)	-1 if no advised speed	km/h	1 Hz

Table 29 List of data registered with Energy Efficient Intersection Control Green Wave mode in Lyon

The list of data for the cooperative priority intersections will contain GPS position and specific information sent by the cooperative system, see the next tables:

Energy Efficient Intersection Control priority control mode	RANGE	UNITS	Logging Frequency
GPS date and time	-	YYYY-MM-DD HH:MM:SS	1 Hz
GPS position	-	GPS coordinates	1 Hz
GPS heading	-	degrees	1 Hz
GPS Speedy	-	Km/h	1 Hz
Priority message received:	-		1 Hz
city id		numerical register	
intersection id	-	numerical register	1 Hz
priority state	0 no priority 1 intersection priority -1unknown	numerical register	1 Hz
distance to the stop line	-1 if distance unknown	m	1 Hz
time until green (if applicable)	-1 if time unknown	s	1 Hz
advised speed (if any)	-1 if no advised speed	km/h	1 Hz

Table 30 List of data data for the cooperative priority intersections in Lyon

When crossing the traffic light:	Description	UNITS	LoggingFrequency
tag HIST	tag to identify specific intersection data	-	Event
Trajet Id	ID diaser of route (0..7)	numerical code	Event
Itinary Id	Database ID of the vane	numerical code	Event
First announce Timestamp	Date and time of the first exchange of data between truck and intersection	YYYY-MM-DD HH:MM:SS	Event
Crossing timestamp	Date and time when truck cross intersection	YYYY-MM-DD HH:MM:SS	Event
Lost time	Time where truck speed < 5km/h	s	Event

Table 31 List of data registered in Energy Efficient Intersection Control with Cooperative System in Lyon

5.2.5.2. File definitions

For both intersections (priority control mode/green wave mode), there will be one file per truck and day (if trucks cross the pilot areas) containing the data described in the previous section. There will be another file containing data registered by the traffic density sensors installed in the pilot sites.

The names of the files follow the same pattern that has been defined previously:

- "yyyy-mm-dd_IDCity_x1_IDZone_x2_IDSystem_y_IDTruck_z_IDCompany_w.txt"
  Where:
  - "yyyy-mm-dd" is the date where the data contained is logged .
  - "x1" : Id of city : Lyon 3.
  - "x2" : Id of area, Route de lyon (cooperative priority) = 0, Gerland (green wave) = 1.
  - "y" : Id of system , for the Energy Efficient Intersection Control is 1.
  - "z" : Id of truck (ex. truck 1 : 2001, truck 2 : 2002, truck 3 : 2003)
  - "w" : ID of company.

The files have a header which contains a line beginning by "#" and describing:

1. Id of the truck which the file comes from.
2. Description of the data fields.

File name example:

- "2010-10-28_IDCity_3_IDZone_0_IDSystem_1_IDTruck_2001_IDCompany_DHL.txt"

An example of file logged for truck identified as "2001" that is approaching the intersection controller "VN052" looks as follows:

```
##################################################
# File for statistic of the day for FREILOT Lyon#
#Truck Id : 2001
# Line format :
# Date,GPSLong,GPSLat,GPSHeading,GPSSpeed,IdTown,IdCarref,PriorityState,DistancePF,TimeBeforeGreen,MaxSpeedAdvised
##################################################
2010/09/13 14:9:57;4.804850;45.781340;36;2;-1;-1;-1;-1;-1;-1
2010/09/13 14:9:58;4.804870;45.781350;37;2;139;52;-1;-1;-1;-1
2010/09/13 14:9:59;4.804870;45.781350;37;4;139;52;-1;-1;-1;-1
2010/09/13 14:10:0;4.804870;45.781350;37;6;139;52;-1;-1;-1;-1
2010/09/13 14:10:1;4.804870;45.781350;38;12;139;52;-1;-1;-1;-1
2010/09/13 14:10:2;4.804870;45.781350;38;13;139;52;-1;-1;-1;-1
HIST ;0 ;0002 ; 21/09/2010 15 :52 :45 ; 21/09/2010 15 :53 :37 ;21
2010/09/13 14:10:3;4.804870;45.781350;38;11;139;52;1;292;7;-1
2010/09/13 14:10:4;4.804870;45.781350;39;15;139;52;1;290;6;-1
2010/09/13 14:10:5;4.804870;45.781350;39;18;139;52;1;285;5;-1
2010/09/13 14:10:6;4.804870;45.781350;40;20;139;52;1;283;4;-1
2010/09/13 14:10:7;4.804870;45.781350;41;23;139;52;1;278;3;-1
2010/09/13 14:10:8;4.804870;45.781350;42;25;139;52;1;275;2;-1
```

Figure 8 Example of file registered in Lyon with the Energy Efficient Intersection Control data logger

5.2.5.3. Local Data Server

The files logged on trucks will be sent via GPRS and locally stored in a FTP server. Then the files will be retrieved from Lyon to the evaluations partners.

5.3. Database

This chapter describes the data management process from the data acquisition systems to the final results.

In this case there will be different locations where the data is collected (Bilbao, Helmond, Lyon and Krakow). The data is stored in the local data servers in each pilot site and in a back up database. This implies that the back up database must be in a fixed place and it should have enough capacity for storing all the data collected during the 12 months of the pilot. For FREILOT, the proposal is having a back up database in CTAG and specific files storage systems, ,belonging to the rest of partners involved in the evaluation tasks, to facilitate data retrieval among all evaluation partners during the data processing period .

The data storage server has capacity enough to store the files coming from the different pilot sites during the experiment. With the global data base centralised in one location, the data files sharing between the evaluation partners will be more effective. Then rest of the process continues with the performance indicator calculation, hypothesis testing and data global assessments.

6. Fuel Consumption and Emissions

One of the main objectives of FREILOT project is the analyses of the impact on fuel consumption introduced by the services. In this sense, the basic measurement needed is the fuel consumption. For the VOLVO/RENAULT trucks, this measure is recorded directly from the truck but, for the other trucks, it was not possible to use a datalogger connected directly to the truck internal network as these trucks come from different providers and the FREILOT partners has not the access. This fact implies the use of GPS based dataloggers, used commonly to record more generic information (for a more detailed description about the different dataloggers see Chapter 5). These dataloggers can not record directly the fuel consumption and, in consequence, a different approach should be applied in this case using models and simulation software to stimate the fuel consumption. The methodology followed is described in next paragrahs.

For the gas emissions stimation, the approach for all trucks was the use of models and simulation software because the measurement in real time was expensive and not realistic.

Concerning the choice of emission models, the usage of the CMEM solution (that does not take into account specific engine characteristics) is due to the fact we aim to simulate an average fleet of trucks. Using an engine-based model should need specific data to make the estimations (which is possible to obtain) but also provide specific inputs for model calibration, making measures and/or providing information for a wide spectrum of vehicles. This is not possible taken into account the project's resources and deadlines, and the goals can be measured using an aggregated model for a mean vehicle (like CMEM).

It seems however important to provide a scientific justification of the model's choice. To do this, we refer to the Model Operability Theory of Bonnafous (1989), more precisely to the Operability's Triangle, which states that an operable model has to verify three conditions : coherence, pertinence and measurability.

Concerning coherence, an engine-based model seems more detailed and able to closer estimate the reality. However, an aggregated model can estimate average results. Since the goal is to estimate emission and consumption trends with respect to a reference, the errors being equivalent on the baseline and on the pilot (cf. CMEM User_Guide_v3.01d SCORA G and al. for a detailed description of the model and their error estimations), a before-after comparison is possible. The error margin can be estimated to 2-5%, which can be seen as a big value but gives an global idea of the impact. Taken into account this fact, an aggregated model relating fuel consumption to acceleration will be more suitable than the COPERT or ARTEMIS tables, usually proposed for planning-forecasting and socio-economic analysis. Note that engine-based models are suitable when making analysis for a given engine definition, and are difficulty adaptable to average fleets (see measurability). Moreover, taken into account the differences between models'parameter, a better error margin is not possible even with engine-based models (cf ARTEMIS Projects Andre M and al, 2006).

Pertinence is difficult to analyse, but we can take into account that the objective is to measure the difference between a before and and an after situation, in average, in order to produce reallistic mean gains associated to each system. A very detailed model, not well calibrated because lack of data is not pertinent, since passing from each engine results to average results will induce errors difficult to identify and study. An aggregate model, based on average vehicles, without engine-based parameters, is based on assumed driving behaviours on mean vehicles. Since vehicles and driving behaviours (eco-driving style, respect of fires/parking areas, etc.) will not evolve for both DSB and EEIC (as seen in DL 4.2. on the basis of distance, speed and acceleration values), the CMEM model seems pertinent in the sense of Bonnafous.

Concerning measurability, we have to note that CMEM needs standard data that are easily obtained from transport carriers and GPS data. Engine-based models need to define several parameters that only manufacturers can exactly define. Althoguh some of them can be obtained from transport carriers, the human effort to obtain all needed data makes that it is not possible to do it within the project's deadlines (to obtain basic information like euro class, capacity and type of vehicle, in three dimension range, took four months and only 40% of the carriers in Bilbao provided all requested information to calibrate CMEM model). Moreover , assuming an average fleet of vehicles (ADEME, 2003) will imply tens of engine configurations for evaluation purposes and hundreds of engine configurations for simulation. At the middle of pilot in Bilbao, the database dimension for GPS evaluation was of more than 9 million lines, taking one week to be prepared for the analysis. An aggregated model allows to speed the emission and consumption estimations, reducing to three classes, and helps the simulation (for WP6 calculations). Moreover, the object reduction (Bonnafous, 1989) is lower than that of ARTEMIS or COPERT tables.

In order to estimate fuel consumption and gas emissions, a methodology is proposed that can use two variants of the data logger system:

- VOLVO/RENAULT Trucks datalogger
- GPS based datalogger (used in non-VOLVO/RENAULT trucks)

After a brief survey on the main methods and software used for fuel consumption and environmental impact of freight transport, two types of models were identified. The first uses average values for speeds and accelerations, and it is mainly used for overall greenhouse gas emissions for transport (ARTEMIS Projects Andre M and al, 2005). The methods belonging to this category use in general synthetic equations, often resumed on tables like those of COPERT and Impact ADEME software solutions. The second is able to estimate instantaneous fuel consumptions and emissions (cf CMEM User_Guide_v3.01d SCORA G and al.).

In next figure (see Figure 9), the complete process for fuel consumption and the emissions calculation is presented:

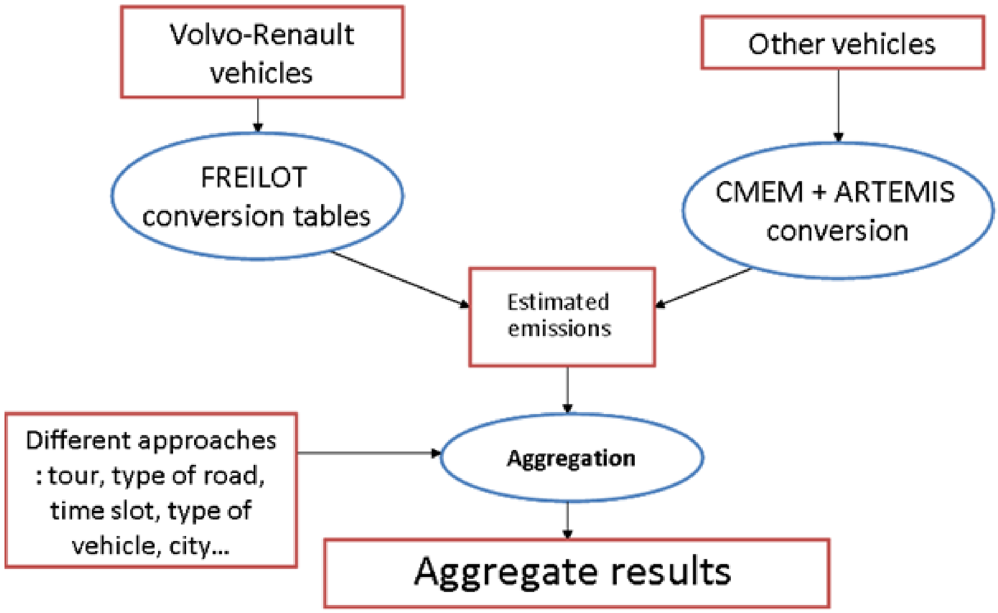

Figure 9 Evaluation of environmental impacts

For trucks piloting AL, SL and EDS, instantaneous fuel consumption will be recorded directly from the vehicle. Then, by aggregating the data (using conversion tables), it is possible to obtain the total fuel consumption.

For other trucks, the fuel consumption will be estimated using an instantaneous model as the CMEM software. The main input parameters are instantaneous speed, instantaneous acceleration, motor type, weight and power of the trucks. Before this estimation, the data recorded with this data logger is going to be processed in order to identify possible bugs, clean the GPS data and track the delivery stops. For this operation, specific software is going to be developed and adjusted. The next figure (Figure 10) shows the process to estimate the indicators from the GPS data:

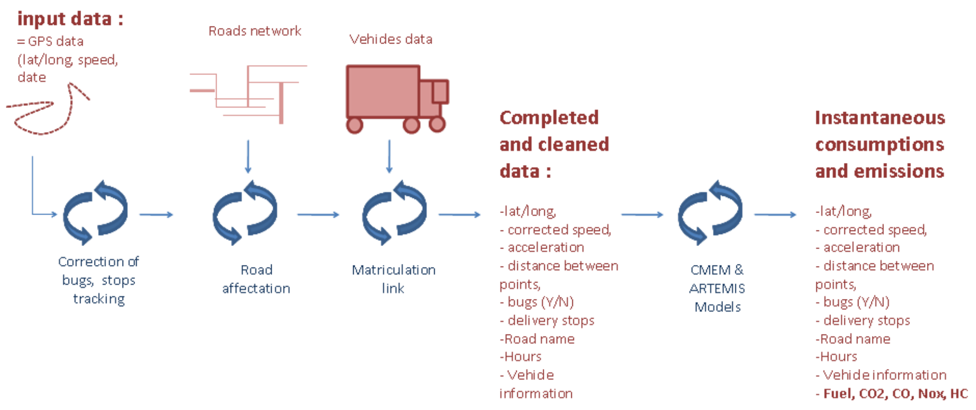

Figure 10 Calculation of fuel consumptions and pollutants emissions for non Volvo-Renault vehicles

According to many authors, fuel consumption and CO_2 emissions are proportionally related (Shimizu and al., 1996). Moreover, as the CMEM software has been calibrated with a similar hypothesis, the relationship coefficient between fuel consumption and CO_2 emissions can be obtained. In addition, an European model as ARTEMIS is used to calibrate the CMEM's estimated values.

6.1. Choice of models

Several models exist in order to estimate consumptions and emissions. However, only few models answer to these constraints :

- the chosen models must take into account accelerations, specifically for EEIC evaluation. Indeed, it is expected that the reduction of fuel consumption will be due to reducing the number of accelerations/decelerations ;
- The model must take into account several types of vehicle because the studied system concern the light-duty vehicles (<3,5T) as well as the heavy vehicle (around 16 T) ;
- The tool must be quick because of the quantity of collected data.(several billons of GPS points). Moreover, it must be able to automate the estimation in a computing program with command lines.

The set of vehicles which participate to the pilot is not representative for the variety of vehicles used for Urban Goods delivery. However, one of the objectives of FREILOT is to be able to generalize the results of the Evaluation to a pan-European context. The approach that has been chosen is to try to apprehender the generalisation work during the evaluation period. Following this principle, a literature search has been made. The methods used in Europe are either for general traffic issues (ADEME, 2003; ARTEMIS, 2006; Gkatzoflias et al., 2007; Melios et al., 2009) or derive from industrial models developed for specific vehicle models and subjected to confidentiality clauses. The general models are public and propose several types of vehicles, both light and heavy, but are only related to the speed and to a typology of average-loaded vehicles. We found only two models that take explicitly into account both: speeds and accelerations in the variable set for fuel consumption and pollutant emissions estimation. Akcelik et al. (2003) propose a model mainly used in the Australian context for private cars. Although the equations can be reproduced and adapted, no calibration on heavy vehicles has been made. Barth et al. (2004) propose a model for the USA context that includes both cars and heavy vehicles.

It is for all these reasons that the CMEM model (Barth et al., 2004) was chosen for estimating fuel consumptions and pollutants emissions according to the instantaneous acceleration, instantaneous speed and some vehicle parameters as the weight. Nevertheless, the CMEM is not fully satisfactory because it is an American Model which does not completely take the European norms into account. Therefore, two solutions were possible to calibrate the CMEM estimation with European references. The first solution is to use real measures from the tested vehicles. This process is long and complex, the vehicles are not very representative for the European fleet, and the difficulty of the process does not allow to be representative of all urban situations (small/large street, different type of traffic, meteorology, etc). The second solution is to use existing models that give emissions for different categories of vehicles (based on weight and Euro norm) according to the average speed in urban conditions. Two of these models are famous in European transportation research: COPERT and ARTEMIS. Today, the COPERT model take into account:

- the hot and cold emissions (which depend on the motor temperature) ,
- different driving conditions
- climatic conditions

Each model is calibrated with a large data set of vehicles (for more details about these models, see ; Gkatzoflias et al., 2007 and ARTEMIS, 2006).

Between COPERT and ARTEMIS, there are some differences of methodology and vehicle data set but both give emissions according to speed . The results can be more or less different but are in the same order of magnitude, mainly for CO_2 and NO_x Emissions. The differences can be more important for HC, CO, and PM10.

6.2. Measurements to be estimated

The CMEM model is able to estimate fuel consumption and CO2, CO, NOx and HC emissions. However, the PM10 emissions do not appear among the possible measures to estimate with this model. COPERT and ARTEMIS are able to estimate estimate fuel consumption and CO2, CO, NOx, HC and PM10 emissions.

Fuel consumption and consequently CO2 emission estimation with the CMEM is robust and realistic. Indeed, after several tests on the baseline data, the aggregated average estimations with the CMEM model are close to those obtained with COPERT and ARTEMIS models. For this reason, fuel consumption and CO2 will be estimated using the CMEM model calibrated using the method presented in next subsection.

NOx and CO estimations will also be estimated using a calibrated CMEM adaptation (see below) because although there are some differences between COPERT and ARTEMIS the first calibrations results are satisfying. This was not the case of HC, which variability in each model and the smaller contribution to air pollution with respect to NOx led us to not take into account this measure in the FREILOT evaluation.

Considering PM10 estimations there are two main limits in the FREILOT pilot:

- The first is that the CMEM model do not allow to estimate the instantaneous PM10 emissions, which suppose to produce only aggregate data without a connection to the acceleration behaviour. In this way, the effects of intersection control on acceleration will not be highlighted in PM10 emission estimation.
- The second is that for the moment, there is no robust model for PM10 estimation, and the main frameworks present many methodological and fundamental differences which seem to converge on the fact that the best analysis seems to be a study on acceleration behaviour, and not on PM10 emission rates, since these two elements are extremely correlated.

For theses reasons, an explicit PM10 estimation is not proposed in the FREILOT evaluation.

6.3. Methodology of calibration

As it was comented at the beginning of this chapter, the models used in FREILOT are wide world validated models that, before being used in FREILOT, it will be calibrated taking into account the trucks used in the pilot. This sub-section describes the calibration process applied.

The first tests for the FREILOT Evaluation have been made with CMEM+ARTEMIS because of the easy availability of ARTEMIS equations. Because CMEM parameters are numerous and difficult to get from carriers, three categories were made of vehicle. For each group, in order to calculate the coefficient factor between CMEM and ARTEMIS, it was used the CMEM's instantaneous emissions recorded on about 50 delivery routes were used.

During the project, if more elements will be taken into account to make a choice between ARTEMIS and COPERT, it will be defined if CMEM+ARTEMIS will be kept or if use CMEM+COPERT will be used.

7. Evaluation Plan

In previous chapters, the Research Questions, the Hypotheses, the measurements and the process for collecting data are described. This section is focused on the description of the evaluation plan, specifying the periods for data collection for each truck in each pilot site, taking into account the combination of services.

One of the main aims of FREILOT is the evaluation of the services described in the four pilotsites (Bilbao, Helmond, Lyon and Krakow). Each pilot site has its own configuration of services implemented and a number of trucks using them (see chapter 3 and D.FL.2.1. Implementation Plan). In order to provide a common evaluation framework in the four pilot sites and for all the services, general experimental designs were defined taking into account the combination of services per truck, independent of the pilot site. In some specific cases, the experimental design have been adapted to the technical needs and the specific conditions of the pilot site.

Each experimental design is composed of a *baseline period* and an *experimental period*. During the *baseline period*, the data defined in previous sections will be recorded without any FREILOT service actived, while during the *experimental period* the data will be registered with the FREILOT services included in the truck activated. In this way, from the baseline, data from the current situation in the cities (without the services) will be available in order to compare with the effect of the services. Then, during the pilot, the same indicators will be analysed with and without the services in order to show the benefits.

Regarding the combination of systems, different combinations are proposed:

- 1 service per truck (AL, ASL, EDS, EEIC, EDS).
- 2 services per truck (SL+ASL, EEIC+SL, AL+EEIC, EDS+EEIC).
- 3 services per truck (AL+ASL+EDS, AL+ASL+EEIC).
- 4 services per truck (AL+ASL+EEIC+EDS).

Therefore, it will be possible to check the effects of the services separately and the effects of the combination of services.

Below (Chapter 7.2~~7.2~~) the general experimental designs proposed at the very beginning of the project are presented. This is a presentation of the first approach for all the services. These general experimental designs were adjusted in each pilot site, taking into account the number of trucks and the combination of systems implemented and are presented in next sub-chapter (Chapter 7.3~~7.3~~). In Chapter 7.4 an overview of the evaluation plan to be executed in the different pilot sites is presented including the starting dates for the data collection. In this chapter, some modifications to the original plan (described in chapter 7.3) were introduced taking into account some technical adaptations. Finally, in chapter 7.4 one table including all the trucks and all the pilot sites of the FREILOT project summarizes the current evaluation plan.

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Before describing the different experimental designs, a subchapter is included explaining the procedure for the questionnaire evaluation.

7.1. Questionnaire Evaluation

Subjective data are gathered by questionnaires developed for each system or service. Each questionnaire will be translated to the pilot sites native language. Moreover, a final dossier will be created with the last translations and an application guide will be included.

The questionnaire will be filled in by each truck driver and fleet operator, and they will be collected at two different moments during the experimental trial period: the first one in the middle of the experimental phase, and second one at the last week before the finish the trial.

Annex II contains the different questionnaires with the items per system and the adaptation of the CVIS questionnaire (only for Delivery Space Booking) is included in Annex III.

7.2. General Experimental Designs

Taking into account the possible combination of systems installed in the trucks, different general experimental designs are proposed.These are described in following paragraphs.

- **Trucks with 1 service.**

2 MONTHS	8 MONTHS	2 MONTHS
System / service OFF	FREILOT service/ system working	System / service OFF
Baseline	FREILOT SYSTEMS Active	Study of carry-over effects

Table 32 Experimental Design (within subject design A-B-A) for trucks with one system implemented

- **Trucks with 2 services.**

In case of combination of the in-vehicle systems (Acceleration Limiter, Adaptive Speed Limiter, and Eco Driving Support), the following experimental design is used:

2 MONTHS	8 MONTHS	2 MONTHS
Systems / services OFF	Two FREILOT services/ systems working simultaneously	Systems / services OFF
Baseline	FREILOT SYSTEMS Active	Study of carry-over effects

Table 33 Experimental Design (within subject design A-B-A) for trucks with two systems implemented

In case that the combination of systems includes at least one of the services that involve infrastructure (Energy Efficient Intersection Control and/or Delivery Space Booking), the experimental design used is the following one:

- Energy Efficient Intersection Control:

2-3 MONTHS	10-9 MONTHS
Energy Efficient Intersection Control OFF	Energy Efficient Intersection Control working
Baseline	FREILOT SERVICES Active

Table 34 Experimental Design (within subject design A-B) for trucks with Energy Efficient Intersection Control Service in combination with another system

- Delivery Space Booking:

In this case the experimental design depends on the performance of each service combination in each pilot site. These specifications are contained in the specific section of each pilot site.

- **Trucks with 3 services**

In this case, the experimental design used is the following one. The design is prepared taking into account that the only combination of 3 systems at this moment is a combination of in-vehicle systems.

2 MONTHS	8 MONTHS	2 MONTHS
Systems / services OFF	Three FREILOT systems/ services working simultaneously	Systems / services OFF
Baseline	FREILOT SYSTEMS Active	Study of carry-over effects

Table 35 Experimental Design (within subject design A-B-A) for trucks with three systems implemented

- **Trucks with more than 3 services**

3 MONTHS	9 MONTHS
Systems / services OFF	Combination of four services or all of them working simultaneously
Baseline	FREILOT SYSTEMS Active

Table 36 Experimental Design for trucks with more than 3 services implemented

7.3. Experimental Designs per Pilot Site

This chapter summarizes the specific experimental designs per truck and per pilot site. The evaluation plan is explained taking into account the number of systems activated in the truck, so, per pilot site there are different tables depending on the number of systems per truck. These trucks in which systems are going to be activated and deactivated in different periods and with different combinations of services, will appear in different tables.

7.3.1. Bilbao Pilot Site

The applications to be tested in Bilbao Pilot Site are: Acceleration/Adaptive Speed Limiter, Eco Driving Support and Delivery Space Booking.

The combinations of systems per trucks are the following ones:

BILBAO	
FREILOT Services Combination	Truck ID
DSB	**127 trucks***
ASL+AL	B06
AL+ASL+EDS	B04

Table 37 Combination of systems per truck in Bilbao

The trucks were added in three phases: at the beginning of the project 37 trucks were confirmed and, 76 trucks more were included after January 2011 in the project and in a third phase 11 vehicles more were included in May 2011.

7.3.1.1. Experimental design

In this case, according to the conditions to this pilot, the experimental design is a case study design where each driver in the FREILOT pilot will drive with and without the system or service.

Taking into account the type of systems (in-vehicle and infrastructure related systems, two different configurations are used:

- For studying the effects of in-vehicle systems (Acceleration Limiter, Adaptive Speed Limiter and Eco Driving Support) and its combinations.
- For studying effects of Delivery Space Booking service.

In this case the design will be a case study design with a baseline (yellow colour) and an experimental condition where the systems are activated (green colour).

The next figures summarise the periods applied for each truck, following the general experimental designs:

Trucks with 1 system:

Number of systems	Truck	Combination	1	2	3	4	5	6	7	8	9	10	11	12
1	B04	EDS												
1	B05	AL												
1	B06	ASL												
1	All trucks	DSB												

Table 38 Field trial phases for 1 system (Bilbao)

At the moment of writing this deliverable, the number of trucks in Bilbao using the DSB is 127. These trucks were included in two phases:

- 35 trucks confirmed their participation at the beginning of the project.
- 60 trucks confirmed their participation after the kick off in Bilbao (October 2010) and they have started using the system in January 2011.
- 29 trucks more were included in the pilot in April 2011.

For the evaluation, the initial 37 trucks have installed the specific GPS datalogger used for DSB (see Chapter 5). The data is recorded during the two phases (baseline/experimental phase) in these trucks. The additional trucks are considered as a change in the conditions of the experiment, so, in this case, the system will be evaluated taking into account different degrees of penetration. In any case, all drivers and fleet operators fill up the questionnaires.

In case of B06 we are collected at the beginning four months of data without the system because the first month of data collection should be discarded (this was the truck used in the demonstration in Bilbao and the first month the sytem was on). For months 8 and 9 a period without the system were planned in order to get data for analysing the effect on the driver after stoping the use of the system (hypothesis SL5).

Trucks with 2 systems:

Number of systems	Truck	Combination	1	2	3	4	5	6	7	8	9	10	11	12
2	B05	AL+EDS												

Table 39 Field trial phases for 2 systems (Bilbao)

Truck with 3 systems:

Number of systems	Truck	Combination	1	2	3	4	5	6	7	8	9	10	11	12
2	B04	EDS+AL+ASL												

Table 40 Field trial phases for 3 systems (Bilbao)

With this proposal, it will be interesting to compare if the systems combinations could show any remarkable difference. Then, the idea is to compare the interaction between Adaptive Speed Limiter and Acceleration Limiter systems and the interaction among Adaptive Speed Limiter, Eco Driving Support and Acceleration Limiter. In any case, it would be convenient to make the results universal because of the characteristic of this experiment. It must be remembered that the characteristics of the pilot site do not allow total control over the other variables than can affect the final results.

The data will be logged during the three phases using the integrated datalogger installed in the trucks (see Chapter 55).

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7.3.2. Helmond Pilot Site

Several applications will be implemented in Helmond: Acceleration Limiter, Adaptive Speed Limiter, Eco Driving Support and Energy Efficient Intersection Control. These applications will be tested using different experimental designs.

The combinations of systems per trucks are the following ones:

HELMOND	
FREILOT Services Combination	Truck ID
AL	H14,
EDS	H18, H19
EEIC	H01, H03, H06, H10 Fire brigade & Ambulances: H30, H31, H32, H33
EEIC +ASL	H15
EEIC + EDS	H17
AL + ASL + EEIC + EDS	H16

Table 41 Combination of systems per truck in Helmond

The fire brigade trucks are not considered in the global FREILOT evaluation in Helmond because the main objective of these specific vehicles is not the same as the FREILOT project (reduction of fuel consumption and CO_2 emissions). For them, the system is a possible solution for having priority at intersections and in this way to improve their reaction time in a safe way. In order to get the feedback from this collective about the system, specific questionnaires were prepared focused on the subjective assessment of the benefits for them.

7.3.2.1. Experimental design

In this case, the experimental design is a case study design where each driver in the FREILOT pilot will drive with and without the system or service.

Taking into account the type of the systems (in-vehicle and infrastructure related systems), two different configurations are used:

- For studying effects of in-vehicle systems (Acceleration Limiter, Eco Driving Support and Adaptive Speed Limiter) and its combinations.
- For studying effects of Energy Efficient Intersection Control service and its combination with Eco Driving Support, Adaptative Speed Limiter and Aceleration Limiter.

These configurations are described below:

Trucks with only one system :

Number of systems	Truck	Combination	1	2	3	4	5	6	7	8	9	10	11	12
1	H14	AL												
1	H18	EDS												
1	H19	EDS												
1	H15	ASL												
1	H01, H03, H06, H10	EEIC												

Table 42 Field trial phases for trucks with only one system (Helmond)

Truck with 2 systems:

Number of systems	Truck	Combination	1	2	3	4	5	6	7	8	9	10	11	12
2	H1**5**	ASL+EEIC												
2	H17	EDS+EEIC												

Table 43 Field trial phases for 2 systems (Helmond)

Truck with 3 and 4 systems:

Number of systems	Truck	Combination	1	2	3	4	5	6	7	8	9	10	11	12
4	H16	AL+ASL+EDS+EEI C												

Table 44 Field trial phases for trucks with 3 and 4 systems (Helmond)

With this proposal, it will be interesting to compare if the systems combinations could show any remarkable difference. The following systems will be compared:

- Adaptive Speed Limiter vs. Acceleration Limiter
- EEIC vs. Adaptive Speed Limiter
- EDS vs. Acceleration Limiter + Adaptive Speed Limiter
- EEIC vs. Acceleration Limiter + Adaptive Speed Limiter + Eco Driving Support

In any case, as mentioned before, it would be convenient to make the results universal because of the characteristic of this kind of experiments. Moreover the characteristics of the pilot site do not allow total control of the other variables than can affect the final results.

7.3.3. Krakow Pilot Site

Similar characteristics as in Helmond are found in the Krakow Pilot Site. Two services are used in Krakow: Eco Driving Support and Energy Efficient Intersection Control.

In this pilot site the systems will be evaluated individually (combinations of systems are not possible), so only the following two configurations were considered:

- For studying effects of Eco Driving Support.
- For studying effects of Energy Efficient Intersection Control service.

The combinations of systems per trucks are the following ones:

KRAKOW	
FREILOT Services Combination	Truck ID
EDS	K01, K02, K03, K04, K05
EEIC	K06, K07 (for the additional trucks to be included there are not identificador for the moment)

Table 45 Combination of systems per truck in Krakow

Trucks with only one system :

Number of systems	Truck	Combination	1	2	3	4	5	6	7	8	9	10	11	12
1	K01, K02, K03, K04, K05	EDS												
1	K06, K07	EEIC												

Table 46 Field trial phases for EDS (Krakow)

The experimental design for the EDS will be the generic one defined for the evaluation of one system individually.

The experimental design for the EEIC will be the same as the defined one in Helmond for the trucks with only EEIC, due to the similarities of both pilot sites in terms of weather. For the moment there are 2 trucks using the EEIC system. In short time, 3 more trucks and 5 buses will be included in the pilot.. The experimental design for these new trucks will be adapted to the defined one.

7.3.4. Lyon Pilot Site

In Lyon all the FREILOT services will be piloted: Acceleration and Adaptive Speed Limiter, Eco Driving Support, Energy Efficient Intersection Control and Delivery Space Booking.

The combinations of systems per trucks are the following ones:

LYON	
FREILOT Services Combination	Truck ID
ASL	L30
AL	L22, L23, L24, L25, L27
AL+ASL	L31
AL+ASL+EEIC	L29
ASL+EEIC	L28
DSB	L38, L39, L40, L41, L42, L43, L44
EDS	L16, L18, L19, L32, L33, L34, L35, L36
EEIC	L45

Table 47 Combination of systems per truck in Lyon

7.3.4.1. Experimental design

The general scheme is similar to the preceding pilot sites. For the Acceleration Limiter, Adaptive Speed Limiter and Eco Driving Support the subject design AB will be used. The baseline duration will be three months. The experimental condition will last nine months.

Taking into account the type of systems (in-vehicle and infrastructure related systems), three configurations are proposed:

- For studying effects of in-vehicle systems (Acceleration Limiter, Adaptive Speed Limiter and Eco Driving Support) and its convinations.
- For studying effects of Delivery Space Booking service.
- For studying effects of Energy Efficient Intersection Control and its combination with Adaptative Speed Limiter and Acceleration Limiter.

Trucks with only one system:

Number of systems	Truck	Combination	1	2	3	4	5	6	7	8	9	10	11	12
1	L22, L23, L24, L25, L27	AL												
1	L16, L18, L19,	EDS												
1	, L32, L33, L34, L35, L36	EDS												
1	L38, L39, L40, L41, L42, L43, L44	DSB												
1	L30	ASL												
1	L31	AL												
1	L45	EEIC												

Table 48 Field trial phases for trucks with only one system (Lyon)

Trucks with 2 systems:

Number of systems	Truck	Combination	1	2	3	4	5	6	7	8	9	10	11	12
2	L28	ASL+EEIC												
2	L29	AL+EEIC												
2	L31	AL+ASL												

Table 49 Field trial phases for trucks with 2 systems (Lyon)

Trucks with 3 systems:

Number of systems	Truck	Combination	1	2	3	4	5	6	7	8	9	10	11	12
3	L29	AL+ASL+EEIC												

Table 50 Field trial phases for trucks with 3 systems (Lyon)

7.4. Summary of the Evaluation Plan By Pilot Site

The following tables show for each truck in each pilot site which periods are planned for the data collection during the baseline and experimental periods. The deviations from the initial evaluation plan defined (see sub-chapter 7.3) are also included in these tables. For each pilot site, the start date of the data collection is indicated.

7.4.1. Summary of the Evaluation Plan in Bilbao

In the Table 51 the Evaluation Plan in Bilbao is presented. This figure includes the number of systems per truck, the ID of each truck, the combination of implemented systems and the conditions of the design.

Number of systems	Truck	Combination	1	2	3	4	5	6	7	8	9	10	11	12
3	B04	AL+ASL+EDS							EDS			AL+ASL+EDS		
3	B05	AL+ASL+EDS							AL			AL+EDS		
3	B06	AL+ASL							ASL					
1	All trucks	DSB				DSB								

Table 51 Evaluation Plan in Bilbao

The collection of baseline data for the trucks with DSB started in the middle of July 2010 and ended in the middle of October 2010.This data was used to develop the data processing tools and to test the data logger equipment. In the middle of October 2010 the experimental data collection started.The experimental period data collection will be finished in the middle of December 2011.

Three periods of manual data collection were defined (it was not possible to have people counting in the streets during the entire year). The manual data collection for the evaluation of the DSB follows the following plan:

- Baseline

  Manual data collection (1 person): 3 complete weeks per site. Period: July-September 2010

- Pilot – Intermediary

  Manual data collection (1 person): 3 complete weeks per site. Period: March-June 2011

- Pilot – Final

  Manual data collection (1 person): 3 complete weeks per site. Period: September-December 2011

Regarding the in-vehicle systems, the baseline data collection was started in February 2011.

7.4.2. Summary of the Evaluation Plan in Helmond

In Table 52 the Evaluation Plan in Helmond is presented. This figure includes the number of systems per truck, the ID of each truck, the combination of implemented systems and the conditions of the design.

<table>
<tr><th>Number of Systems</th><th>Truck</th><th>Combination</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th></tr>
<tr><td>1</td><td>H01, H03, H06, H10</td><td>EEIC</td><td colspan="2"></td><td colspan="4">EEIC</td><td colspan="2"></td><td colspan="4">EEIC</td></tr>
<tr><td>1</td><td>H14</td><td>AL</td><td colspan="3"></td><td colspan="9">AL</td></tr>
<tr><td>2</td><td>H15</td><td>ASL+EEIC</td><td colspan="2"></td><td colspan="6">ASL</td><td colspan="4"></td></tr>
<tr><td>4</td><td>H16</td><td>AL+ASL+EDS+EEIC</td><td colspan="3"></td><td colspan="9">AL+ASL+EDS+EEIC</td></tr>
<tr><td>2</td><td>H17</td><td>EDS+EEIC</td><td colspan="3"></td><td colspan="9">EDS+EEIC</td></tr>
<tr><td>1</td><td>H18, H19</td><td>EDS</td><td colspan="3"></td><td colspan="9">EDS</td></tr>
</table>

Table 52 Evaluation Plan in Helmond

The collection of baseline data for Energy Efficient Intersection Control started in January 2011. The pilot of the system started at the end of October of 2010. The data collected in November 2010 and December 2010 was discarded for evaluation taking into account that the first month, the system was tested for stability and in December 2010 the conditions of traffic are completely different due to the Christmas holidays. The baseline data collection will continue for two months.

For the in-vehicle systems, the baseline data collection started in at the end of February 2011, when the services were installed in the truck.

7.4.3. Summary of the Evaluation Plan in Krakow

In Table 53 the Evaluation Plan in Krakow is presented. This figure includes the number of systems per truck, the ID of each truck, the combination of implemented systems and the conditions of the design.

Number of systems	Truck	Combination	1	2	3	4	5	6	7	8	9	10	11	12
1	K01, K02, K03, K06, K07	EDS								EDS				
1	K06, K07	EEIC					EEIC					EEIC		

Table 53 Evaluation Plan in Krakow

For the in-vehicle systems the baseline data collection is planned to start in July 2011 (week 30) and will be finished in October 2011, when the experimental period will start.

For the EEIC trucks, we have different periods for starting the data collection:

- Two trucks started the baseline data collection in April 2011 (week 14).
- The starting date for the additional 3 trucks and 5 buses is not defined yet.

7.4.4. Summary of the Evaluation Plan in Lyon

In Table 54 the Evaluation Plan in Lyon is presented. This figure includes the number of systems per truck, the ID of each truck, the combination of implemented systems and the conditions of the design.

Number of systems	Truck	Combination	1	2	3	4	5	6	7	8	9	10	11	12
1	L22, L23, L24, L25, L27	AL										AL		
1	L16, L18, L19,	EDS								EDS				
1	L32, L33, L34, L35, L36	EDS									EDS			
1	L38, L39, L40, L41, L42, L43, L44	DSB									DSB			
1	L45	EEIC								EEIC				
3	L28	AL+ASL+EEIC						ASL+EEIC						
3	L29	AL+ASL+EEIC						AL+EEIC					AL+ASL+EEIC	
2	L31	AL+ASL						AL					AL+ASL	
1	L30	ASL										ASL		

Table 54 Evaluation Plan in Lyon

The collection of baseline data for the trucks with the DSB service started in January 2011 and it is planned to end in the June 2011, when the experimental period data collection will start. Initially, the period defined for the baseline data collection was defined for three months but, due to some installation constrains and the few amount of data collected during the baseline period the start of the experimental period with data collection will start in July 2011.

Three periods of manual data collection were defined (it was not possible to have people counting in the streets during the entire year). The manual data collection for the evaluation of the DSB follows the following plan:

- Baseline

  Manual data collection (3 people): 3 complete weeks per site. Period: January-February 2011

- Pilot – Intermediary

  Manual data collection (3 people): 3 complete weeks per site. Period: September 2011

- Pilot – Final

  Manual data collection (3 people): 3 complete weeks per site. Period: December 2011

The collection of baseline data for the trucks with the EEIC started in February 2011 and ended in April 2011, when the experimental phase with the system activated started.

For the in-vehicle systems, there are two starting dates:

- Three trucks (L16, L18 and L19) started the baseline data collection in April 2011 (week 15). The installation were finish in March 2011 but some adjustments were needed before starting the data collection.
- The trucks L28, L29, L30, L31, L32, L33, L34, L35, L36 and L37 started the baseline data collection period in May 2011(week 21).
- The trucks L22, L23, L24, L25 and L27 will start the baseline data collection period in August 2011 (week 34).

7.5. Summary of the Evaluation Plan per Pilot Site and per Truck

In the next table, the evaluation plan for all the trucks and pilot sites included in the FREILOT project is summarized as it is currently executed. As it was explained in chapter 7.4, in some trucks the duration of the periods were modified due to some technical adaptations. The original evaluation plan can be checked in chapter 7.3 per pilot site.

Bilbao Pilot Site														
Number of systems	Truck	Combination	1	2	3	4	5	6	7	8	9	10	11	12
3	B04	AL+ASL+EDS							EDS			AL+ASL+EDS		
3	B05	AL+ASL+EDS							AL			AL+EDS		
3	B06	AL+ASL							ASL					
1	All trucks	DSB				DSB								
Helmond Pilot Site														
Number of Systems	Truck	Combination	1	2	3	4	5	6	7	8	9	10	11	12
1	H01	EEIC			EEIC						EEIC			
1	H03	EEIC			EEIC						EEIC			
1	H06	EEIC			EEIC						EEIC			
1	H10	EEIC			EEIC						EEIC			
1	H14	AL				AL								
1	H18	EDS				EDS								
1	H19	EDS				EDS								
2	H15	ASL+EEIC			ASL+EEIC									
2	H16	AL+ASL+EDS+ EEIC				AL+ASL+EDS+EEIC								
2	H17	EDS+EEIC				EDS+EEIC								
Krakow Pilot Site														
Number of systems	Truck	Combination	1	2	3	4	5	6	7	8	9	10	11	12
1	K01	EDS				EDS								
1	K02	EDS				EDS								
1	K03	EDS				EDS								
1	K04	EDS				EDS								
1	K05	EDS				EDS								
1	K06	EEIC			EEIC						EEIC			
1	K07	EEIC			EEIC						EEIC			
Lyon Pilot Site														
Number of systems	Truck	Combination	1	2	3	4	5	6	7	8	9	10	11	12
1	L22	AL							AL					
1	L23	AL							AL					
1	L24	AL							AL					

1	L25	AL			AL		
1	L27	AL			AL		
1	L16	EDS		EDS			
1	L18	EDS		EDS			
1	L19	EDS		EDS			
1	L32	EDS		EDS			
1	L33	EDS		EDS			
1	L34	EDS		EDS			
1	L35	EDS		EDS			
1	L36	EDS		EDS			
1	L38	DSB		DSB			
1	L39	DSB		DSB			
1	L40	DSB		DSB			
1	L41	DSB		DSB			
1	L42	DSB		DSB			
1	L43	DSB		DSB			
1	L44	DSB		DSB			
1	L45	EEIC		EEIC			
2	L28	AL+ASL+EEIC		ASL+EEIC			
2	L29	AL+ASL+EEIC		AL+EEIC		AL+EEIC+ASL	
1	L30	ASL				ASL+AL	
2	L31	ASL+AL		AL		ASL+AL	

Table 55 Experimental Designs Comparison (current state)

8. Overview on General Results

Initially in FREILOT DoW, it was planned to have a total of 27 vehicles among the different test sites in order to perform the study and to obtain results. With this amount of trucks it was clear that the extrapolation of results will be really complicated, so, in this project it was not planned a scaling up action. Despite this, the project has as main objective to analyses a potential reduction of fuel consumption up to 25% in the four pilot sites selected, taking into account the specific conditions of each pilot site. This 25% was proposed as upper value taking into account the estimation of benefits that each separate FREILOT element will show. The baseline of this forecast were simulations and applied research results, these now need to take the next step towards deployment, they need to be proven in real-life, operational conditions (see explanation in DoW).

In order to study the potential reduction of these services, during the pilot it was an objective to obtain in one side, the results of each service individually and the results of the combinations of services, when possible. The following premises will be taken into account:

- The interference of DSB and EEIC in terms of fuel reduction with the other services is not significative, so, in order to stimate the reduction of a combination, the results obtained for DSB and EEIC can be sum up directly with the results of the others.
- SL, ASL and EDS could interfere ones with the others so the results obtained for each one separately can not being added directly to the results obtained with the others.

Taking into account these premises, once the results will be available, it will be possible to stimate the reduction of all the services and check if it is possible to achieve the 25% of reduction.

Before starting operation, the number of trucks to participate in the project is high in comparison with the number planned (see Section 3, Table 2). So, this offers the possibility of doing a general quantification of results specially for the services and pilot sites with a high number of vehicles. In this case, a close cooperation with WP6 was established. WP6 needs to quantify the benefit obtained per service in a general way (not depending on the site or trucks), so, they defined a specific methodology in collaboration with WP4 (see deliverable D.FL.6.1 Bussines Models sections 3 and 4) which,taking as an input the results obtained in WP4, generalizate these results by system and use them to quantify the benefits of each one. The common approach between WP4 and WP6 was defined from the point of view of deployment trying to cover the second main objective of FREILOT: base on the results of the pilot to provide basis for post-pilot operation of the services in the four sites and deployment of the services.

The general methodology to obtain the quantification of benefits is based in the following steps and common approach between WP4 and WP6:

- Identification of the main indicators to be analysed per service taking into account the main benefits spected.
- Definition of the scenarios (in this case, the most probable bussines scenario) to do the generalization.
- Identification of impact expectation for each scenario relating each one with the potential benefits (depending on the scenario, the benefit will be evaluated with a set of indicators).
- Provision (from WP4 to WP6) of the indicators obtained in the different sites for the different services.
- Calculation of benefits from the indicators measured for each scenario.
- Multi-criteria analyses to obtain the impact of the benefits for each scenario in each stakeholder.

The complete description of the methodology applied and the results obtained will be included in D.FL.6.1 Bussiness Models.

9. Conclusions and Next Steps

The main objective of this document is to provide the general framework for evaluation in the different pilot sites. With this action it is possible to ensure a common and effective evaluation framework for all the pilot sites from the first phase of the project. It is a relevant issue for the correct development of FREILOT pilot.

The first version of the document submitted in July 2009 presented the basic evaluation methodology, including the data description, general specifications of data logging and data management process. Due to the early phase of development, there were some decisions that should be considered in the following months. Therefore, this document has been reviewed and completed adding more details during the last months. Depending on the final functionality of services, final number of trucks/drivers and other environmental conditions in each pilot site might be adjusted and it might be necessary to adapt the experimental designs.

At this moment the pilot phase of the project has started in all pilot sites and the evaluation methodology and plan is in execution now. During last months, with the first data provided, the indicators defined at the beginning of the project were reviewed, specially if it is possible to generate them correctly with the data logged. Additionally, a deep analyses of the emissions measurements was done (see Chapter 6) and additional indicators (specially NOx) will be taken into account in FREILOT evaluation.

Data collection is done following the specifications proposed in this document. For the moment, some minor errors were detected in the data. One constraint is guarantying a data collection period of 12 months, because some of the services have delays in the start of the baseline collection (see Chapter 7.4). The proposal is to extend the data collection period until first quarter of 2012. This implies an extension of the project in order to have enough time to do the data analyses and the results report.

In general, the Evaluation Plan is followed in all the pilot sites. In some cases (e.g. DSB Lyon) an adaptation of the proposed plan were done after the collection of the first data, taking into account the quality and quantity and the need of solving some technical issues. It is not discarded the need of doing some little adaptations during the last part of the project taking into account the quality of the data collected.

The next activities of WP4 require a close collaboration with WP3 – Operation and WP6 – Deployment Enablers. The partners from WP3 are responsible for the operation of the FREILOT systems in the four pilot sites and collection of the data according to the experimental designs defined. This data is going to being sent to WP4 partners, who are responsible for the data analyses. After the generation of indicators, these will be sent to the WP6, where the generalization of the results from the evaluation process will be done in order to identify the benefits of the different combinations of services in terms of fuel consumption and emissions reduction, social impacts and driver behaviour. A brief description of this process is included in D.FL.6.1. Business Models.

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Annex I: State of Art

This chapter summarizes the relevant information extracted from the state of the art of pilot tests carried out until this moment. A total of twelve FOT projects or studies were identified as Field Operational Test although a couple of them make reference to the same FOT. In the annex I a table summarizes the authors and year, number of participants and trucks, mileage for each study, experimental design, parameters, measures, and other important characteristics.

Most of the studies are related to the assessment of safety aspects and how to improve the security on roads. The only test reference about the evaluation of environmental impact in a field test is the design for a new transportation centre in the independence National Historic Park where they evaluate the influence of buses in the National Park and they proposed design alternatives (Spiller & Mickela, 2000).

Next part of this chapter, a brief summary of the each study will be presented.

Evaluation of an Automotive Rear-End Collision Avoidance System

This FOT was focused on the ACAS performance, capability and safety benefits. Moreover, it was interesting to analyze the driver acceptance of the systems. A sample of 66 drivers participated in this study (March 2003-November 2004). In the experimental design, participants driver without ACAS (first week, baseline) and next 3 weeks they drove with ACAS. Driving behaviour was evaluated through indicators such as travel speed, time headway or distraction.

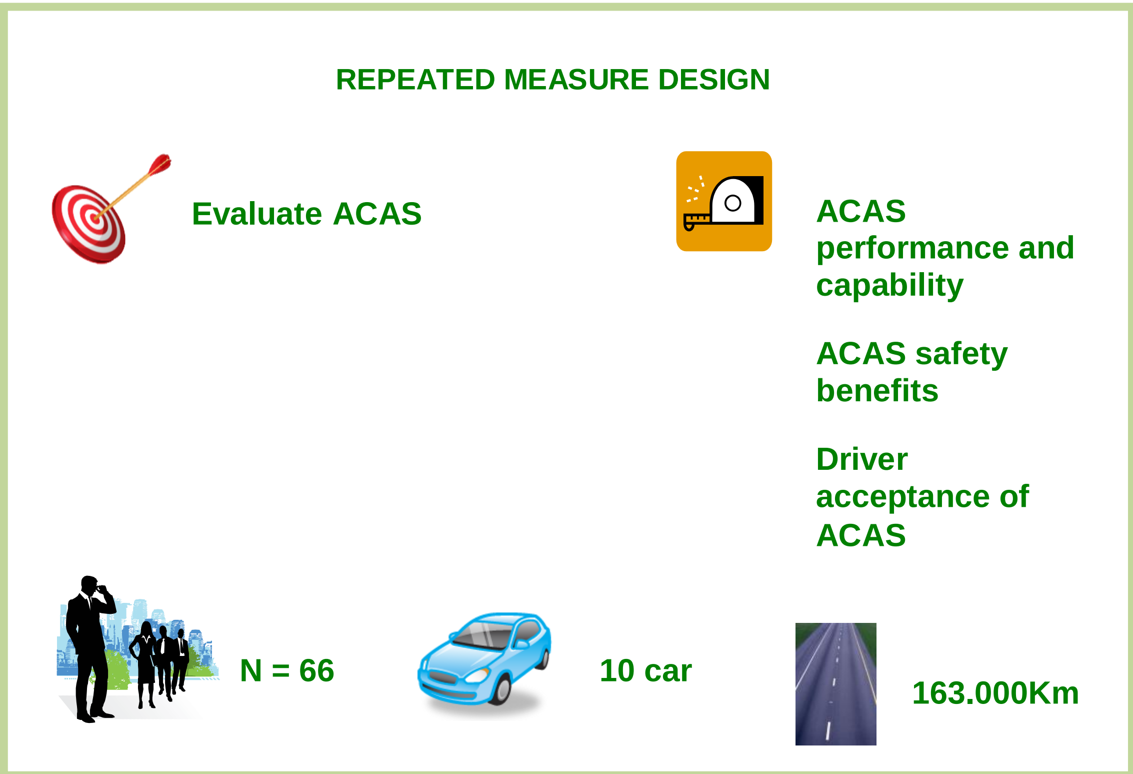


Figure 11 Main characteristics of "Evaluation of an Automotive Rear-End Collision Avoidance System" FOT.

Overall Field Trial Results

This study is focused on a behavioural and attitudinal analysis of field trials with twenty cars with ISA (Intelligent Speed Adaptation). The experimental design was composed by three different phases. The first one (for one month) was the baseline and the participant drive without ISA system. Next four months subjects drove with the ISA system active and finally, the last month they drove with the ISA inactive (Design ABA).

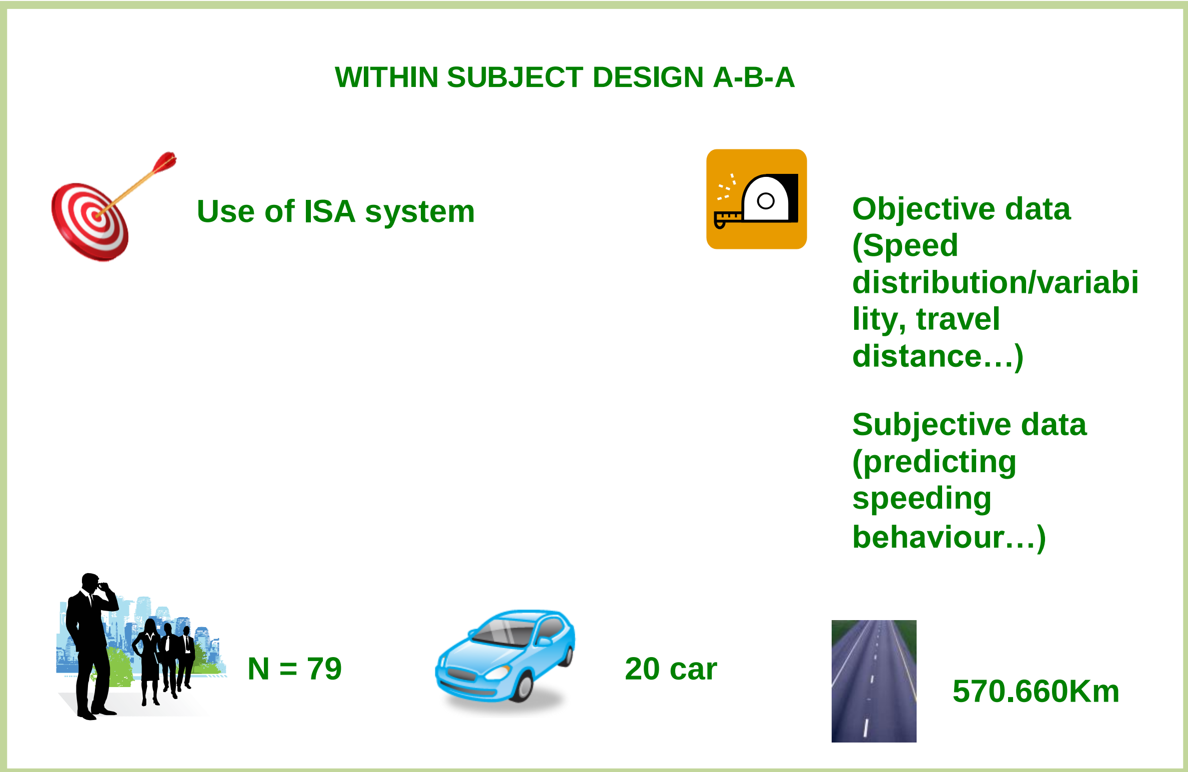


Figure 12 Main characteristics of "Overall Field Trial Results" FOT.

Road Departure Crash Warning System Field Operational Test: Methodology and Results

The main objective of this project was to evaluate the suitability of road departure crash warning systems looking for safety-related impacts within the driving data, determining driver acceptance of the system and making observations of system performance. The sample was comprised of 87 drivers. The experimental design was a within-subject where each driver's baseline (6 days) was compared with the treatment condition (20 days). Driver behaviour was evaluated through indicators as means speed or percentage eyes off road time and subjective opinions where related with usefulness, satisfaction, or perceived behavioural control.

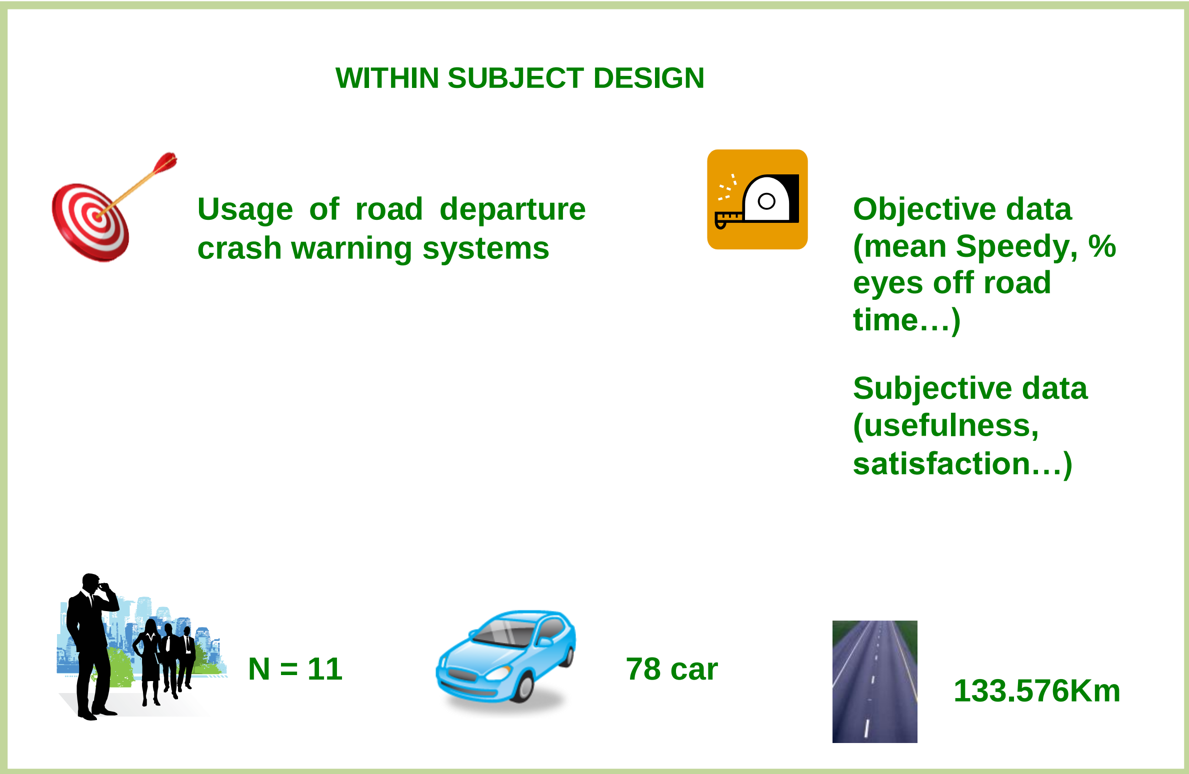


Figure 13 Main characteristics of "Road Departure Crash Warning System Field Operational Test: Methodology and Results" FOT.

Intelligent Speed Adaptation

The main objective of the “Intelligent Speed Adaptation” study was to investigate the car driver behaviour when using the ISA systems. This project tried to resolve questions about the acceptance of ISA, if the ISA system reduced the amount of speeding, how behaviour changes over the long term when driving with ISA, when and where drivers choose to override the voluntary ISA or how assess the impact of ISA on the quality of their driving.

Participants were private motorist and for the fleet trials they were recruited from local organizations. Some driver characteristics were taking into account such as gender, aged and if they were intender/non intender (based on prior intention to speed). A fleet of twenty cars was equipped with the ISA system. The first month they drove without system, the next months they drove with the system, and finally the last month participants they drove with the ISA system switched off.

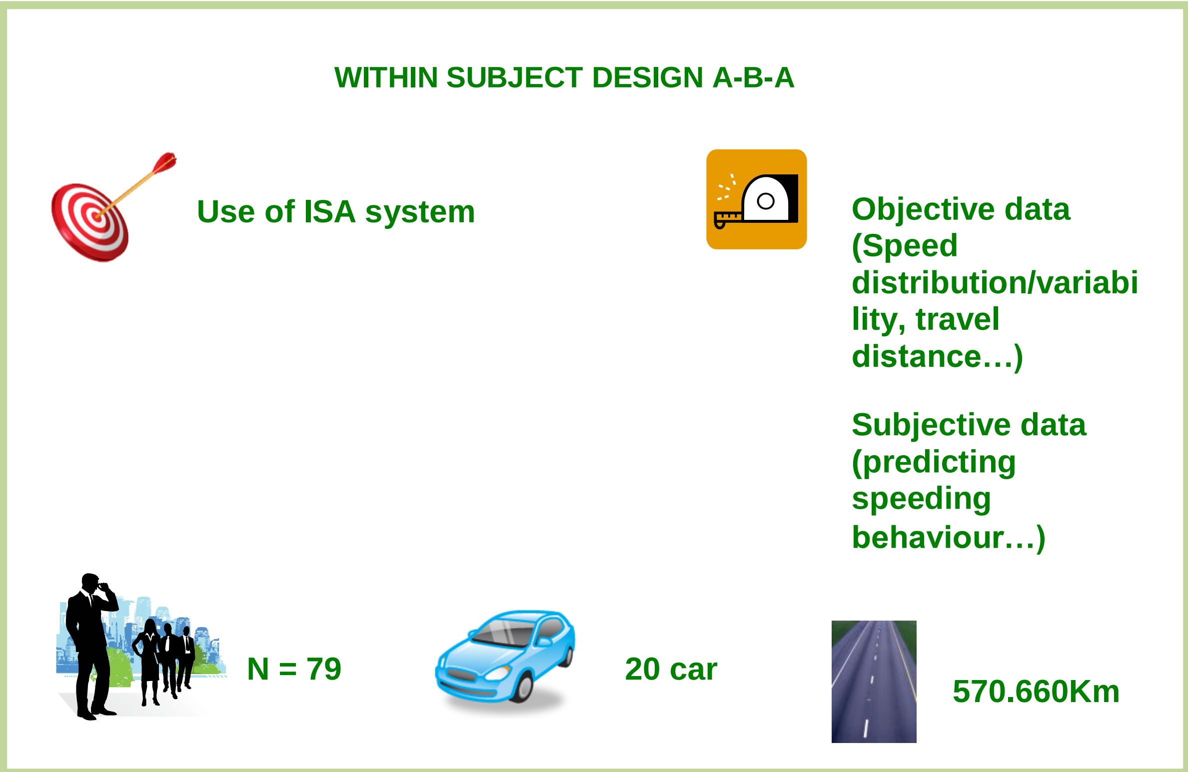


Figure 14 Main characteristics of “Intelligent Speed Adaptation” FOT.

An Overview of the 100-car Naturalistic Study and Findings

The main objective of this study was to provide information about driver performance, behaviour, environment, and other factors related to critical incidents, near crashes and crashes. The sample was comprised of 109 drivers (60% male, 40% female). In this Naturalistic study a total of 43.000 hours of data was registered during 12-13 months with experimental conditions.

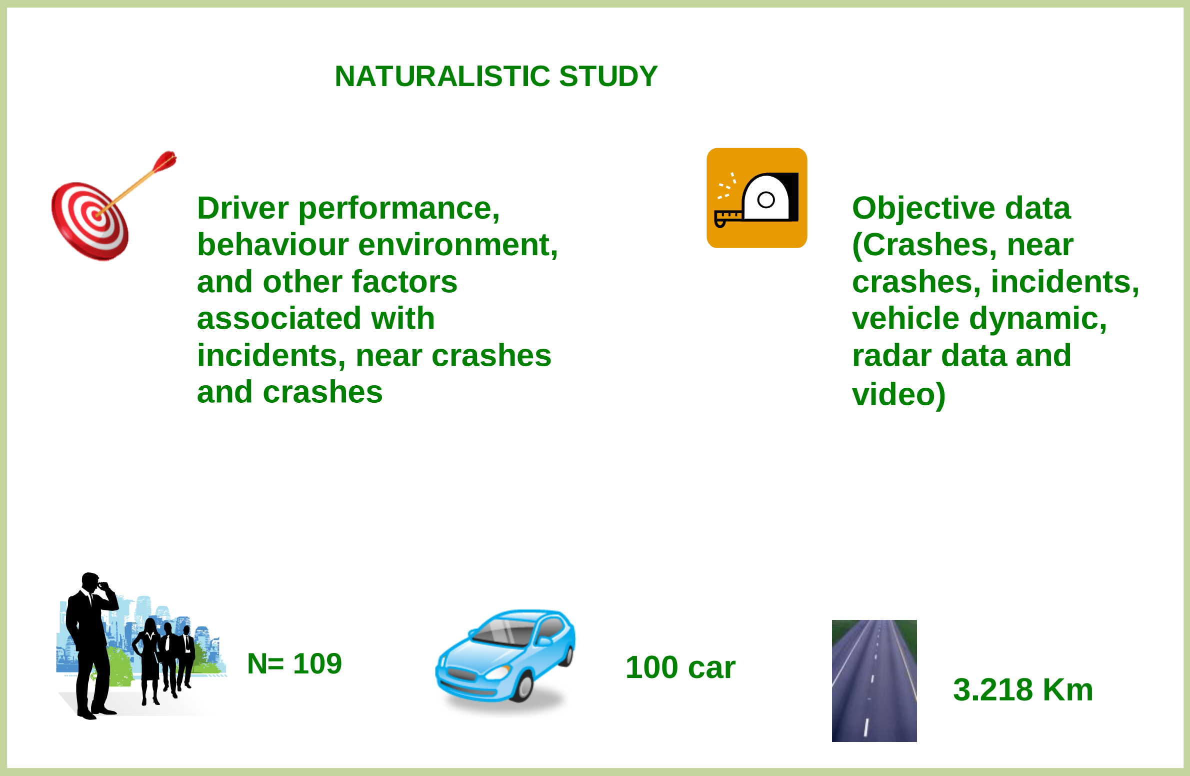


Figure 15 Main characteristics of "An Overview of the 100-car Naturalistic Study and Findings" FOT.

Evaluation of the Mack Intelligent Vehicle Initiative Field Operational Test

This study was focused on the testing of a Lane Departure Warning System (LDWS) in order to achieve an in-depth understanding of the system benefits, ascertain the performance and capability potential of the system and assess the user acceptance. The study also assessed the product maturity for deployment and addressed the institutional a legal issues that might impact deployment. The sample was composed by 31 drivers. The study was divided in three phases during 12 months (March 2004-March 2005): baseline period (without system), active period (with system) and post-active period (without system). During each phase on-board data were collected. The total number of km. done by the trucks were 43.000 Km.

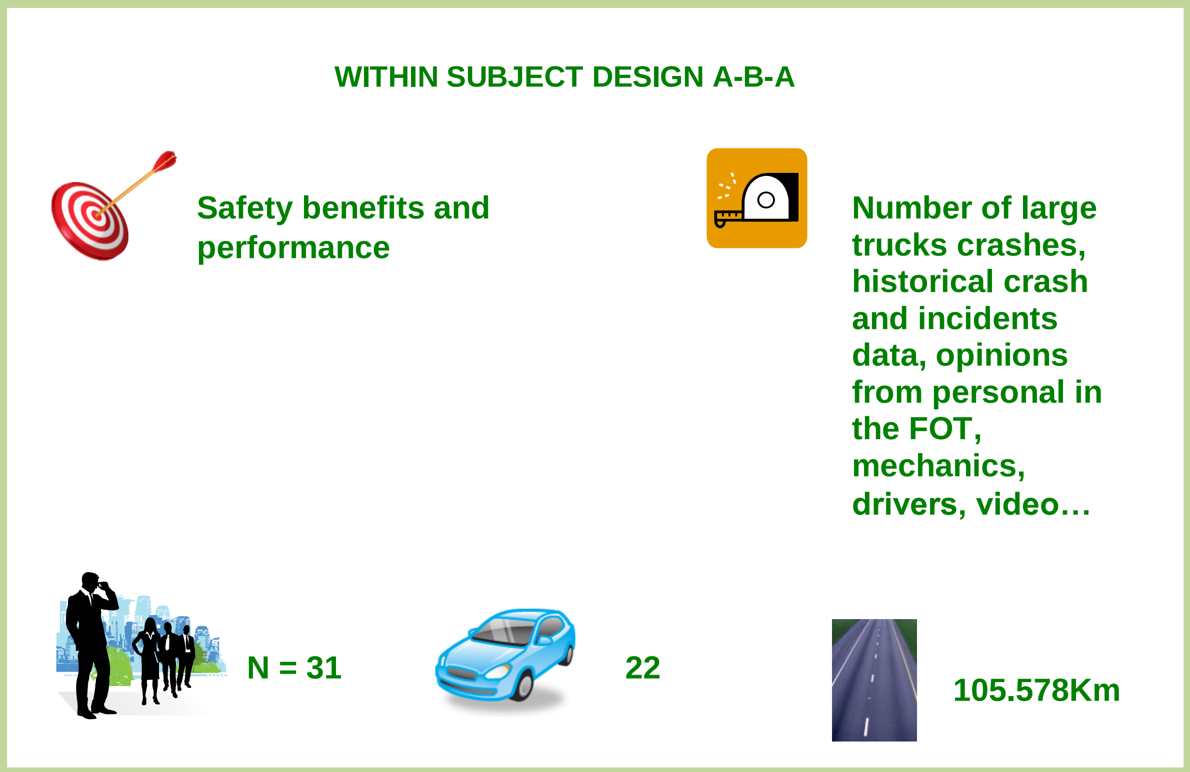


Figure 16 Main characteristics of "Evaluation of the Mack Intelligent Vehicle Initiative Field Operational Test" FOT.

Evaluation of the Freightliner Intelligent Vehicle Initiative Field Operational Test

The main objective of this FOT was to achieve an in-depth understanding of safety, mobility, efficiency, productivity benefits, and environmental quality benefits and assess the user acceptance and human factors. Furthermore, evaluate IVSS performance and capability potential, the product maturity for deployment and address institutional and legal issues that might affect deployment. The study used a repeated-measures design and the FOT plan was conducted over a 15 month period. Driver behaviour was evaluated through e.g. speed time history, average speed, lateral accelerations and subjective opinions where gathered about usability, acceptance, trust or workload driver perceptions.

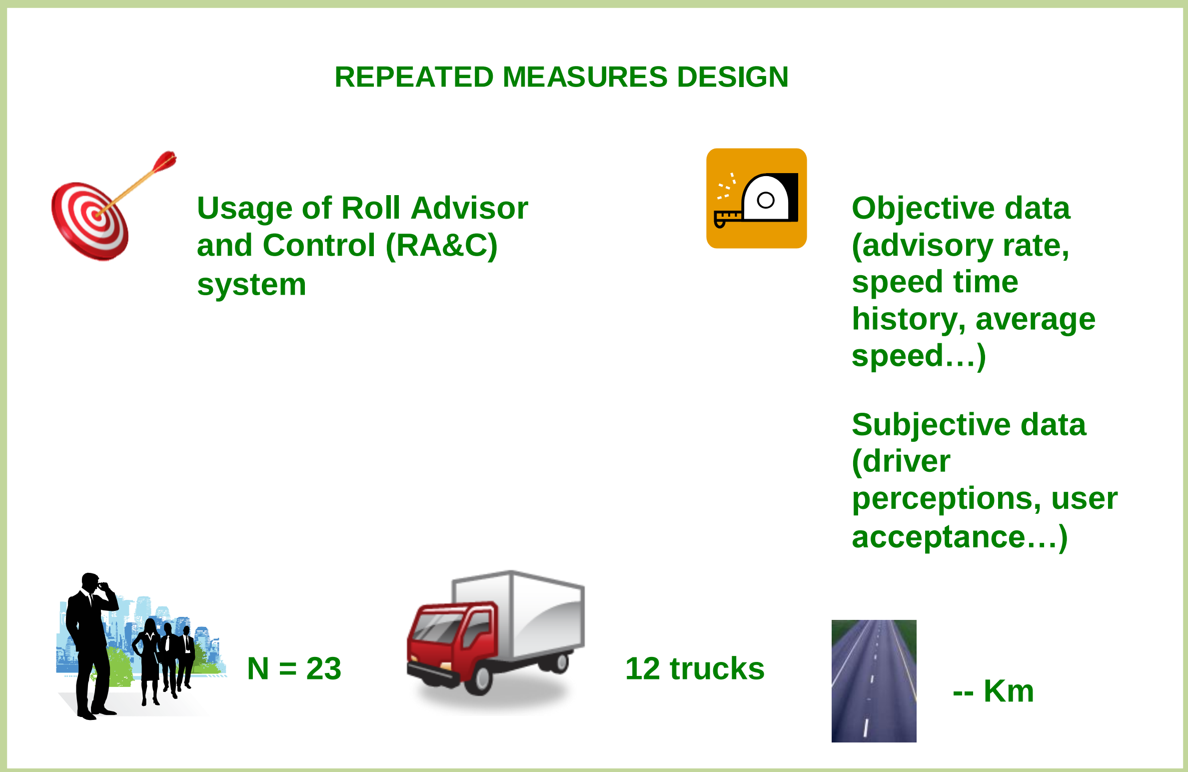


Figure 17 Main characteristics of "Evaluation of the Freightliner Intelligent Vehicle Initiative Field Operational Test" FOT.

Volvo Truck North Field Operational Test: Evaluation of Advanced Safety

Systems for Heavy Truck Tractors

This FOT aimed to evaluate the performance in a real world environment of the following Advanced Safety Systems: Collision Warning system (CWS), Adaptive Cruise Control (ACC), disc brakes and an electronically controlled system (ECBS). Secondary objectives of the FOT were the acceleration of the deployment of the Advanced Safety Systems, help forge strategic partnerships in the transport industry and assess the state-of-the-art in safety benefits analysis for these systems.

The 3-year data collection involved 100 new tractors consisting of 50 (Control) vehicles equipped with US Xpress normal specifications (including CWS), and 50 (Test) vehicles equipped with the Advanced Safety Systems. Baseline vehicles (a 20-vehicle subset of the 50 Control vehicles) were operated for part of the FOT with their CWS driver displays disconnected. All of the FOT vehicles were equipped with onboard data acquisition systems. Beginning in January 2001, the vehicles were placed into service with US Xpress, and were operated in normal revenue generating service throughout the 48 contiguous United States.

For the evaluation both subjective and objective data were collected. The subjective data were collected through surveys and driver interviews, while for recording objective data (e.g. time to collision, speed, acceleration, etc.) a data recording system (DAS) based in a computer on board was used. The DAS system record data of the vehicle and the Advanced Safety Systems and download the data to a central computer by remote wireless. Video information was also recorded during the FOTs. The large amount of data recorded during the 3 years of FOT implied the use of data reduction techniques before the analyses.

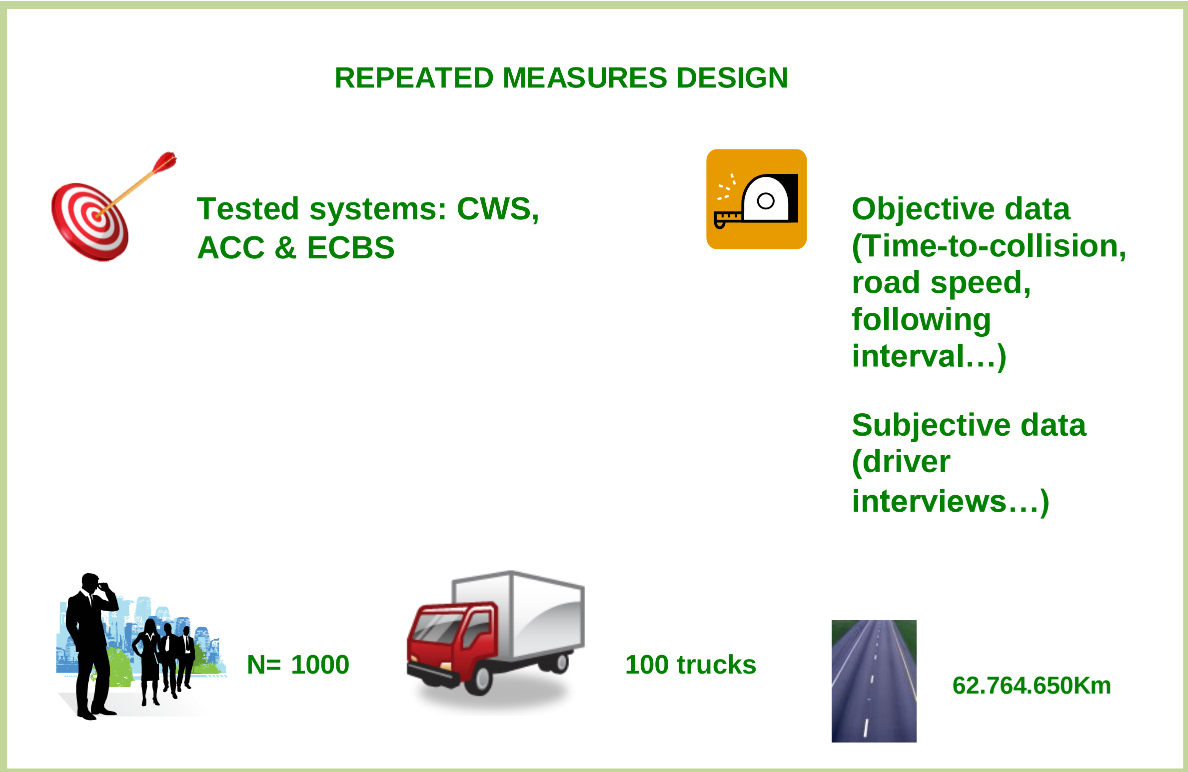


Figure 18 Main characteristics of "Volvo Truck North Field Operational Test: Evaluation of Advanced Safety Systems for Heavy Truck Tractors" FOT.

Automotive Collision Avoidance System Field Operational Test Report:

Methodology and Results

The objective of this FOT is to analyze the effects of ACAS on driving behaviour. To reach this aim 96 drivers participated in this study. The design proposed was a mixed-factor design: between –subjects' variables made reference to driver age and driver age while the within-subjects variables were related with ACAS disabled (baseline) versus ACAS enabled. The period of the test was of twelve months. Driver behaviour was evaluated through the time headway, the systems usage, the overtaking manoeuvres, and the selection of freeway lane…etc. Moreover subjective aspects such as usability, acceptance, trust or workload were analyzed.

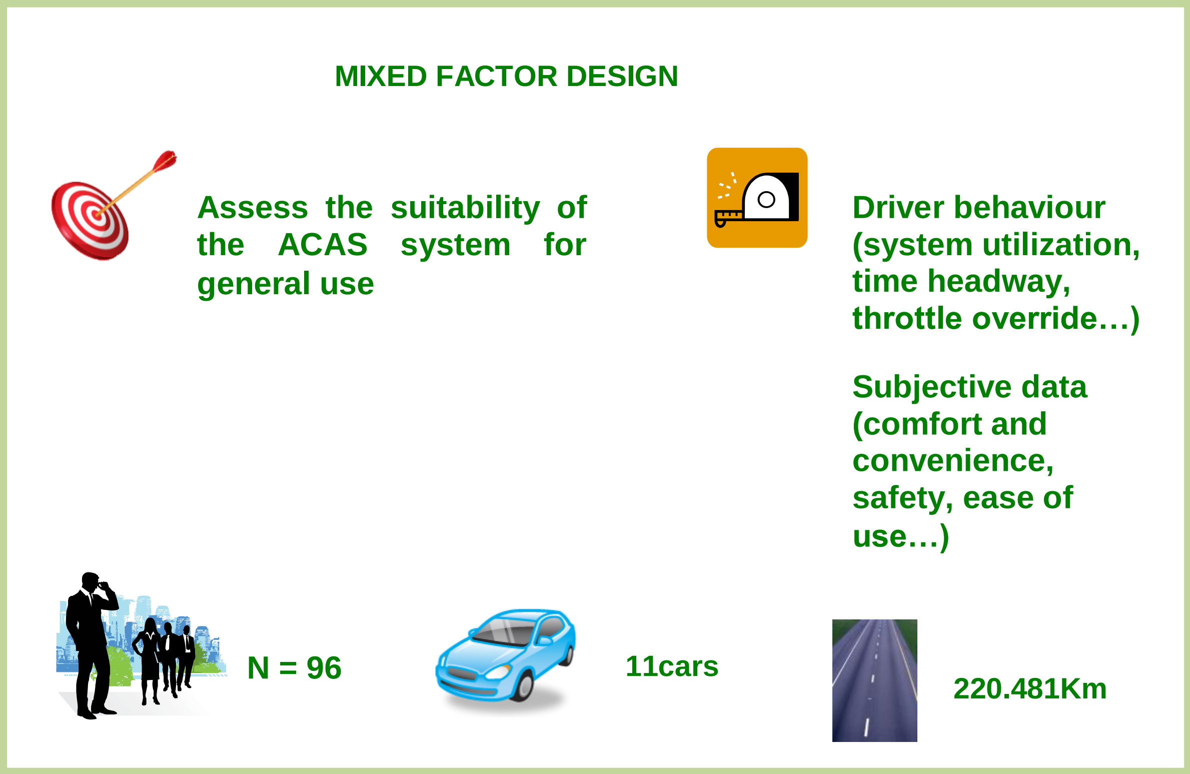


Figure 19 Main characteristics of "Automotive Collision Avoid System Field Operational Test Report: Methodology and Results" FOT.

Intelligent Cruise Control Field Operational Test

The target of this FOT was to characterize safety and comfort issues. The main device analyzed in this study was the ACC system. Ten field-vehicles were used in this project. The results presented the driving experience of 108 volunteer participants who used an ACC-equipped car. The experimental design was a naturalistic one without constraining where or when the participants were driving. The independent variables associated with driver characteristic were age, conventional-cruise-control usage, and duration of exposure to ACC. Performance indicators such as velocity, frequency of cut-in, time to impact…were analyzed. Moreover, subjective indicators such as usefulness, satisfaction or willingness to purchase were evaluated too.

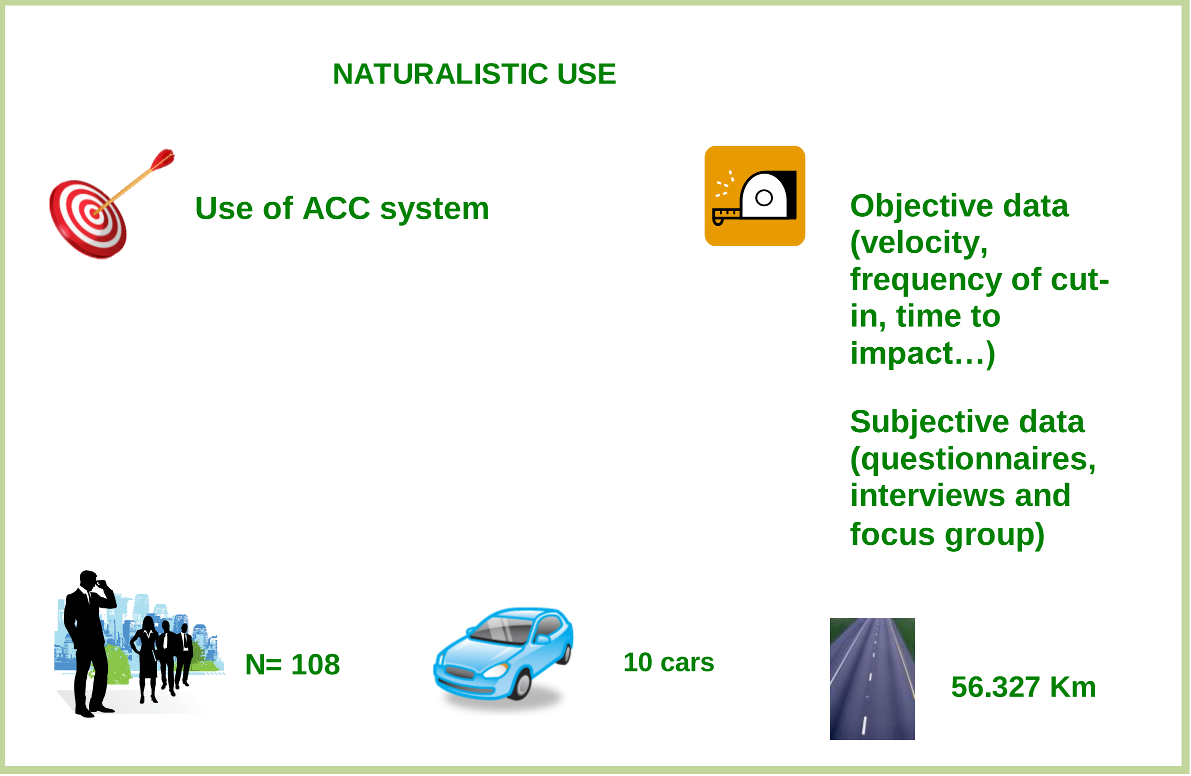


Figure 20 Main characteristics of "Intelligent Cruise Control Field Operational Test" FOT.

Integrated Vehicle-Based Safety Systems Heavy-Truck On-Road Test

Report

The main objective of this study was carried out a series of on-road verification tests to assess the performance of an integrated safety system for light vehicles. The study was part of the Integrated Vehicle-Based Safety Systems (IVBSS) initiative in the Intelligent Transportation Systems (ITS) program of the U.S. Department of Transportation and addresses the prevention of rear-end, lane change, and road departure crashes. The goal of the IVBSS program is to accelerate the deployment of integrated crash warning systems for light vehicles and heavy commercial trucks that help prevent rear-end, lane change, and road departure crashes.

For the study a prototype integrated system provides FCW (Forward Crash Warning), Lane Departure Warning (LDW), and LCM (Lane Change Merge). This system was integrated in an International 8600 heavy truck for the road tests that was driven in an uncontrolled driving environment on public roads.

Test objectives were to measure the system's susceptibility to nuisance alerts, assess alerts in perceived crash situations, and evaluate system availability over a wide range of driving conditions. On-road tests were conducted three times between September 2007 and March 2008. Data collected during the tests was analyzed and used to evaluate system readiness for a field operational test planned for 2009 and to identify areas of system performance that could be improved prior to the start of the field test.

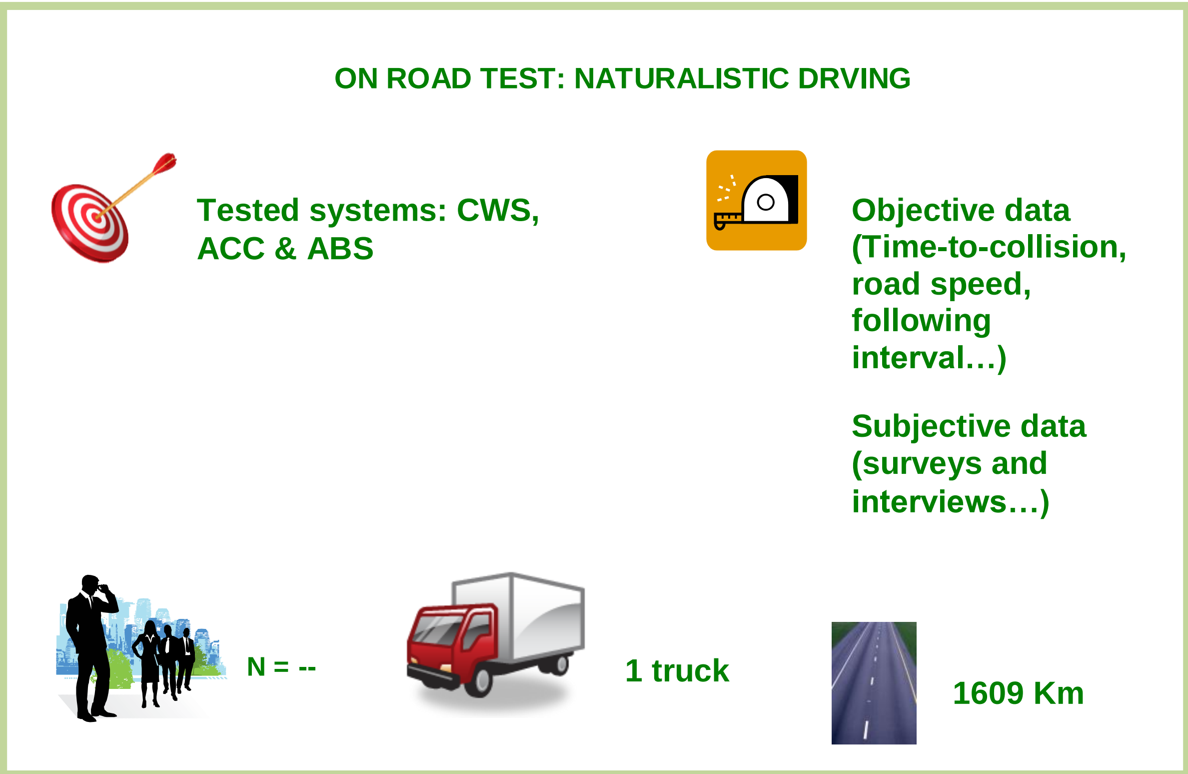


Figure 21 Main characteristics of "Integrated Vehicle-Based Safety Systems Heavy-Truck On-Road Test Report" FOT.

Evaluation of the Volvo Intelligent Vehicle Initiative Field Operational Test.

The IVI program was focused in the evaluation of the effectiveness of IVSS and estimation of the social benefits and costs, taking as reference the deployment in the FOTs and in case the IVSS were deployed across the entire heavy vehicles national fleet.

Three primary goals are presented in this study: Achieve an in-depth understanding of the safety benefits of intelligent vehicle safety systems (IVSS), assess user (driver) acceptance and human factors, and analyze the ratio of life-cycle benefits to costs for deploying the IVSS on a societal level.

Three systems were tested: Collision Warning System (CWS), Adaptive Cruise Control (ACC) and Advanced Braking System (ABS). And they were designed to assist commercial vehicle drivers in order to reduce the occurrence and severity of rear-end crashes as well as lane change / merge crashes.

For this study, new Volvo tractors were equipped with IVSS technologies and instrumented for data collection before being leased and laced in normal service operations. Depending on the safety systems installed on the tractors, they were divided into three groups: 50 “test” vehicles, equipped with the three safety technologies (CWS, ACC and AdvBS); 30 “control” vehicles, equipped with CWS; and 20 “Baseline” vehicles, equipped with a disabled CWS for the first 18 months of the FOT, and then with enabled CWS for the remaining time of the FOT. When the CWS was disabled, data were collected, but the driver display was not active and alerts were not communicated to the drivers.

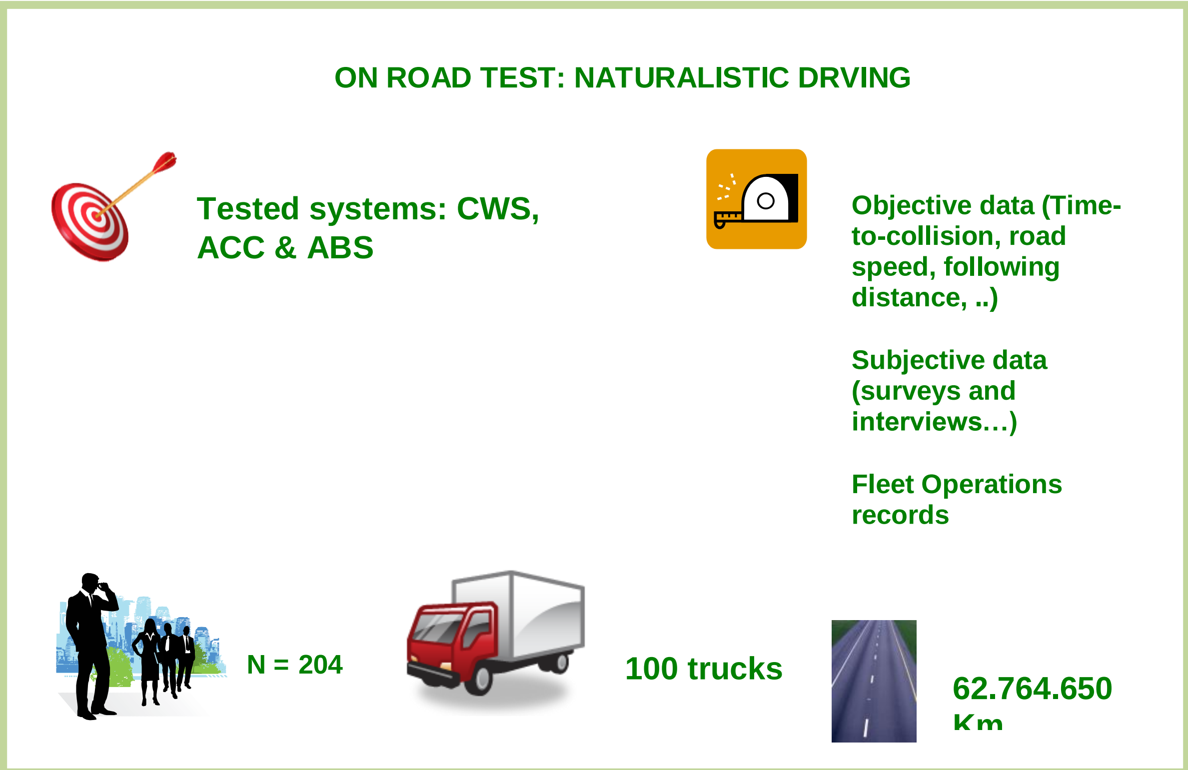


Figure 22 Main characteristics of “Evaluation of the Volvo Intelligent Vehicle Initiative Field Operational Test Version 1.3” FOT

Annex II: General FREILOT Questionnaires

FREILOT QUESTIONNAIRE

Number/ID:

Date:

Please, indicate the system/s or service which you have experience with and how long you have used it:

Acceleration Limiter:	**Number of Months:**
Delivery Space Booking:	**Number of Months:**
Eco-driving support:	**Number of Months:**
Intersection Control:	**Number of Months:**
Speed Limiter:	**Number of Months:**

To reach the objectives of FREILOT study will be necessary to collect general descriptive information for each participant.

Please read each question carefully. If you do not understand something, feel free to ask any of the researchers. Your participation is completely voluntary. Thank you very much for your collaboration.

DEMOGRAPHIC CHARACTERISTICS:

1. Age:

2. Gender:
   - ☐ Male
   - ☐ Female

3. Educational level:
   - ☐ Without studies
   - ☐ Primary studies
   - ☐ Secondary studies
   - ☐ Vocational training
   - ☐ Certificate degree
   - ☐ Graduate
   - ☐ Other

4. Occupation:

DRIVING EXPERIENCE:

5. Driving license (it depends on the country?):
   - ☐ A1
   - ☐ A
   - ☐ B
   - ☐ C1
   - ☐ C
   - ☐ D1
   - ☐ D
   - ☐ E

6. What age do you start to drive?

7. How many years have you got as truck driver?

8. How often do you drive?
   - ☐ At least once a week
   - ☐ More than once a week
   - ☐ At least once a day

9. Habitually, what is your timetable?

10. Approximately, how many kilometres do you drive per year (average)?
    - ☐ <10.000 Km.
    - ☐ 10.000 – 15.000 Km.
    - ☐ 15.001 – 20.000 Km.
    - ☐ >20.000 Km.

11. Indicate in type of road you usually drive (only tick one answer),
    - ☐ Highway
    - ☐ Dual carriageway
    - ☐ National road
    - ☐ Rural road
    - ☐ Urban road

12. In the last 5 years, how many fines did you received by driving offence?:

13. Are you colour blind?:
    - ☐ Yes
    - ☐ No.

14. Are you hearing impaired?:
    - ☐ Yes
    - ☐ No.

15. Are you required to wear corrective lenses to drive (glasses or contact lenses)?
    - ☐ Yes
    - ☐ No

ACCELERATION LIMITER:
Please, express your degree of agreement or disagreement with each statement by ticking the appropriate number (0 is related with **Totally disagree** and 10 **Totally agree**):

1. I believe the Acceleration Limiter service works properly										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
2. I think that the use of the Acceleration Limiter service has provided me more efficient and controlled delivery practices										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
3. I am confident in my ability to drive the truck safely with the Acceleration Limiter service										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
4. I trust the Acceleration Limiter service										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
5. It is simple to indentify the functions of the Acceleration Limiter service										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
6. I consider that I have adopted an eco-friendly style when using Acceleration Limiter service										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
7. After using Acceleration Limiter I like the service										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
8. The freight transport image in urban areas is improved with the usage of Acceleration Limiter service										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
9. Using the Acceleration Limiter service, I decrease capacity of acceleration on flat road										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
10. I believe the urban congestion has increased with the usage of the Acceleration Limiter										

service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

11. More I use the Acceleration Limiter service, I feel less stressed

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

12. I think I have achieved a higher driving comfort using Acceleration Limiter service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

13. I am confident of using Acceleration Limiter service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

14. More I use the Acceleration Limiter service, I feel more apprehensive about it

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

15. I believe I have the indispensable knowledge to utilize the Acceleration Limiter service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

16. The use of Acceleration Limiter services makes urban driving easier

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

17. Using the Acceleration Limiter service, I consider my driving is more safety

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

18. I think that using the Acceleration Limiter service increases the efficacy of my work

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

19. I believe that my work conditions have improved with the use of Acceleration Limiter service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

20. It is easy to understand how the Acceleration Limiter service works

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

21. I drive in a more effective way reducing my fuel consumption when using Acceleration Limiter service

0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
22. I think the Acceleration Limiter is effective to not exceed the speed limitations										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
23. I accept increase on journey duration as a trade off to decreased fuel consumption										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐

DELIVERY SPACE BOOKING:

Please, express your degree of agreement or disagreement with each statement by ticking the appropriate number (0 is related with **Totally disagree** and 10 **Totally agree**):

1. I am confident of using Delivery Space Booking service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

2. Since I use the Delivery Space Booking service is easier to me to find free spaces to the delivery/unloading task

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

3. My safety has increased since I used the Delivery Space Booking service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

4. I think I have achieved a higher driving comfort using Delivery Space Booking service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

5. I think that using the Delivery Space Booking service increases the efficacy of my work

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

6. More I use the Delivery Space Booking service, I feel less stressed

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

7. The freight transport image in urban areas is improved with the usage of Delivery Space Booking service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

8. The Delivery Space Booking service facilitates my delivery task because I don't need to look for free spaces

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

9. I have less tickets/fines because of double-parked since I used Delivery Space Booking service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

10. I believe that my work conditions have improved with the use of Delivery Space Booking service

0	1	2	3	4	5	6	7	8	9	10

☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

11. I think the traffic flow gets benefits with the Delivery Space Booking service (the rest of the drivers do not hold up because of double lines, less congestions…

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

12. I think the Delivery Space Booking service does not disturb me in my driving task

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

13. I consider the Delivery Space Booking service improves the freight image in urban areas because decrease the number of double lane stops

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

14. I think the Delivery Space Booking service facilitates my delivery operations

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

15. After using Delivery Space Booking I like the service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

16. I have experienced that the delivery efficiency on urban areas increased with the use of Delivery Space Booking

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

17. I believe the Delivery Space Booking service works properly

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

18. More I use the Delivery Space Booking service, I feel more apprehensive about it

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

19. I believe the rest of the drivers appreciate the Delivery Space Booking service because they will find easier to drive in the city without double lines and trucks parked on the pavement, less stress…

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

20. I think that the use of the Delivery Space Booking service has provided me more efficient and controlled delivery practices

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

21. I feel safe when I unload the goods using the space obtained by the Delivery Space Booking service

0	1	2	3	4	5	6	7	8	9	10

☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

22. Using the Delivery Space Booking service, I consider the driving is more safety

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

23. I think it is easier to find a free space since I used the Delivery Space Booking service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

24. I trust the Delivery Space Booking service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

25. I appreciate Delivery Space Booking service because it helps me to reduce fuel consumption

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

26. I consider that there are more availability space with the Delivery Space Booking service usage

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

27. I am confident in my ability to drive the truck safely with the Delivery Space Booking service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

28. I find the Delivery Space Booking service is easy to use

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

29. I think the Delivery Space Booking service is effective to reduce double lane stops

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

30. I accept increase on journey duration as a trade off to decreased fuel consumption

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

ECO-DRIVING SUPPORT:

Please, express your degree of agreement or disagreement with each statement by ticking the appropriate number (0 is related with **Totally disagree** and 10 **Totally agree**):

1. After using Eco-driving support I like the service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

2. I think the Eco-driving support improves the freight transport image in urban areas taking into account that its use reduces the CO2 emissions and other pollutants

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

3. I am confident in my ability to drive the truck safely with the Eco-driving support

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

4. The use of Eco-driving support services makes urban driving easier

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

5. I think the Eco-driving is effective to reduce the fuel consumption and the pollutants

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

6. I think I have achieved a higher driving comfort using Eco-driving support services

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

7. The freight transport image in urban areas is improved with the usage of Eco-driving support

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

8. I am confident of using Eco-driving support

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

9. I trust the Eco-driving support service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

10. I think that using the Eco-driving support service increases the efficacy of my work										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
11. I consider that I have adopted an eco-friendly style when using Eco-Driving support service										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
12. More I use the Eco-driving support service, I feel more apprehensive about it										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
13. It is easy to understand how the Eco-driving support works										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
14. I believe the Eco-driving support service works properly										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
15. I think that the use of the Eco-driving support has provided me more efficient and controlled delivery practices										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
16. More I use the Eco-driving support, I feel less stressed										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
17. I drive in a more effective way reducing my fuel consumption when using Eco-driving support service										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
18. I have difficulties to follow the instructions of Eco-driving support in stressful situations										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
19. I believe I have the indispensable knowledge to utilize the Eco-driving support service										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
20. Using the Eco-driving support, I consider my driving is more safety										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐

21. It is simple to indentify the functions of the Eco-driving support										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
22. I believe that my work conditions have improved with the use of the Eco-driving support										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
23. I believe that the advices provided by the Eco-driving support are adequate										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
24. I accept increase on journey duration as a trade off to decreased fuel consumption										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐

OPEN ISSUES[1] We would like to know your opinion regarding the way that the information is showed in the on-board component. We appreciate your opinion as user to improve this service.
What is your overall impression to information showed in the on-board application?
Do you feel the information showed is enough? Why?
What did you like best about the information showed?
What did you like least about the information showed?
If you were the on-board developer, what would be the first thing you would do to improve it?
Is there anything that you feel is missing on the on-board?
If you were to describe the way that the information is showed to a colleague in a sentence or two, what would you say?
Do you have any other final comments or questions?

[1] These questions will be reviewed when the final on-board format with the driver information will be provided.

INTERSECTION CONTROL:

Please, express your degree of agreement or disagreement with each statement by ticking the appropriate number (0 is related with **Totally disagree** and 10 **Totally agree**):

1. It is easy to understand how the Intersection Control service works

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

2. I trust the Intersection Control service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

3. I believe that my work conditions have improved with the use of the EEIC service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

4. The freight transport image in urban areas is improved with the usage of Intersection Control service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

5. I am confident of using Intersection Control service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

6. I consider the length of traffic queues in road intersections are smaller with the usage of Intersection Control service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

7. I think I have achieved a higher driving comfort using Intersection Control service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

8. After using Intersection Control I like the service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

9. It is simple to indentify the functions of the Intersection Control service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

10. I think that using the Intersection Control service increases the efficacy of my work

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

11. I believe the Intersection Control service works properly

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

12. I think that the use of the Intersection Control service has provided me more efficient and controlled delivery practices

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

13. The use of Intersection Control services makes urban driving easier

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

14. I think the Intersection Control is effective to manage the traffic in the road intersections

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

15. I am confident in my ability to drive the truck safely with the Intersection Control service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

16. I believe I have the indispensable knowledge to utilize the Intersection Control service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

17. More I use the Intersection Control service, I feel less stressed

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

18. I have experienced that the delivery efficiency on urban areas increased with the use of Intersection Control service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

19. Using the Intersection Control service, I consider my driving is more safety

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

20. More I use the Intersection Control service, I feel more apprehensive about it

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

21. I accept increase on journey duration as a trade off to decreased fuel consumption

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

SPEED LIMITER:

Please, express your degree of agreement or disagreement with each statement by ticking the appropriate number (0 is related with **Totally disagree** and 10 **Totally agree**):

1. It is simple to indentify the functions of the Speed Limiter service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

2. The use of Speed Limiter services makes urban driving easier

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

3. I think the Speed Limiter is effective to not exceed the speed limitations

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

4. I think I have achieved a higher driving comfort using Speed Limiter

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

5. The freight transport image in urban areas is improved with the usage of Speed Limiter service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

6. I think that using the Speed Limiter service increases the efficacy of my work

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

7. I am confident of using Speed Limiter service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

8. I believe that my work conditions have improved with the use of the Speed Limiter service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

9. Speed Limiter service disturbs me when I drive

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

10. It is easy to understand how the Speed Limiter service works

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

11. I believe I have the indispensable knowledge to utilize the Speed Limiter service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

12. More I use the Speed Limiter service, I feel more apprehensive about it

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

13. I think that the use of the Speed Limiter service has provided me more efficient and controlled delivery practices

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

14. I believe the Speed Limiter service works properly

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

15. I believe the urban congestion has increased with the usage of the Speed Limiter service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

16. I drive in a more effective way reducing my fuel consumption when using Speed Limiter service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

17. I think the speed limitation provide by the Speed Limiter service is acceptable

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

18. I trust the Speed Limiter service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

19. Using the Speed Limiter service, I consider my driving is more safety

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

20. More I use the Speed Limiter service, I feel less stressed

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

21. I am confident in my ability to drive the truck safely with the Speed Limiter service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

22. I accept/acknowledge speed limit recommendations from the Speed Limiter service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
23. The use of The Speed Limiter service helps me in the driving task										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
24. After using Speed Limiter I like the service										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
25. I accept increase on journey duration as a trade off to decreased fuel consumption										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
26. I consider that I have adopted an eco-friendly style when using Eco-Driving support service										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

FREILOT FLEET OPERATOR QUESTIONNAIRE

FREILOT FLEET OPERATOR QUESTIONNAIRE

Number/ID:

Date:

To reach the objectives of FREILOT study will be necessary to collect general descriptive information for each participant including fleet operators.

Please read each question carefully. If you do not understand something, feel free to ask any of the researchers. Your participation is completely voluntary. Thank you very much for your collaboration.

GENERAL INFORMATION:

1. Fleet company:
2. Number of trucks in this project:
3. Number of drivers in this project:
4. Position in the company (optional):

ACCELERATION LIMITER:

Please, express your degree of agreement or disagreement with each statement by ticking the appropriate number (0 is related with **Totally disagree** and 10 **Totally agree**):

1. Our company believe the Acceleration Limiter service is positive for our company

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

2. We think the safe of our drivers increases with the use of the Acceleration Limiter service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

3. Our company trust the Acceleration Limiter service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

4. The freight transport image in urban areas improves with the usage of AL service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

5. The image of the city has improved with the use of Acceleration Limiter service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

6. In general, we think our drivers are confident of using Acceleration Limiter service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

7. Our company believe our company has the indispensable conditions to use the AL

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

8. According our perception, the Acceleration Limiter service improves the environmental image of our company

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

9. We think that using the Acceleration Limiter service increases the efficacy of our company work

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

10. Our company accept increase on journey duration as a trade off to decreased fuel consumption

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

DELIVERY SPACE BOOKING:

Please, express your degree of agreement or disagreement with each statement by ticking the appropriate number (0 is related with **Totally disagree** and 10 **Totally agree**):

1. Since our company use the Delivery Space Booking service is easier to us to realize the delivery/unloading task

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

2. We perceive that the safety of our drivers increased since I used the Delivery Space Booking service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

3. We think that using the Delivery Space Booking service increases the efficacy of our company work

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

4. We believe that the freight transport image in urban areas is improved with the usage of Delivery Space Booking service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

5. The Delivery Space Booking service facilitates the delivery task of my company because our drivers don't need to look for free spaces

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

6. We believe that our company improves the organization and management of urban distribution processes

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

7. Our company have less tickets/fines because of double-parked since we used Delivery Space Booking service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

8. We think the traffic flow gets benefits with the Delivery Space Booking service (the rest of the drivers do not hold up because of double lines, less congestions…)

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

9. We think the Delivery Space Booking service does not disturb our drivers in their driving task

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

10. We consider the Delivery Space Booking service improves the freight image in urban

areas because decrease the number of double lane stops										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
11. We think the Delivery Space Booking service facilitates our delivery operations										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
12. After using Delivery Space Booking we like the service										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
13. We believe the Delivery Space Booking service works properly										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
14. The image of the city has improved with the use of Delivery Space Booking										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
15. More we use the Delivery Space Booking service, we feel more apprehensive about it										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
16. Our company believe the our drivers appreciate the Delivery Space Booking service because they will find easier to drive in the city without double lines and trucks parked on the pavement, less stress…										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
17. When our company unload the goods using the space obtained by the Delivery Space Booking service we think that the delivery load is safer										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
18. Using the Delivery Space Booking service, our company consider the driving of our drivers is more safety										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
19. We think our company distributes more goods in less time since we are using Delivery Space Booking service										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
20. We think it is easier to find a free space for our company since we used the Delivery Space Booking service										
0	1	2	3	4	5	6	7	8	9	10

☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
21. Our company trust the Delivery Space Booking service										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
22. According our perception, the Delivery Space Booking service improves the environmental image of our company										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
23. We appreciate Delivery Space Booking service because it helps our company to reduce fuel consumption										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
24. We consider that there are more availability space with the Delivery Space Booking service usage										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
25. We find the Delivery Space Booking service is easy to use										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
26. We think the Delivery Space Booking service is effective to reduce double lane stops										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
27. Our company accept increase on journey duration as a trade off to decreased fuel consumption										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

ECO-DRIVING SUPPORT:

Please, express your degree of agreement or disagreement with each statement by ticking the appropriate number (0 is related with **Totally disagree** and 10 **Totally agree**):

1. After using Eco-driving support we like the service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

2. The image of the city has improved with the use of Eco-driving support

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

3. We think the Eco-driving support improves the freight transport image in urban areas taking into account that its use reduces the CO2 emissions and other pollutants

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

4. The use of Eco-driving support services makes urban driving easier

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

5. We think the Eco-driving is effective to reduce the fuel consumption and the pollutants

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

6. The freight transport image in urban areas is improved with the usage of Eco-driving support

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

7. Our company is confident of using Eco-driving support

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

8. Our company trust the Eco-driving support service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

9. We think that using the Eco-driving support service increases the efficacy of our company work

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

10. More we use the Eco-driving support service, we feel more apprehensive about it

0	1	2	3	4	5	6	7	8	9	10

☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
11. According our perception, the Eco-driving support service improves the environmental image of our company										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
12. It is easy to understand how the Eco-driving support works										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
13. We believe the Eco-driving support service works properly										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
14. We believe our company drivers have the indispensable knowledge to utilize the Eco-driving support service										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
15. Using the Eco-driving support service, our company consider the driving of our drivers is more safety										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
16. We believe that the advices provide by the Eco-driving support are adequate										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
17. Our company accept increase on journey duration as a trade off to decreased fuel consumption										
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

INTERSECTION CONTROL:
Please, express your degree of agreement or disagreement with each statement by ticking the appropriate number (0 is related with **Totally disagree** and 10 **Totally agree**):

1. It is easy to understand how the Intersection Control service works										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
2. Our company trust the Intersection Control service										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
3. According our perception, the Intersection Control service improves the environmental image of our company										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
4. The freight transport image in urban areas is improved with the usage of Intersection Control service										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
5. We consider the length of traffic queues in road intersections are smaller with the usage of Intersection Control service										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
6. We believe that our company improves the organization and management of urban distribution processes										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
7. After using Intersection Control we like the service										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
8. We think that using the Intersection Control service increases the efficacy of our company work										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
9. We believe the Intersection Control service works properly										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
10. The use of Intersection Control services makes urban driving easier										

0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
11. We think the Intersection Control is effective to manage the traffic in the road intersections										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
12. The image of the city has improved with the use of Intersection Control services										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
13. Our company accept increase on journey duration as a trade off to decreased fuel consumption										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐

SPEED LIMITER:

Please, express your degree of agreement or disagreement with each statement by ticking the appropriate number (0 is related with **Totally disagree** and 10 **Totally agree**):

1. The use of Speed Limiter services makes urban driving easier

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

2. We think the Speed Limiter is effective to not exceed the speed limitations

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

3. The freight transport image in urban areas is improved with the usage of Speed Limiter service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

4. We think that using the Speed Limiter service increases the efficacy of our company work

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

5. The image of the city has improved with the use of Speed Limiter service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

6. We believe the Speed Limiter service works properly

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

7. We believe the urban congestion has increased with the usage of the Speed Limiter service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

8. According our perception, the Speed Limiter service improves the environmental image of our company

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

9. Our company trust the Speed Limiter service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

10. Using the Speed Limiter service, our company consider safer the driving of our drivers

0	1	2	3	4	5	6	7	8	9	10

☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
11. After using Speed Limiter our company like the service										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐
12. Our company accept increase on journey duration as a trade off to decreased fuel consumption										
0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐

FREILOT Questionnaires_Ambulace/Fire_Brigade

FREILOT QUESTIONNAIRE

Number/ID:

Date:

Please, indicate the system/s or service which you have experience with and how long you have used it:

IC: **Number of Months:**

To reach the objectives of FREILOT study will be necessary to collect general descriptive information for each participant.

Please read each question carefully. If you do not understand something, feel free to ask any of the researchers. Your participation is completely voluntary. Thank you very much for your collaboration.

DEMOGRAPHIC CHARACTERISTICS:

1. Age:

2. Gender:
   - ☐ Male
   - ☐ Female

3. Educational level:
   - ☐ Without studies
   - ☐ Primary studies
   - ☐ Secondary studies
   - ☐ Vocational training
   - ☐ Certificate degree
   - ☐ Graduate
   - ☐ Other

4. Occupation:

DRIVING EXPERIENCE:

5. Driving license (it depends on the country?):
   - ☐ A1
   - ☐ A
   - ☐ B
   - ☐ C1
   - ☐ C
   - ☐ D1
   - ☐ D
   - ☐ E

6. What age do you start to drive?

7. How many years have you got as fire truck/ambulance driver?

8. How often do you drive?

- ☐ At least once a week
- ☐ More than once a week
- ☐ At least once a day

9. Habitually, what is your timetable?

10. Approximately, how many kilometres do you drive per year (average)?
    - ☐ <10.000 Km.
    - ☐ 10.000 – 15.000 Km.
    - ☐ 15.001 – 20.000 Km.
    - ☐ >20.000 Km.

11. Indicate in type of road you usually drive (only tick one answer),
    - ☐ Highway
    - ☐ Dual carriageway
    - ☐ National road
    - ☐ Rural road
    - ☐ Urban road

12. In the last 5 years, how many fines did you received by driving offence?:

13. Are you colour blind?:
    - ☐ Yes
    - ☐ No.

14. Are you hearing impaired?:
    - ☐ Yes
    - ☐ No.

15. Are you required to wear corrective lenses to drive (glasses or contact lenses)?
    - ☐ Yes
    - ☐ No

INTERSECTION CONTROL:

Please, express your degree of agreement or disagreement with each statement by ticking the appropriate number (0 is related with **Totally disagree** and 10 **Totally agree**):

General Questions

1. It is easy to understand how the Intersection Control service works

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

2. The ambulance service/fire brigade image in urban areas is improved with the usage of Intersection Control service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

3. I believe that my work conditions have improved with the use of Intersection Control

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

4. I consider the length of traffic queues in road intersections are smaller with the usage of Intersection Control service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

5. After using Intersection Control I like the service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

6. I think I have achieved a higher driving comfort using Intersection Control service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

7. It is simple to indentify the functions of the Intersection Control service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

8. I believe I have the indispensable knowledge to utilize the Intersection Control service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

9. More I use the Intersection Control service, I feel less stressed

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

10. More I use the Intersection Control service, I feel more apprehensive about it

0	1	2	3	4	5	6	7	8	9	10

☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Normal driving (truck priority)

1. I trust the Intersection Control service in normal driving

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

2. I am confident of using Intersection Control service in normal driving

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

3. I think that using the Intersection Control service in normal driving increases the efficacy of my work

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

4. The use of Intersection Control services makes urban driving easier in normal driving

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

5. I think the Intersection Control is effective to manage the traffic in the road intersections in normal driving

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

6. I am confident in my ability to drive the ambulance/ fire brigade truck safely with the Intersection Control service in normal driving

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

7. I believe I have the indispensable knowledge to utilize the Intersection Control service

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

8. Using the Intersection Control service, I consider my driving is more safety in normal driving

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

9. More I use the Intersection Control service, I feel more apprehensive about it

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Emergency driving (absolute priority)

1. I trust the Intersection Control service in emergency driving

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

2. The emergency priority service decreases the driving time through the city

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

3. I am confident of using Intersection Control service in emergency driving

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

4. The emergency priority service increases the safety of the other road users.

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

5. I think that using the Intersection Control service in emergency driving increases the efficacy of my work

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

6. I believe the Intersection Control service works properly in emergency driving

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

7. The use of Intersection Control services makes urban driving easier in emergency driving

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

8. I think the Intersection Control is effective to manage the traffic in the road intersections in emergency driving

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

9. I am confident in my ability to drive the ambulance/ fire brigade truck safely with the Intersection Control service in emergency driving

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

10. Using the Intersection Control service, I consider my driving is more safety in emergency driving

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Annex III: FREILOT Questionnaires : CVIS adaptation to FREILOT DSB Pilot sites

Pre-deployment Training Day

Month 2011

This survey was designed to support the evaluation of the Co-operative Vehicle and Infrastructure Systems (CVIS) Project and in particular the deployment of the Urban Parking Zones application on a mixed-use street in central London to manage a freight loading bay in Earl's Court Road. Furthermore, this questionnaire will be used and adapted to FREILOT pilot with the aim of obtain relevant information.

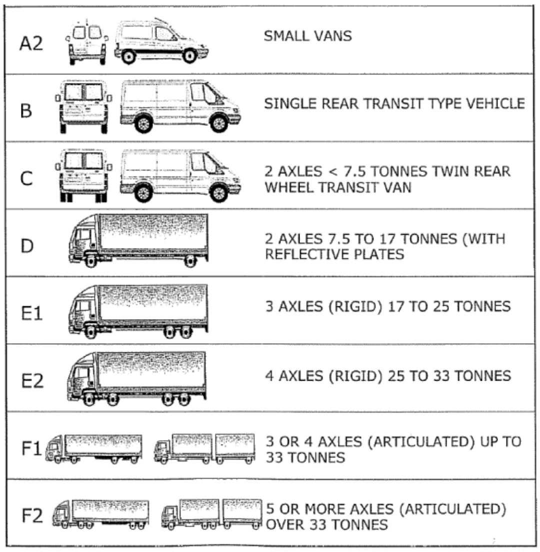
Your responses will be used to identify the extent to which the FREILOT DSB service may help to better manage on-street loading bays. Moreover, the results could be compared with the CVIS project results. Responses will be used solely for this purpose. A second questionnaire will be circulated at the end of the field trial period to gather your experiences of using the system.

This questionnaire consists of 3 sections and 17 questions in total. It will take approximately 20 minutes to complete.

Your participation in this research project is very much appreciated.

About your organization

1.1	Name	
1.2	Organization	
1.3	Job title	
1.4	Approximately how many of each of these types of vehicle do you operate in Bilbao/Lyon?	



Other (please specify):

1.5	Please list the locations of your depots?	
1.6	Approximately how many deliveries does your organization make per day in Bilbao/Lyon? (please tick, or leave blank if unknown)	1-5 [ ] 6-10 [ ] 11-20 [ ] 21-50 [ ] 51+ [ ]
1.7	Approximately how many deliveries will an individual vehicle make between visits to a depot? (please tick, or leave blank if unknown)	1-3 [ ] 4-6 [ ] 7-10 [ ] 11-15 [ ] 16+ [ ]

Use of on-street loading bays

2.1	Do you experience problems with on-street loading bay access in Bilbao/Lyon?	Yes [ ] No [ ]
2.2	Please state your most significant problem relating to on-street loading bay access	
2.3	Do you experience similar problems in other urban centres?	Yes [ ] No [ ]

2.4	What action do you take if a loading bay is occupied on arrival? Please indicate which of the following responses you would consider, and give your order of preference (e.g. write in "1" for first choice, "2" for second and so on. Leave blank if the response is not considered)	
	[ ]	Park as close as possible to the loading bay and continue with delivery
	[ ]	Park at a holding location near bay and wait in vehicle for bay to become free
	[ ]	Drive around the block and return to bay hoping that it is free
	[ ]	Reschedule delivery for later in the same day
	[ ]	Reschedule delivery for another day
	[ ]	Other (please specify):

2.5	Would you attempt to communicate with the driver of the vehicle occupying the bay to see how much longer they would be there?	Yes [ ]	No [ ]

2.6	Please indicate which of the following circumstances in your experience most frequently lead to receipt of parking tickets;	
	[ ]	Illegally parked adjacent to occupied loading bay
	[ ]	Legally parked, but overstaying time limit for the loading bay
	[ ]	Illegally parked for a delivery where no loading bay is present
	[ ]	Other (please specify):

Scheduling and Routing

3.1	Do you make use of a software tool to schedule your deliveries and assign them to vehicles?	Yes [ ]	No [ ]
	If "Yes" then which system do you currently use?		

3.2	When are deliveries/collections assigned to vehicles?	
	[ ]	En route
	[ ]	Start of shift
	[ ]	Previous day
	[ ]	Recurring pattern
	[ ]	Other (please specify):
3.3	How are your vehicles routed to their destinations?	
	[ ]	Driver experience of routes
	[ ]	Use of printed maps
	[ ]	Use of standalone in-car navigation system with route guidance (e.g. TomTom)
	[ ]	Use of integrated route guidance within a fleet management system
	[ ]	Other (Please specify)

3.4	Based on your initial impressions, please comment below on the user-friendliness of the FREILOT software and the extent to which it includes the features you require:

Many thanks for your time and assistance in the FREILOT Evaluation process

CVIS Pilot site Participant Survey

Post-Trial Participant Experience Survey

Month 2011

This survey was designed to support the evaluation of the Co-operative Vehicle and Infrastructure Systems (CVIS) Project and in particular the deployment of the Urban Parking Zones application on a mixed-use street in central London to manage a freight loading bay in Earl's Court Road. Furthermore, this questionnaire will be used and adapted to FREILOT pilot with the aim of obtain relevant information.

Your responses will be used to identify the extent to which the FREILOT DSB service may help to better manage on-street loading bays. Moreover, the results could be compared with the CVIS project results. Responses will be used solely for this purpose.

This questionnaire consists of 3 sections and 19 questions in total. It will take approximately 20 minutes to complete.

Your participation in this research project is very much appreciated.

About your organization

1.1	Name	
1.2	Organization	
1.3	Job title	

1.4	Please list the location of your depot for the vehicle fitted with the FREILOT DSB space(s)?	
1.5	Approximately how many deliveries does this vehicle make per day in Bilbao/Lyon? (please tick, or leave blank if unknown)	1-5 6-10 11-20 21-50 51+ [ ] [ ] [ ] [ ] [ ]
1.6	Approximately how many deliveries will an individual vehicle make between visits to a depot? (please tick, or leave blank if unknown)	1-3 4-6 7-10 11-15 16+ [ ] [ ] [ ] [ ] [ ]

Overall experience of FREILOT DSB Trials

2.1	How do you rate your overall experience of the FREILOT trials? Please indicate with a mark on this scale.	Good Bad [| | | |]
2.2	How do you rate the usefulness of the Urban Parking Zones application?	[ ] Very useful [ ] Quite useful [ ] Not useful [ ] Unhelpful
2.3	How did you rate the reliability of the service?	[ ] Very Reliable [ ] Quite reliable [ ] Not reliable
2.4	Did the use of the system improve your experience of using the loading bay? [ ] Yes [ ] No [ ] Don't know	
2.5	Has the trial lead to reduced delivery times of your vehicles at that loading bay? [ ] Yes [ ] No [ ] Don't know If "Yes", by approximately how much per delivery? ________________________	
2.6	How often did you experience a fully occupied bay during the trial? [ ] Never [ ] Occasionally (1 to 3 times during the trial)	

	[ ] Frequently (4 or more times during the trial) [ ] Don' know
2.7	Please add any specific comments or feedback about the trial, not covered elsewhere in this questionnaire?

System ease of use

3.1	Which system components did you make use of during the trial? Please indicate all that apply.		[ ] Booking System [ ] Other (please specify) ____________________
3.2	How do you rate these systems in terms of ease of use? Please indicate on the scales below		
	Booking System	Easy to use [-1-----------------3------------------5-] Hard to use	
	Other (please specify)	Easy to use [-1-----------------3------------------5-] Hard to use	
3.3	Did you have any specific issues with the systems? Please briefly describe.		
	Booking System:		
3.4	How important to you are the following features?		
	Booking or re-booking of delivery slots on the day of delivery?	Very important [-1------------3 -------------5-] Not important	
	Integration with other fleet management tools and in-vehicle devices?	Very important [-1------------3--------------5-] Not important	
3.5	What suggestions would you make to refine the system?		

Many thanks for your time and assistance in the FREILOT Evaluation process

Annex IV: First proposal of the measure list needed.

The original list of measures needed per hypothesis (presented in previous versions of this deliverable) is kept in the annex section after analyzing the data that can be provided by the DAS (see chapter 10). In blue note the measures that are not available directly from data loggers devices, but can be obtained with pos-processing methods. In red the data that is not available.

1. Energy Efficient Intersection Control

RQ1_1 Hypo EEIC1, EEIC3, EEIC5	**Overall estimated fuel consumption in use case X will be lower than reference (default non-prioritised control)**
TRUCK	[Truck ID] [Fuel Consumption] [Distance drive by the truck] [GPS position]
SYSTEM	[Intersection ID] [Mode of operation] [Priority state][Time until green][Advised Speed] [State of traffic lights]
ENVIRONMENT	[Traffic Intensity]
DRIVER	[Driver ID]
RQ1_1 Hypo EEIC2, EEIC4, EEIC6, EEIC7, EEIC8, EEIC9	**Measured fuel consumption in the specific fleet in use case X will be Y% lower than reference (default non-prioritised control)**
TRUCK	[Truck ID] [Fuel Consumption] [Distance drive by the truck] [GPS position]
SYSTEM	[Intersection ID] [Mode of operation] [Priority state][Time until green][Advised Speed] [State of traffic lights]
ENVIRONMENT	[Traffic Intensity]
DRIVER	[Driver ID]
RQ1_1 Hypo EEIC10, EEIC11, EEIC12	**Estimated fuel consumption of HGV's in use case X will be Y% lower than reference case (default non-prioritised control)**
TRUCK	[Truck ID] [Fuel Consumption] [Distance drive by the truck] [GPS position]
SYSTEM	[Intersection ID] [Mode of operation] [Priority state][Time until green][Advised Speed] [State of traffic lights]
ENVIRONMENT	[Traffic Intensity]
DRIVER	[Driver ID]
RQ8_1 Hypo EEIC13, EEIC14, EEIC15, EEIC16, EEIC 17, EEIC18	**Average cycle times on the intersections will increase nu more than Y% in use case X**
TRUCK	
SYSTEM	[Intersection ID] [Mode of operation] [Priority state][Time until green][Advised Speed] [State of traffic lights]
ENVIRONMENT	[Traffic Intensity]
DRIVER	
RQ8_1 Hypo EEIC19, EEIC20, EEIC21	**Overall travel times on main routes will remain unchanged in use case X**

TRUCK	[Truck ID] [Fuel Consumption] [Distance drive by the truck]
SYSTEM	[Intersection ID] [Mode of operation] [Priority state][Time until green][Advised Speed] [State of traffic lights]
ENVIRONMENT	[Traffic Intensity]
DRIVER	[Driver ID]
RQ8_1 Hypo EEIC22, EEIC23, EEIC24	**Increase in travel times on crossing routes will be lower than Y% in use case X**
TRUCK	[Truck ID] [Fuel Consumption] [Distance drive by the truck] [GPS position]
SYSTEM	[Intersection ID] [Mode of operation] [Priority state][Time until green][Advised Speed] [State of traffic lights]
ENVIRONMENT	[Traffic Intensity]
DRIVER	[Driver ID]
RQ8_1 Hypo EEIC25, EEIC26, EEIC27	**Travel times on main routes will improve by Y% in use case X**
TRUCK	[Truck ID] [Fuel Consumption] [Distance drive by the truck] [GPS position]
SYSTEM	[Intersection ID] [Mode of operation] [Priority state][Time until green][Advised Speed] [State of traffic lights]
ENVIRONMENT	[Traffic Intensity]
DRIVER	[Driver ID]
RQ8_1 Hypo EEIC28, EEIC29, EEIC30	**Increase in travel times on crossing routes will be lower than Y% in use case X**
TRUCK	[Truck ID] [Fuel Consumption] [Distance drive by the truck] [GPS position]
SYSTEM	[Intersection ID] [Mode of operation] [Priority state][Time until green][Advised Speed] [State of traffic lights]
ENVIRONMENT	[Traffic Intensity]
DRIVER	[Driver ID]

Table 56 Direct measurements Energy Efficient Intersection Control

2. Adaptive Speed Limiter

RQ8_2 Hypo ASL1	**Using Adaptive Speed Limiter service, the time of delivery will increase**
TRUCK	[Truck ID] [Distance drive by the truck] [Speed] [GPS position]
SYSTEM	[Activation of system (ON/OFF)] [Speed limit value] [Number of times the system is activated during a trip]
ENVIRONMENT	[Number of stops in intersections] [Stops/slow speed in congestions]
DRIVER	[Driver ID] [Driver use of the system (accept/no accept limitation)]

RQ1_2 Hypo ASL2	**Using Adaptive Speed Limiter service reduces fuel consumption**
TRUCK	[Truck ID] [Distance drive by the truck] [Speed] [Fuel Consumption] [GPS position]
SYSTEM	[Activation of system (ON/OFF)] [Speed limit value] [Number of times the system is activated during a trip] [Number of times the system prevents the driver from over-speeding during the trip] [Number of times the driver overruns the Speed Limit]
ENVIRONMENT	[Number of stops in intersections] [Stops/slow speed in congestions]
DRIVER	[Driver ID] [Driver use of the system (accept/no accept limitation)]
RQ9_2 Hypo ASL3	**A truck using the Adaptive Speed Limiter service will not disturb surrounding traffic**
TRUCK	[Truck ID] [Distance drive by the truck] [Speed] [GPS position]
SYSTEM	[Activation of system (ON/OFF)] [Speed limit value] [Number of times the system is activated during a trip]
ENVIRONMENT	[Number of stops in intersections] [Stops/slow speed in congestions] [Traffic Intensity]
DRIVER	[Driver ID] [Driver use of the system (accept/no accept limitation)]
RQ4_2 Hypo ASL4	**Average speed of the truck will be decrease with the usage of the Adaptive Speed Limiter**
TRUCK	[Truck ID] [Distance drive by the truck] [Speed] [GPS position]
SYSTEM	[Activation of system (ON/OFF)] [Speed limit value] [Number of times the system is activated during a trip]
ENVIRONMENT	[Number of stops in intersections] [Stops/slow speed in congestions]
DRIVER	[Driver ID] [Driver use of the system (accept/no accept limitation)]
RQ5_2 Hypo ASL5	**Driver braking behaviour will change with the usage of Adaptive Speed Limiter**
TRUCK	[Truck ID] [Distance drive by the truck] [Speed] [Use of brake (On/Off)] [Brake Pressure] [GPS position]
SYSTEM	[Activation of system (ON/OFF)] [Speed limit value] [Number of times the system is activated during a trip]
ENVIRONMENT	[Number of stops in intersections] [Stops/slow speed in congestions]
DRIVER	[Driver ID] [Driver use of the system (accept/no accept limitation)]

Table 57 Direct measurements Adaptive Speed Limiter

3. Acceleration Limiter

RQ1_2 Hypo AL1	**Using Acceleration Limiter service fuel consumption will decrease**
TRUCK	[Truck ID] [Distance drive by the truck] [Acceleration] [Fuel Consumption] [GPS position]
SYSTEM	[Activation of system (ON/OFF)] [Acceleration limit value] [Number of times the system is activated during a trip]
ENVIRONMENT	[Number of stops in intersections] [Stops/slow speed in congestions]
DRIVER	[Driver ID] [Driver use of the system (accept/no accept limitation)]
RQ8_2 Hypo AL2	**Using Acceleration Limiter service load capacity will not change**
TRUCK	[Truck ID] [Distance drive by the truck] [Acceleration] [Load capacity] [GPS position]
SYSTEM	[Activation of system (ON/OFF)] [Acceleration limit value] [Number of times the system is activated during a trip]
ENVIRONMENT	[Number of stops in intersections] [Stops/slow speed in congestions]
DRIVER	[Driver ID] [Driver use of the system (accept/no accept limitation)]
RQ6_2 Hypo AL3	**Using Acceleration Limiter service driver will decreased capacity of acceleration on flat road**
TRUCK	[Truck ID] [Distance drive by the truck] [Acceleration] [GPS position]
SYSTEM	[Activation of system (ON/OFF)] [Acceleration limit value] [Number of times the system is activated during a trip]
ENVIRONMENT	[Number of stops in intersections] [Stops/slow speed in congestions]
DRIVER	[Driver ID] [Driver use of the system (accept/no accept limitation)]
RQ2_2 Hypo AL5	**Acceleration Limiter usage will decrease the CO_2 emissions and other pollutants**
TRUCK	[Truck ID] [Distance drive by the truck] [Acceleration] [Emissions] [GPS position]
SYSTEM	[Activation of system (ON/OFF)] [Acceleration limit value] [Number of times the system is activated during a trip]
ENVIRONMENT	[Number of stops in intersections] [Stops/slow speed in congestions]
DRIVER	[Driver ID] [Driver use of the system (accept/no accept limitation)]
RQ3_2 Hypo AL6	**Acceleration Limiter usage will decrease emissions of other pollutants.**
TRUCK	[Truck ID] [Distance drive by the truck] [Acceleration] [Emissions] [GPS position]
SYSTEM	[Activation of system (ON/OFF)] [Acceleration limit value] [Number of times the system is activated during a trip]
ENVIRONMENT	[Number of stops in intersections] [Stops/slow speed in congestions]
DRIVER	[Driver ID] [Driver use of the system (accept/no accept limitation)]

RQ4_2 Hypo AL8	**Driver will accelerate less with the usage of the acceleration system**
TRUCK	[Truck ID] [Distance drive by the truck] [Acceleration] [Accelerator Use (ON/OFF)] [GPS position]
SYSTEM	[Activation of system (ON/OFF)] [Acceleration limit value] [Number of times the system is activated during a trip]
ENVIRONMENT	[Number of stops in intersections] [Stops/slow speed in congestions]
DRIVER	[Driver ID] [Driver use of the system (accept/no accept limitation)]

Table 58 Direct measurements Acceleration Limiter

4. Eco Driving Support

RQ1_3 Hypo EDS1	**Using Eco Driving will support the driver to drive in a way that reduces fuel consumption.**
TRUCK	[Truck ID] [Distance drive by the truck] [Fuel Consumption] [GPS position]
SYSTEM	[When the system gives an advice (ON/OFF)] [Advice given by the system] [Number of advices given per route]
ENVIRONMENT	[Number of stops in intersections] [Stops/slow speed in congestions]
DRIVER	[Driver ID] [Driver use of the system (accept/no accept limitation)]
RQ2_3 Hypo EDS2	**Following the advice from the Eco Driving Support service fuel consumption will decrease.**
TRUCK	[Truck ID] [Distance drive by the truck] [Fuel Consumption] [GPS position]
SYSTEM	[When the system gives an advice (ON/OFF)] [Advice given by the system] [Number of advices given per route]
ENVIRONMENT	[Number of stops in intersections] [Stops/slow speed in congestions]
DRIVER	[Driver ID] [Driver use of the system (accept/no accept limitation)]
RQ2_3 Hypo EDS3	**Following the advice from the Eco Driving Support service CO_2 emissions will decrease.**
TRUCK	[Truck ID] [Distance drive by the truck] [Emissions] [GPS position]
SYSTEM	[When the system gives an advice (ON/OFF)] [Advice given by the system] [Number of advices given per route]
ENVIRONMENT	[Number of stops in intersections] [Stops/slow speed in congestions]
DRIVER	[Driver ID] [Driver use of the system (accept/no accept limitation)]
RQ4_3, RQ6_3 Hypo EDS4	**Following the advice from the Eco Driving Support service harsh acceleration and braking will reduce.**
TRUCK	[Truck ID] [Distance drive by the truck] [Speed] [Acceleration] [Brake Use (ON/OFF)] [Accelerator Use (ON/OFF)] [GPS position]
SYSTEM	[When the system gives an advice (ON/OFF)] [Advice given by the system] [Number of advices given per route]
ENVIRONMENT	[Number of stops in intersections] [Stops/slow speed in congestions]
DRIVER	[Driver ID] [Driver use of the system (accept/no accept limitation)]

Table 59 Direct measurements Eco Driving Support

5. Delivery Space Booking

RQ8_4 **Hypo DSB1**	**Delivery space booking reduces the lengths of delivery journeys**
TRUCK	[Truck ID] [Distance drive by the truck] [Speed] [GPS position]
SYSTEM	[Mode of operation of the system] [ID of DSB stop]
ENVIRONMENT	[Number of stops in intersections] [Stops/slow speed in congestions]
DRIVER	[Driver ID]
RQ7_4, RQ8_4 **Hypo DSB2**	**Delivery space booking reduces the time of delivery journeys**
TRUCK	[Truck ID] [Distance drive by the truck] [Speed] [GPS position]
SYSTEM	[Mode of operation of the system] [ID of DSB stop] [Date]
ENVIRONMENT	[Number of stops in intersections] [Stops/slow speed in congestions]
DRIVER	[Driver ID]
RQ1_4 **Hypo DSB3**	**Delivery Space Booking service decreases the fuel consumption**
TRUCK	[Truck ID] [Fuel Consumption] [Distance drive by the truck] [GPS position]
SYSTEM	[Mode of operation of the system] [ID of DSB stop]
ENVIRONMENT	[Traffic intensity] [Congestion]
DRIVER	[Driver ID]
RQ2_4 **Hypo DSB4**	**Delivery Space Booking decreases the CO_2 emissions.**
TRUCK	[Truck ID] [Fuel Consumption] [Emissions] [Distance drive by the truck] [GPS position]
SYSTEM	[Mode of operation of the system] [ID of DSB stop]
ENVIRONMENT	[Traffic intensity] [Congestion]
DRIVER	[Driver ID]
RQ2_4 **Hypo DSB5**	**Delivery Space Booking decreases the emission of other pollutants**
TRUCK	[Truck ID] [Fuel Consumption] [Emissions] [Distance drive by the truck] [GPS position]
SYSTEM	[Mode of operation of the system] [ID of DSB stop]
ENVIRONMENT	[Traffic intensity] [Congestion]
DRIVER	[Driver ID]
RQ3_4, RQ8_4 **Hypo DSB6**	**Drivers decreases the double lane stops with the Delivery Space Booking usage.**
TRUCK	[Truck ID] [GPS position]
SYSTEM	[Mode of operation of the system] [ID of DSB stop] [Number of double lane stops in the DSB stop of other vehicles per day]
ENVIRONMENT	[Traffic intensity]
DRIVER	[Driver ID]

Table 60 Direct measurements Delivery Space Booking

Annex V: FREILOT Truck list for the Evaluation Plan

For each pilot site and service, the following table summarizes the trucks considered for the preparation of the evaluation plan.

Site	TruckID	Operator	EEIC	ASL	AL	EDS	DSB
Bilbao	B04	Nanuk					
Bilbao	B05	Nanuk					
Bilbao	B06	Nanuk					
Bilbao	B08	Azkar					
Bilbao	B09	Azkar					
Bilbao	B10	Azkar					
Bilbao	B11	Azkar					
Bilbao	B12	BIZKAI IZARRA					
Bilbao	B13	BIZKAI IZARRA					
Bilbao	B14	Patxi					
Bilbao	B15	Patxi					
Bilbao	B16	Zubillaga					
Bilbao	B17	Zubillaga					
Bilbao	B18	Zubillaga					
Bilbao	B19	Zubillaga					
Bilbao	B20	Zubillaga					
Bilbao	B21	Medrano					
Bilbao	B22	Medrano					
Bilbao	B23	Unialco					
Bilbao	B24	Unialco					
Bilbao	B25	VEN					
Bilbao	B26	Eroski					
Bilbao	B27	Eroski					
Bilbao	B28	Euskodis					
Bilbao	B29	Euskodis					
Bilbao	B30	Euskodis					
Bilbao	B31	Euskodis					
Bilbao	B32	Coca cola					
Bilbao	B33	Coca cola					
Bilbao	B34	SEUR					
Bilbao	B35	SEUR					
Bilbao	B36	MRW					
Bilbao	B37	MRW					
Bilbao	B38	DHL					
Bilbao	B39	DHL					
Bilbao	B40	DHL					
Bilbao	B41	DHL					
Bilbao	B42	DHL					
Bilbao	B43	Nanuk					
Bilbao	B44	Nanuk					
Bilbao	B45	Nanuk					
Helmond	H01	Van den Broek					
Helmond	H03	Van den Broek					
Helmond	H06	Van den Broek					

Helmond	H10	Van den Broek					
Helmond	H14	Van den Broek					
Helmond	H15	Van den Broek					
Helmond	H16	Van den Broek					
Helmond	H17	Van den Broek					
Helmond	H18	Van den Broek					
Helmond	H19	Van den Broek					
Helmond	H30	Fire brigade					
Helmond	H31	Fire brigade					
Helmond	H32	Fire brigade					
Helmond	H33	Fire brigade					
Krakow	K01	Temperi					
Krakow	K02	Temperi					
Krakow	K03	Temperi					
Krakow	K04	Temperi					
Krakow	K05	Temperi					
Krakow	K06	Temperi					
Krakow	K07	Temperi					
Lyon	L16	Pomona					
Lyon	L18	Pomona					
Lyon	L19	Pomona					
Lyon	L22	STEF-TFE					
Lyon	L23	STEF-TFE					
Lyon	L24	STEF-TFE					
Lyon	L25	STEF-TFE					
Lyon	L27	STEF-TFE					
Lyon	L28	Pomona					
Lyon	L29	Pomona					
Lyon	L30	Pomona					
Lyon	L31	Pomona					
Lyon	L32	Pomona					
Lyon	L33	Pomona					
Lyon	L34	Pomona					
Lyon	L35	Pomona					
Lyon	L36	Pomona					
Lyon	L37	Pomona					
Lyon	L38	UPS					
Lyon	L39	UPS					
Lyon	L40	Easydis					
Lyon	L41	Easydis					
Lyon	L42	Easydis					
Lyon	L43	France Express					
Lyon	L44	France Express					
Lyon	L45	Grand Lyon					

Table 61 FREILOT Truck list for the Evaluation Plan

New more trucks will be added in Krakov using the EEIC service, but for the moment the type of truck and the identification is not fixed.

Annex VI: Table of Figures

Annex VII: Tables

Annex VIII: Abbreviations and Definitions

Abbreviation	Definition
ABS	Anti-lock Brake System
AC	Adaptive Control
ACAS	Automotive Collision Avoidance System
ACC	Adaptive Cruise Control
ADEME	Agence de l'Environement et de la Maîtrise de l'Energie
AdvBS	Advanced Brake System
AL	Acceleration Limiter
ARTEMIS	A Semantic Web Service-Based P2P Infrastructure for the Interoperability of Medical Information System
CAN	Controlled Area Network
CMEM	Community Microwave Emissions Model
CO_2	Carbon Dioxide
COPERT	Computer Programm to Calculate Emissions from Road Transport
CVIS	Co-operative Vehicle and Infraestructure Systems
CWS	Collision Warning System
DA	Driving Acceptance
DAS	Data Recording System
dB	Decibel
DB	Driving Behaviour
D.FL.	Deliverable FREILOT
D.FL. 2.1.	Deliverable FREILOT Implementation Plan
D.FL. 6.1.	Deliverable FREILOT Bussiness Model
DSB	Delivery Space Booking
ECBS	Electronic Controlled Braking System
EDS	Eco Driving Support
E&FC	Environment & Fuel Consumption
EMS	Engineer Management System
FCW	Forward Collision Warning
FESTA	Field operational test support Action
FOT	Field Operational Test
FTP	File Transfer Protocol
GIS	Geographic Information System
GPRS	General Packet Radio Service
GPS	Global Positioning System
GW	Green Wave

HGV	Heavy Goods Vehicle
Hz	Herz
Km / h.	Kilometers per hour
EEIC	Energy Efficient Intersection Control
IC	Isolated Control (regarding Energy Efficient Intersection Control system)
ID	Identification Number
INC	Energy Efficient Intersection Control
ISA	Intelligent Speed Adaptation
ITS	Intelligent Transport Systems
IVBSS	Integrated Vehicle-Based Safety Systems
IVSS	Intelligent Vehicle Safety Systems
l	Litre
LCM	Lane Change Merge
LDW	Lane Departure Warning
LDWS	Lane Departure Warning System
LIN	Local Interconnect Network
m	meter
MOST	Media Oriented Systems Transport
NOx	Nitrogen Oxides
PI	Performance Indicator
RA&C	Roll Advisor and Control System
RDCW	System that combine LDW & CSW
RQ	Research Question
s	Second
SF	Specific Fleet
SL	Adaptive Speed Limiter
TE	Traffic Efficiency
USB	Universal Serial Bus
VISSIM	"Verkehr In Städten-SIMulation" (Traffic Simulation in Cities)
Wi-Fi	Wireless Fidelity
WP	Work Package