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COMMONS DEED

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TeleFOT, Field Operational Tests of Aftermarket Nomadic Devices in Vehicles, Early Results

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Summary

This paper presents the European Large Scale Collaborative Project TeleFOT, describing its status and its first results. The paper is structured into two main sections:

The **first paragraph** briefly introduces the justification and core elements of TeleFOT, showing the scope and primary objectives of the project. Significant research and development in Europe in recent years have been focusing on Intelligent Transport Systems (ITS), since they are contributing to a change in mobility. The number of devices supporting transportation is increasing. In particular, the market penetration of aftermarket nomadic devices as personal navigation devices (PND) or smart phones is growing exponentially according to the market trends, but no scientific evidence of impacts directly related to the use of aftermarket and nomadic devices in vehicle exist yet. Therefore there is a need to test via Field Operational Tests (FOT) the impacts of driver support functions on the driving task, including future interactive traffic services that will become part of driving environment systems.

The **second paragraph** of this paper illustrates the Field Operational Tests to be conducted in TeleFOT and progress reached so far in the project. These include (but are not limited to) large scale test sites in 8 member states, FOT framework creation, benchmarking, piloting and data analysis planning.

TeleFOT core elements

TeleFOT (Field Operational Tests of Aftermarket and Nomadic Devices in Vehicles), as a Large Scale Collaborative Project under the Seventh Framework Programme, acts in response to a need recognised by the European Commission, namely to test the impacts of driver support functions on the driving task with large fleets of test drivers in real-life driving conditions. In particular, TeleFOT aims to assess the impacts of functions provided by aftermarket and nomadic devices, including future interactive traffic services that will become part of driving environment systems within the next five years.

Today the number of devices supporting transportation is increasing. In particular, the market penetration of aftermarket nomadic devices as personal navigation devices (PND) or smart phones has been growing exponentially. Their use is carefully studied in laboratories before getting to the market and many research projects have successfully developed and demonstrated a wide number of

transport applications. Nevertheless there is still uncertainty on what really happens when such devices are used in real traffic conditions. TeleFOT is the widest pan-European field trial aiming to assess the impact of nomadic devices on the driving task.

Other innovative aspects covered in TeleFOT are linked to the way information is collected and communicated. Driver behaviour/vehicle dynamics data loggers are used for automated data collection. An automated system for Machine-to-Machine (M2M) communication from the vehicle data logger to the database and from the database to a data user allows subject information management and data security.

Test regime

Field Operational Tests in TeleFOT are based on a large number of drivers (up to 3000 drivers) using mobile devices already on the market in their own vehicles, where they interact with the functions and services provided to them. Their reactions and behaviour are recorded with data loggers mounted on their vehicles and transferred to the databank for the analysis.

The experimental design contains setting up two groups of drivers: one serves as a test group, having aftermarket and nomadic devices onboard. The second group without these devices and services serves as control drivers with whom the performance is compared.

The data are collected in different phases of the testing period: i) Pre-test, ii) During the tests, iii) Post-test phase. Long term impact data are collected after about one year of starting the tests with functions/services/devices.

By 2012 the project will achieve a comprehensive assessment of the efficiency, quality, robustness and user friendliness of mobile in-vehicle ITS systems for smarter, safer and cleaner driving.

Field Operational Tests in TeleFOT

Progress so far, FOT Framework

The project has completed the definition of functions and the equipment to be used in research. The research hypotheses and indicators have also been completed together with the data analysis plans for the studied impact areas of **safety, mobility & behavior, efficiency, environment and user up-take**. The novel process for defining research questions and hypotheses in TeleFOT is illustrated in Figure 1.

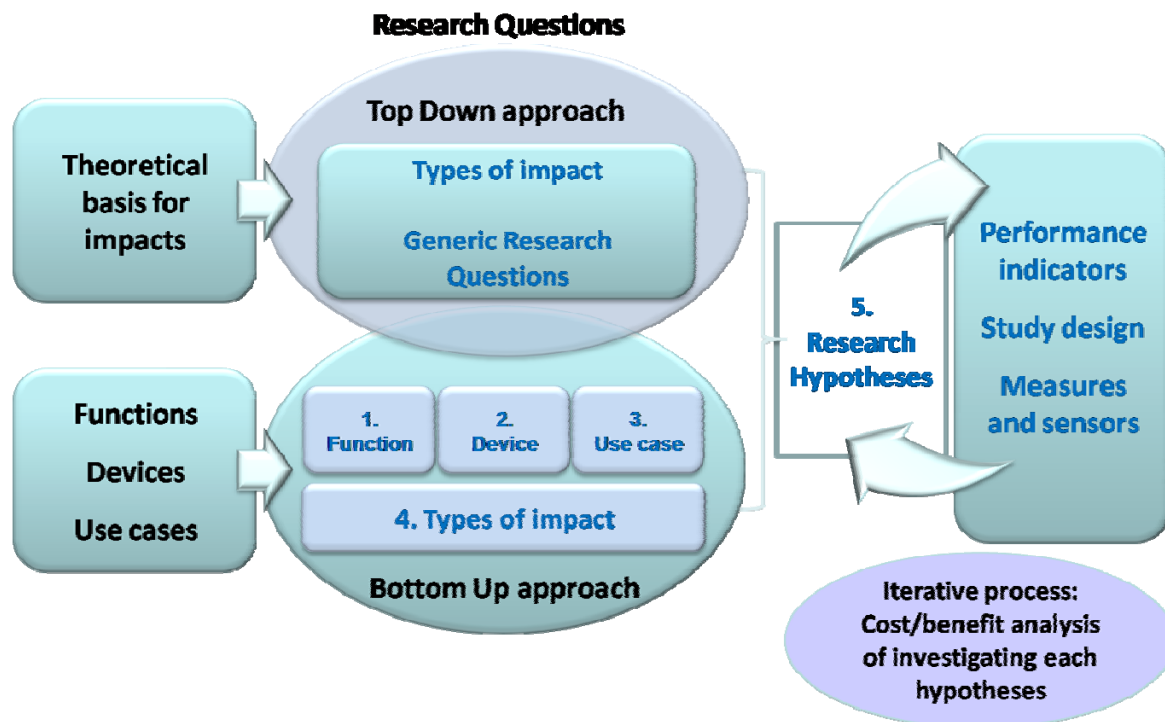


Figure 1: TeleFOT process for defining Research questions and hypotheses

As part of the pre-field-testing phase various nomadic device dashboard mounting types were tested in laboratory conditions with crash-tests (Figure 2). This was done to rule out and ban any potentially dangerous mounting types in the actual large scale tests.

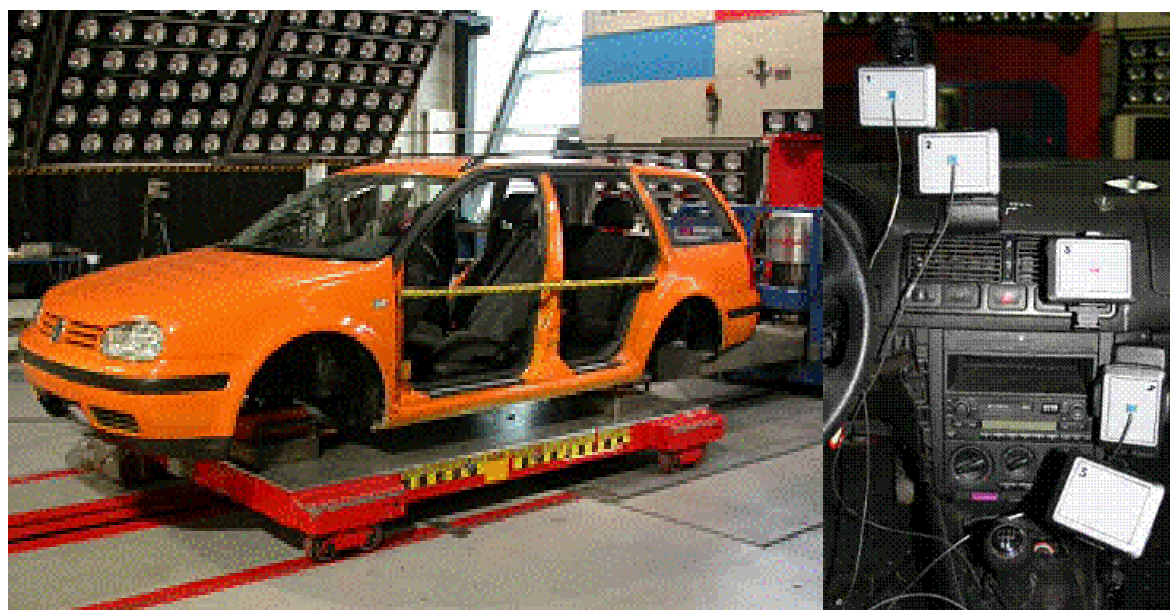


Figure 2: ADAC crash test set-up used in TeleFOT mounting tests

Progress so far: Field Operational Tests

Large scale test sites

Probably the most defining characteristic of the project activity during the first two years of TeleFOT is the set-up of the actual test sites. The resulting 8 large scale test sites are illustrated in Figure 3.

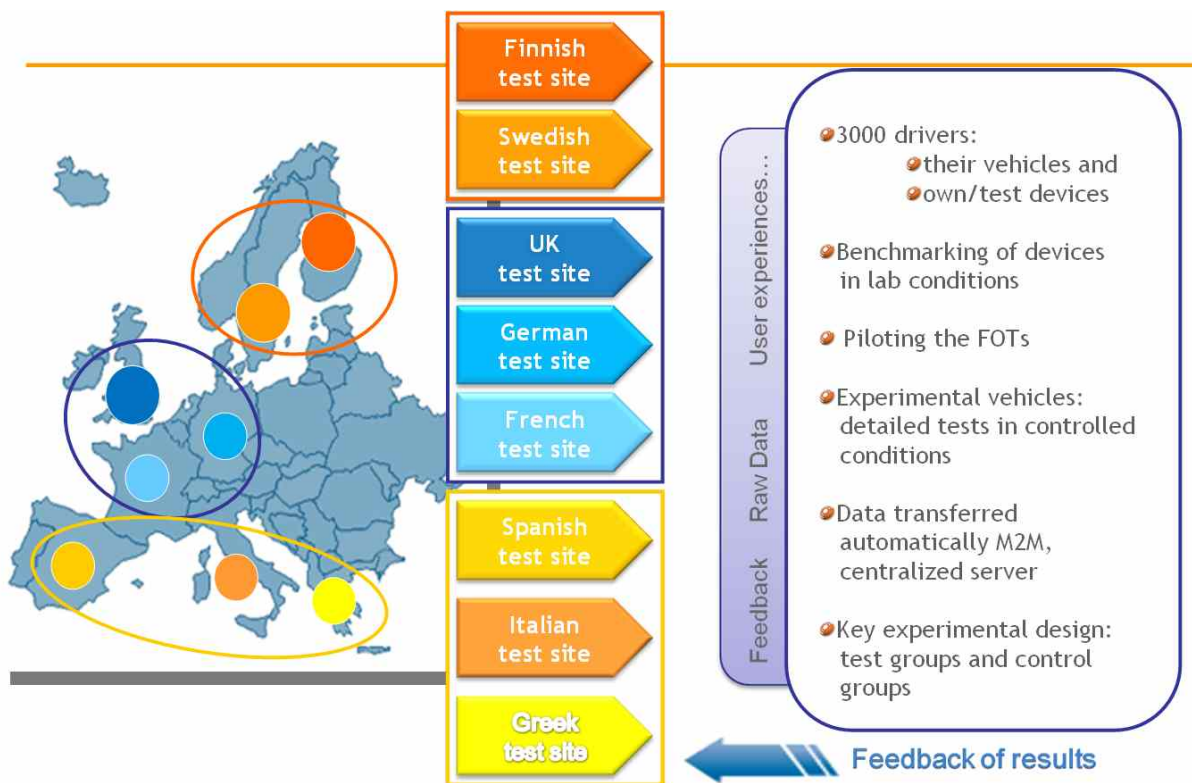


Figure 3: TeleFOT Test Sites

The TeleFOT project consists of **Large scale FOTs** (LFOTs) and **Detailed FOTs** (DFOTs). The real-time **function areas** under impact assessment in the project are: i) Functions supporting safe speeds and driving behaviour [i.e. Speed Alert and Speed Limit Information] ii) Traffic information for safe and efficient travel; iii) Road weather information; iv) Navigation support; v) Efficient and Green driving; vi) Emergency eCall. In Detailed FOTs Adaptive cruise control (ACC), Forward collision warning (FCW), Lane departure warning (LDW) and Lane keeping assist (LKA) are also to be tested. The in-vehicle use of the systems to be studied in TeleFOT cover the **context of travel, transport, and traffic**.

TeleFOT pilots for LFOTs

During the final steps before the FOTs are launched, important feedback is being received from pilot tests which are being undertaken at a small number of test sites. These have been pioneered at the Valladolid Test Site in Spain, the Thessaloniki Test Site in Greece and the Oulu Test Site in Finland. The results from the pilot-studies will be useful to the Consortium as a whole for process verification and they will also provide valuable information which will allow fine-tuning of the test tools.

The experiences gained from the pilot tests have been and will be extremely important for determining the feasibility and suitability of Large Scale testing, since the whole FOT processes are reproduced on a limited scale. This includes in particular the test conditions, tools, questionnaires and support line. Pilot tests are next to start in most of the TeleFOT test sites: some of the FOTs in Finland, Sweden, Italy, Spain, UK, Germany and Greece are close to making a final technical and logistic assessment of the tools to be used in the trials, as well as to ensure good-quality dataflow throughout the tests.

Currently in a list of test sites, like in Greece and in the Valladolid Test Site in Spain, pilot tests are already close to completion. Test sites are in full readiness for launch, including technical and organisational arrangements both at conceptual and material levels. The test scenarios and test plans per test site and FOT are defined in close collaboration with the TeleFOT Test Sites and the sub projects for FOT Framework and Data Analysis. The recruitment campaigns completed so far have been successful.

Pilot execution in TeleFOT: Case Valladolid

One of the first TeleFOT pilot tests has been carried out in Valladolid, a mid size city located in the North-West of Spain. Officially launched on May 1st after a briefing session with subjects, pilots were executed during May 2010. Three of the 23 TeleFOT partners are involved in this Test Site: Cidaut (working as a test site coordinator and an evaluation manager), Blom (providing the navigation support service with specific logging capabilities) and Rucker Lypsa (providing technical support for FOTs deployment).



Figure 4: Valladolid pilot test in progress in Spain

In line with the overall TeleFOT challenges, the Valladolid FOT aims at assessing the impacts of the functions provided by a personal navigation device on the driving task in terms of safety, mobility, environment and user acceptance. For 3 weeks a sample of 6 subjects were driving with a navigation device onboard, with specific logging capabilities specifically developed within TeleFOT. In order to determine the feasibility and suitability of the actual tests, the whole FOT process was reproduced in terms of conditions, tools, questionnaires, support line, although in a limited scale. Currently (at the time of writing), the Valladolid test site is analysing the data coming from the pilot tests in detail. Preliminary results of the pilot tests performed in the Valladolid test site are planned to be ready and out soon after that. Valladolid partners will be allowed to refine the design and be prepared for the deployment of the large-scale field testing. As a further step, the detailed FOT, planned in Valladolid for 2011 will be defined in order to complement the results obtained from the large-scale FOTs. Furthermore, the Valladolid experience will be also useful to the IP project for process verification, which represents a valuable feedback to allow a fine tuning of the corresponding tools.

“Detailed FOTs”

Detailed FOTs (DFOTs) are conceived to complement the large-scale FOTs, allowing a deeper measurement of behavioural parameters. They enable a causal explanation of the driver behaviour: subjects in fact receive instructions on the route and react to given instructions.

The TeleFOT consortium found it necessary to carry out detailed tests across Europe, since cultural differences explaining driver behaviour and reactions have been identified to be significant by earlier European behavioural studies and accident statistics. In the following, a case example of a detailed FOT from Greece:

Detailed FOTs complementing LFOTs: Case Greece

In all the Southern test sites, both large-scale and detailed FOTs will be conducted. In Greece four DFOTs are planned, starting in the last quarter of 2010 in the area of Thessaloniki, the second biggest Greek city.



Figure 5: Pilot testing in action in Thessaloniki, Greece

Traffic information, Speed limit information, Speed alert, Navigation support (static) are the functions to be tested in the Greek DFOTs, to be provided by a GPS-enabled PDA. Also ADAS (Lane departure Warning and Collision Avoidance System) are to be tested. The research vehicle has been instrumented by many peripheral sensors. The signals of these sensors are transmitted via the CAN bus protocol.

In order to guarantee comparability of results, the Greek FOTs employ a within subjects design, in which the same subjects will participate in all the above DFOTs and baselines: thus four experimental conditions plus a 4-stage baseline (with four different baseline cases) will be adopted, In order to achieve a better understanding of the driver behaviour and the effect of the tested nomadic devices. During these baselines, the nomadic devices will run normally, while the ADAS functions will operate in the instrumented vehicle, registering all relevant parameters (headway, TTC, TLC, etc.) without however providing warnings to the driver. In this way it will be possible to study the effects of the functions combined with ADAS, while also in the baselines the parameters that are affected by the use of ADAS will be registered by the equipped vehicle.

Progress so far: The analysis and evaluation of collected data

TeleFOT has during its second year developed individual plans for the analyses of data – analysis that is scheduled to start during project year 3. Research Questions and Hypotheses were developed and refined using a top-down and bottom-up approach that was described above. The initial process resulted in approximately 120 research questions although subsequent stages resulted in a final list of approximately 40 core research questions with associated hypotheses. These have formed the basis of the data analysis plans in each assessment domain. The plans also encompass possible analytical approaches both in the DFOTs and the LFOTs. In the LFOTs, the analyses are likely to be mainly focussed around logged data with supporting information from focus groups and questionnaires. However, in the DFOTs, the main analyses are likely to be more qualitative and, for the safety evaluation will involve extensive analysis of video data to observe visual behaviour.

There are differences within the assessment domains in terms of analysis. For example, the Mobility and User Uptake analyses are likely to be mainly centred upon analysis of the questionnaires since the logged data will provide little of relevance in these domains. However, for Efficiency and Environment, logged data will be more relevant whilst Safety will involve a combination of logged plus questionnaire data. There will also be a difference in terms of the data that will be used to answer questions in the DFOTs. The logging capabilities within the DFOTs will be significantly higher than within the LFOTs and will therefore allow more in-depth analyses to be conducted albeit with fewer subjects.

The road ahead

The actual field tests are now completing the preparatory piloting stage and they are starting in the summer of 2010. The next steps include finalising the test sites set-up in accordance to the pilot test results and proceeding to the actual FOT execution. The TeleFOT test tools have been defined and most of the test sites are completing the material purchases to allow the FOTs start, including nomadic devices, software and hardware data loggers, software applications.

Acknowledgements

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