FIELD OPERATIONAL TESTS
Evaluating ITS-applications in a real-world environment

FOT-Net is a support action co-funded by the European Commission to network FOT activities at European, national and international level.
FOT-Net aims to gather European and international stakeholders in a strategic networking platform to present results of Field Operational Tests (FOTs), identify and discuss common working items and promote a common approach for FOTs - the FESTA methodology.

Services include a bi-annual newsletter; stakeholders meetings gathering European players interested in FOTs to share information, results and developments of European and national trials; a series of in-depth seminars to promote the use of a common FOT methodology and address specific issues arising when organising a FOT; and an online catalogue of national and European FOTs, which serves as a reference for all FOT organisers.

FOT-Net is a Specific Support Action funded by the European Commission DG Information Society and Media under the Seventh Framework Programme.

For more information, visit www.fot-net.eu
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Field Operational Tests
– testing ITS applications in the real world

Field Operational Tests (FOTs) are large-scale testing programmes aiming at a comprehensive assessment of the efficiency, quality, robustness and acceptance of ICT solutions used for smarter, safer, cleaner, and more comfortable transport solutions, such as navigation and traffic information, and advanced driver assistance. This includes stand-alone in-car systems as well as cooperative systems. FOTs are a step towards the market deployment of mature systems that have proven their functional effectiveness in validation tests with a limited number of test drivers and often on closed test tracks.

Usually, it is agreed that FOTs – as large scale tests – should involve at least 100 vehicles – although this number often is reduced to as little as 20-50 vehicles due to financial and organisational limitations. Constitutive for FOTs, however, is that ordinary drivers are testing the systems during their daily driving on the roads. After all, we want to know how the systems impact on safety and traffic flows in real life.

FOTs can be structured according to the main type of applications tested:

- ADAS – Advanced Driver Assistance Systems (Autonomous Systems)
- ISA – Intelligent Speed Adaptation
- Cooperative (Vehicle-Infrastructure) Systems

In addition, we find an increasing number of so called Naturalistic Driving Studies that aim at collecting data on driver behaviour in the natural, real-world setting in order to better understand the relation between driver behaviour and traffic situation. Such data allow for example for better analysis of causes for crashes, thus supporting the development and evaluation of countermeasures, e.g. in the form of ADAS.

This brochure invites you to consider the relevance of FOTs in the evaluation and deployment of ITS, and to explore the research questions and results of the main FOT projects and Naturalistic Driving Studies recently finished or currently ongoing. Public authorities play a crucial role in ITS deployment but are often underrepresented in FOT projects. We therefore take a particular look at why public authorities engage in FOTs. A look at the FOT timeline and the Europe map of test sites will show you that a lot is going on in the world of Field Operational Tests.

“\nThe European Commission has been investing in Field Operational Tests over the last few years, to achieve a comprehensive assessment of the efficiency, quality, robustness and user-friendliness of ICT solutions for smarter, safer and cleaner vehicles and real-time network management. FOTs have proven to be a powerful tool to understand questions which are crucial for the market introduction and penetration of these systems: how does the driver use the system, what are the short and long term effects, how can the systems’ performance be further improved? Pan-European FOTs secure the involvement of a wide range of public and private stakeholders, as well as comparative methods for evaluation of the systems across many Member States. This is further reinforced by the European-funded FESTA methodology, which provides a common approach for conducting FOTs to increase comparability and transferability of results, while FOT-Net offers a European networking platform for anyone interested in Field Operational Tests, their set-up and their results. “

Wolfgang Höfs, Head of Sector ICT for low carbon mobility, European Commission, DG Information Society
For many applications, in particular in the field of advanced driver assistance systems (ADAS) and intelligent speed adaptation systems (ISA), the studies suggest reasonable safety gains at a justified cost-benefit ratio.

This explains why expectations of many stakeholders towards the systems are high. However, what is not taken into account in this kind of studies is – amongst others – whether ordinary drivers will react on the support systems in the intended way, whether they will accept the support and under which traffic conditions they will use the system. These factors might significantly influence the real-life safety potential of the systems.

Therefore, such assumptions on safety benefits need to be confirmed by data gathered in real-life situations with ordinary drivers. Field Operational Tests (FOT) are the instrument to collect such data.

FOTs also have the potential to address another issue: despite recognised benefits, the market penetration of many safety systems still is rather low. FOTs that involve the relevant stakeholders for deployment (e.g. freight operators, fleet managers) and raise public awareness – with political decision makers and the general public – can significantly contribute to a faster market take-up of effective safety systems. This for example has been shown by the Dutch AOS FOT that tested several advanced driver assistance systems on trucks (see page 6-8).

Over the last decades, a large number of ICT-based transport applications for a cleaner, safer, smarter, and more comfortable mobility have been successfully developed and demonstrated in research projects throughout Europe. Scenario-based studies have indicated the potential societal benefits of the applications in terms of increased traffic safety, reduced environmental impact and better traffic flow, and have discussed the cost-benefit aspects.

Field Operational Tests – an essential step towards deploying ITS solutions

Vehicle to infrastructure communications will soon be a reality in Japan. (...) Early implementation and wide deployment is very important for cooperative systems to become a reality. Field testing is crucial to investigate the effectiveness of existing hardware, systems, and functions before we deploy these.

Masao Fukushima, Engineering Director
IT&ITS Engineering Department, NISSAN
Advanced Driver Assistance Systems (ADAS)

Statistics have proven that more than 90% of all road accidents are caused by human error. Active road safety measures have the objective to avoid such accidents. Among these, Advanced Driver Assistance Systems (ADAS) more particularly aim at raising drivers’ awareness of potentially hazardous situations, thus reducing human error. ADAS can also be described as autonomous systems as they are in-vehicle based only.

The AOS FOT is quite unique because of its scale. Of course, OEMs individually carry out run tests with HWM, FCW, ACC, LDWA & DC. However, this is the most comprehensive FOT ever conducted with accident prevention systems.

Paul Potters, Manager of ITS Netherlands

In recent years, several field operational tests have been conducted all over Europe, the United States and Asia, which assessed various ADAS applications. The most discussed include: adaptive cruise control, forward collision warning, lane departure warning, speed limit assistance, curve speed assistance, dangerous spot warning, and intersection collision avoidance.

Results of hitherto conducted FOTs do not provide a clear picture on the effectiveness and safety impact of the systems. The evaluation results on how many accidents could be prevented usually come with quite a high uncertainty margin. Furthermore, the various FOTs differ in the (detailed) application settings and in those parameters relevant for transferring results to other contexts, such as the road network, vehicle fleet, traffic situation, and probably also cultural differences in driver behaviour.

However, most projects conclude that due to prolonged headway times and distances to other vehicles, there is a positive impact on safety. Nevertheless, there are also drawbacks of which the safety impacts are not clear yet. There is for example the possibility that users become so confident that the systems will prevent accidents that they tend to engage in secondary tasks or take additional risks.

Moreover, the effect of a bundle of ADA systems so far remains unclear. Sure is that the effects of single systems cannot simply be added up. Several systems address the same type of conflict situation (e.g. ACC and FCW both lead to longer headway times thus reducing conflict situations) and one avoided crash in these situations cannot be credited to both systems.

Any additional safety impact of course is desirable but for a broad market deployment it is necessary to know if the additional investment is justified by the cost-benefit ratio.

Besides evaluating the safety impact of ADAS, the FOTs also contributed to raising awareness for the relevance of such safety systems with political decision makers and users (fleet managers, drivers), thus pushing the market take-up. A good example of this effect is the Dutch AOS project. The project was initiated by the Ministry of Transport and more than 2,000 lorries from different freight operators were involved in the test. Several public and high-level events ensured that the results were broadly disseminated. After the successful tests, fleet owners aimed to equip all their vehicles with the systems.

Despite the number of FOTs that have already been conducted, there are still many open issues to be addressed in further field tests and through a further evaluation of results, including the potential safety gain of different applications and of a bundle of applications, the impact of possible negative side effects, and the transferability of results to other contexts.
Much has been done in the past decades to improve driving safety on the roads. Now, Advanced Driver Assistance Systems (ADAS) are being deployed. These address more than 90% of the accidents by assisting the driver in their driving decisions. They really influence the day-to-day driving behaviour. So, projects like euroFOT demonstrate in scientific terms how much difference intelligent safety systems make for ordinary drivers on real roads.

Aria Etemad, Ford, Coordinator of euroFOT

Field Operational Tests on ADAS (for more details see the FOT wiki)

- AOS, The Netherlands
- Assisted Driver, The Netherlands
- Belonitor, The Netherlands
- LDWA Truck FOT, The Netherlands
- NiDP, UK
- ACAS, USA
- DDWS, USA
- Freightliner IIVI FOT, USA
- Intelligent Cruise Control FOT, USA
- IVBSS, USA
- Volvo Intelligent Vehicle Initiative FOT, USA
- Mack Intelligent Vehicle Initiative FOT, USA
- Road Departure Crash Warning System FOT, USA
- SafeMiles, Canada
- Australian TAC SafeCar Project, Australia
- SKY Project - Opposite Direction Driving Prevention on Highway, Japan
- SKY Project - Dynamic Route Guidance by Probe Car Data, Japan

euroFOT is coordinating a pan-European in-the-field test of driver assistance functions. The FOT will focus in particular on eight functions that assist the driver in detecting hazards, preventing accidents and making driving more efficient. These include:

Assisting the driver in forward/rear directional safety - longitudinal control functions:
- Adaptive Cruise Control
- Forward Collision Warning
- Speed Control System

Assisting the driver to detect hazards at the sides of the car – lateral control functions:
- Blind Spot Information System
- Lane Departure Warning / Lane Assist / Impairment Warning

Advanced applications:
- Curve Speed Warning
- Fuel Efficiency Adviser
- Safe Human/Machine Interface

In addition to assessing the effectiveness of the functions, the FOT will also offer early publicity of the technologies, and provide an analysis of the user acceptance and its subsequent potential for market penetration. The eight functions will be tested in close to 1000 vehicles from nine European OEM brands, across France, Germany, Italy and Sweden. The operations will be organised in eight operation centres led by major OEMs.

Co-funded by the European Commission, euroFOT will run from May 2008 to February 2012. The project involves 28 partners, including major European vehicle manufacturers as well as leading automotive technology suppliers and research institutes.

US IVBSS FOT
For integrated crash warning systems

The US Integrated Vehicle-Based Safety Systems (IVBSS) programme conducted a field test to collect data to objectively assess the potential safety benefits and driver acceptance associated with prototype integrated crash warning systems. The IVBSS programme started in November 2005 and ends in April 2011, with the FOT phase of the programme running from June 2008 until November 2010.

The IVBSS prototype includes three integrated crash-warning subsystems (forward crash, lateral drift, and lane change/merge warnings); the light-vehicle platform also has a fourth subsystem, curve-speed warning. For the light-vehicle portion of the FOT, 108 lay drivers operated test vehicles for a period of six weeks. Forty commercial-truck drivers from a commercial fleet operated heavy trucks in place of their Class 8 tractors for a period of five months.

All vehicles were instrumented to capture information regarding the driving environment, driver activity, system behaviour, and vehicle kinematics. Data from the FOT can be used as a basis for answering many questions concerning the warning system and how drivers use it.

The FOT analysis will address three broad study areas: driver acceptance and driver understanding of the crash warning system; driving performance and driver behaviour with and without the system, including safety-related findings; and potential successes and challenges of integrated crash warning products, when deployed.


Dutch AOS FOT: Accident prevention systems for lorries

In 2008 and 2009, commissioned by the Dutch Ministry of Transport, Public Works and Water Management, Connekt undertook a large-scale field operational test with active driver assistance systems, or so-called accident prevention systems for lorries. Over a period of eight months, the AOS FOT tested five different accident prevention systems with 2,400 vehicles: Adaptive Cruise Control, Lane Departure Warning, Forward Collision Warning / Headway Monitoring & Warning, Directional Control/Roll over Control (DC/ROC) (detects situations where the steerability of the vehicle is endangered and intervenes by braking on one of the wheels); and Black Box Feed Back (the driver receives feedback about his driving performance compared to other drivers).

The effectiveness of the warnings was assessed for all the systems. The extent to which the driver responded to the warnings effectively was also examined. The results of the measurements in the field operational test show that the various accident prevention systems have an effect on the driving performance of the driver.

The systems reduce the risks of accidents, with the most important indicators being: longer following times between vehicles; reduced risk of tipping; driving less closely to the vehicle in front; fewer unintentional line crossings; and driving at a more regular speed. The accompanying survey of the drivers shows that their experiences confirm the indicators above.

Intelligent Speed Adaptation (ISA)

One of the actions designed to increase road safety is the adoption of Intelligent Speed Adaptation (ISA). In essence, an ISA system constantly monitors both the vehicle speed and the local speed limit on a road and takes action whenever the vehicle is detected to be exceeding the speed limit. An Advisory ISA will warn the driver when he or she is speeding. The system can also be linked to the vehicle engine and perhaps brakes, to curtail speed to the speed limit while still allowing the driver to override the system (Voluntary ISA). A Mandatory ISA does not allow the driver to override the system (also called Non-Overridable ISA).

The FOT-Net Wiki provides information about ten FOTs on ISA conducted during the past ten years. Some of the trials only focussed on Advisory ISA, others investigated the voluntary version, while some projects in particular aimed at comparing the effects of the different ISA options. A more recent project, the Danish ‘Pay as you Speed’ FOT, researched the effect of a combination of a speeding warning with financial incentives. Speeding was recorded and reduced the promised bonus of 30% on the insurance rate of the driver.

Most FOTs used on-board devices, but also nomadic (off-board) devices are considered: the pan-European project TeleFOT, the Swedish MOTION project and the Lancashire ISA project in the UK are using mobile phones and/or navigation devices for an advisory ISA.

The main research objectives of these FOTs have been to understand how drivers use the system, and to investigate the effects of ISA on driver behaviour (with a particular focus on speeding) and the acceptance of different ISA systems among drivers. As a next step, some projects have used the FOT results (as part of a larger study) to assess the societal safety impact of ISA and have performed cost-benefit analyses. More recent projects have also investigated the impact of ISA on fuel consumption, i.e. carbon emissions (e.g. the UK ISA).

The general finding of the ISA trials is that the system does reduce speeding among all categories of drivers, with Mandatory ISA showing the highest effects and Advisory ISA the lowest. The FOT results also seem to coincide in the fact that ISA effectiveness differs due to sex and age of drivers. The UK ISA reports even state that there is a tendency for the ISA to be overridden the most by those drivers who would benefit the most, i.e. young and male drivers with the tendency to speed. In general, the acceptance of ISA among drivers was found to be split, ranging from hostile ‘would-never-use’ drivers to those appreciating the safety potential.

Those projects that have tested the system on several road categories come to different results regarding how system effectiveness varies by road type (motorways, rural roads, built-up area, etc). Differences might partly relate to different pre-ISA speeding behaviour on different road categories in the test countries. In general, transferability of the field trial results to other contexts is limited.

More detailed comparisons between the FOT results are difficult due to differences in many test parameters: first of all, the ISA settings varied significantly between the trials. This does not only refer to the advisory, voluntary or mandatory ISA, but also for example to the speed exceedance at which a warning or intervention is triggered. In the Swedish MOTION project for example, drivers could change the default settings; the majority chose to be warned at 5-10 km/h above speed limit.

Intelligent Speed Adaptation (ISA)

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Despite the predominantly positive findings on the safety potential of ISA, no country so far has established legal requirements for vehicles to be equipped with ISA. A major reason probably is the lack of user acceptance for a mandatory ISA, which would have the highest impacts.

In the UK, research commissioned by the Department for Transport (and based on the UK ISA results), investigated a market driven scenario for deployment of (advisory) ISA and an authority driven deployment scenario (starting with voluntary, later on mandatory ISA). Results clearly indicate that for any scenario the benefits considerably would outweigh the costs, with a significantly higher safety potential and a better cost-benefit ratio for the authority driven approach.

"Today there is an increasing need to move and stay connected, with other people, as well as with the environment. The market penetration of aftermarket nomadic devices has been growing exponentially and so has their use in vehicles - both while driving and as a passenger. These devices are carefully studied before releasing them to the market, but there is still little scientific evidence on what really happens when they are introduced in real-life conditions. How does the driver use a system in a vehicle, what are the short and long term effects on safety, environment, efficiency and mobility - those crucial issues are at the core of TeleFOT."

Petri Mononen, VTT, Coordinator of TeleFOT

Field Operational Tests on ISA (for more details see the FOT wiki)

- ISA Trials, Gent, Belgium
- INFATI, Denmark
- Pay As You Speed, Denmark
- ISA Trial, Finland
- LAVIA, France
- ISA Sweden
- MOTION, Sweden
- ISA UK
- London ISA, UK
- SKY Project - Intelligent Speed Advisory, Japan
- New South Wales ISA Trial, Australia

NSW ISA
- testing advisory ISA in Australia

The NSW ISA project started in 2008 and aims to research the potential road safety benefits of advisory ISA systems, measure the economic effects in terms of fuel consumption and effects on travel time, and assess the acceptability of ISA systems to drivers and managers using and administering private fleets, and to drivers of private vehicles.

Led by the New South Wales Centre for Road Safety, this is the largest trial of Advisory Intelligent Speed Adaptation technology in Australia. More than 100 vehicles from private fleets are taking part. It is a unique trial because each vehicle is connected to a centralised computer system which automatically updates changes to speed zones. Already more than two million individual speed compliance records from trial vehicles have been collected as part of the project. Attitudinal and behavioural studies have also been conducted as part of the trial. Results should be expected by the end of 2010.

UK Intelligent Speed Adaptation trials

The Intelligent Speed Adaptation project was commissioned to investigate how drivers would behave when using a Voluntary ISA in everyday car driving. Important issues covered were how different types of driver (younger/older, male/female, habitual speeder/non-speeder) would be affected in terms of speed choice by use of the system, how their attitudes to the system would evolve over time, and whether they would revert to their pre-ISA speeding behaviour once the system was switched off.

The car and truck trials demonstrated that ISA is now a mature technology capable of delivering substantial reductions in excessive speed and thereby considerable benefits in terms of safety. The behavioral results from the car trials show that the overridable ISA reduced the amount of speeding among every category of user.

The project was funded by the UK Department for Transport.

More information:

TeleFOT trialling nomadic devices

TeleFOT is a European Commission co-funded project aiming to assess the impacts of aftermarket and nomadic devices used in vehicles for driver support (including future interactive traffic services) and to raise wide awareness of the functions and potential these devices offer, by implementing Field Operational Tests.

Aftermarket and nomadic devices can provide different types of driver support functions and almost nothing is known yet about their safety and other impacts when used in vehicles by drivers. The market penetration of portable navigators and smart phones is exploding today, making the time for the project ideal. The FOT will aim at a comprehensive assessment of the efficiency, quality, robustness and user friendliness of in-vehicle systems, such as ICT for smarter, safer and cleaner driving.

The following functions will be tested (covering two main areas: safe driving and economic and fuel efficient driving):

- Traffic information
- Speed limit information
- Speed alert
- Navigation support (static)
- Navigation support (dynamic)
- Green driving support
- eCall
- Forward Collision Warning
- Lane Departure Warning

Up to 3000 drivers in TeleFOT-equipped vehicles will be driving in Finland, Sweden, Germany, UK, France, Greece, Italy and Spain.

More information:
**Timeline of FOT projects**

**FOT Wiki - The free encyclopedia of FOTs**

The FOT Wiki is an open catalogue of all FOTs. It can be accessed and modified freely by the FOT network. The Wiki intends to be a resource for anyone interested in field operational tests, their organisation, their set up and their results. Through the Wiki we aim to build up a catalogue of key information about various past, current and planned field tests in Europe, North America and Asia-Pacific.

Further details about the projects mentioned in this brochure can be found in the FOT Wiki at [http://wiki.fot-net.eu/](http://wiki.fot-net.eu/)

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Cooperative Vehicle-Infrastructure Systems are based on two-way communication between vehicles or vehicles and infrastructure. Compared to vehicle-based systems, this allows for many new applications in favour of better traffic management and road safety. However, the cooperation between vehicles and infrastructure adds additional challenges to conducting FOTs.

Cooperative systems are systems by which a vehicle communicates wirelessly with another vehicle or with roadside infrastructure. Compared to purely vehicle-based advanced driver assistance systems, cooperative systems technology allows for a two-way communication: information is not only provided to the vehicle/driver, but the vehicle will also send information (e.g. on speed, route, incidents, etc.) via the roadside infrastructure to the traffic management centre and to other vehicles.

For Field Operational Tests, cooperative systems provide special methodological challenges: not only the vehicles need to be equipped, but so does the infrastructure. As resources usually are limited, only a certain stretch of infrastructure (e.g. some intersections, some km’s of motorways) can be equipped. One challenge is to ensure that the equipped vehicles travel on the equipped roads and, in case of vehicle-to-vehicle applications like cooperative cruise control, to frequently meet each other in order to collect a reasonable data set about the cooperative applications under evaluation. This, however, should be secured without giving the drivers many instructions that would challenge the FOT methodology in its principle of having ordinary drivers testing the applications in their daily routine driving.

In order to address this challenge, the German simTD FOT employs an internal test fleet of up to 100 controlled vehicles and an external fleet of about 300 free-flowing vehicles. 20 vehicles of the internal fleet will be driven by professional drivers who will get instructions in order to create certain scenarios. The other drivers’ reaction to the scenarios will be used to evaluate the cooperative functions.

The Japanese SKY FOT on intersection collision avoidance used another approach: with 2,000 ordinary drivers, a high number of volunteers were recruited in order to assure sufficient data collection. Drivers did not get any special instructions on their route choice. This approach was possible because the FOT is led by NISSAN. The vehicle manufacturer offered the customers the needed cooperative equipment for free – that provides added value to the drivers in terms of additional functions (e.g. automatic toll collection) – if they volunteered for the test.

Besides the high penetration rate needed for some applications, other methodological issues with the evaluation of cooperative systems include:

• In principle, the FESTA methodology is applicable for evaluating cooperative systems in FOTs, but tools and procedures may be different, for example for scaling up the results.
• In addition to FOTs, simulation models and tools are needed to interpret the findings of FOTs, to scale-up the results and to predict the impact.
• Systems tested in FOTs are often a combination of several different functions and/or applications which makes evaluation of separate functions difficult; testing functions and/or systems separately on the other hand would not reflect reality and maybe impractical.
• Different penetration rates of the same function may result in different function operation;
• Evaluation of cooperative systems may require extra data from surrounding vehicles and from the infrastructure;
• Not only the reaction of equipped drivers needs to be investigated, also the behaviour of non-equipped users is important: how are they influenced, how to measure their behaviour, acceptance etc.;

So far, FOTs of cooperative systems have been conducted mainly in the US and in Japan. In some European countries, FOTs have started and results are expected around 2012. For 2011, the start of two pan-European FOTs is expected; one of these based on the preparation work done in the PRE-DRIVE C2X project.
The project simTD – “Sichere Intelligente Mobilität – Testfeld Deutschland” (Safe Intelligent Mobility – Test Field Germany) started in September 2008 as a joint effort of the automotive, supplier, and telecommunications industry, the public sector and scientific institutions. simTD’s goal is to leverage the significant potential of car-to-car/infrastructure communication for improving traffic safety and mobility. Tested applications include the timely delivery of danger warnings and traffic information, the detection of local traffic situations, as well as additional services such as infotainment applications. The tests will be conducted on urban and interurban roads and motorways in Frankfurt and the Rhine-Main area, involving several hundreds of test vehicles.


Japanese SKY FOTs on vehicle-infrastructure communication

The SKY project includes several FOTs based on vehicle-infrastructure communication. The FOTs address for example intersection collision avoidance, intelligent speed advice, and dynamic route guidance. Trials on intersection collision avoidance systems in urban areas have now paved the way for national deployment of these systems. The field tests included stop sign and red light violation avoidance, warnings when a vehicle approached the intersection on the side road, warnings when drivers exceeded the speed. All systems tested were already on the market (or soon to be). Results show a significant reduction in stop sign and red light violations and reduced speeds in approaching intersections. The field tests were conducted between 2006 and 2009 by a consortium of several industry partners and police departments and was led by NISSAN.

PRE-DRIVE C2X on cooperative systems

Between 2008 and 2010 the PRE-DRIVE C2X project established a pan-European architecture framework for cooperative systems, in order to ensure interoperability of all different applications of vehicle to vehicle and to infrastructure communications for safety and mobility. The project helped to pave the way for the forthcoming FOTs on cooperative systems in Europe. Co-funded by the European Commission, PRE-DRIVE C2X brought together leading European OEMs, suppliers, software developers, traffic engineers and research institutes.

PRE-DRIVE C2X cooperated with COMeSafety in the development of the architecture for a European cooperative driving system. COMeSafety is an EC-funded project dealing with all issues related to vehicle-to-vehicle and vehicle-to-infrastructure communications, among its aims are the consolidation of research results and worldwide harmonization of activities. The results of the joint work between PRE-DRIVE C2X and COMeSafety will feed into the standardisation bodies namely ETSI (European Telecommunications Standards Institute).

Based on this, PRE-DRIVE C2X developed a state-of-the-art testing environment which included a test management centre, as well as software and hardware for onboard and road-side units. This prepared the ground for scenario based testing in real traffic conditions which will be executed in the upcoming DRIVE C2X FOT project.

The DRIVE C2X project will carry out a comprehensive assessment of cooperative systems through FOTs across Europe in order to verify their benefits and to pave the way for market implementation. DRIVE C2X will bring together various ongoing national activities and ensure the compatibility of emerging systems. The aim is not to set up new national test sites but to make use of already existing national test sites as far as possible and connect them into a large European testing platform.


IntelliDriveSM – The US programme on vehicle-infrastructure communication

"FOTs help NHTSA obtain more in-depth knowledge of advanced safety systems and information on their performance, effectiveness and driver acceptance. Data collected during the field trials are also used to estimate potential safety benefits, support decision making, and programmes such as the Agency’s consumer information programme, the New Car Assessment Programme (NCAP) to promote effective safety technologies."

Jack Ference, Electronics Engineer
US National Highway Traffic Safety Administration (NHTSA)

IntelliDriveSM is a multimodal initiative that aims to enable safe, interoperable networked wireless communications among vehicles, the infrastructure, and passengers’ personal communications devices. It is sponsored by the U.S. Department of Transportation (USDOT) and others to leverage the potentially transformative capabilities of wireless technology to make surface transportation safer, smarter and greener. USDOT research is supporting the development and testing of IntelliDriveSM technologies and applications, to determine their potential benefits and costs.

In 2003, the USDOT had launched the Vehicle Infrastructure Integration (VII) programme. In order to reflect the expansion of research in this domain, the USDOT rebranded the VII programme as IntelliDriveSM. Other research initiatives which involve field testing, such as CICAS (Cooperative Intersection Collision Avoidance Systems) and SafeTrip-21 continue as part of the IntelliDriveSM initiative.

The IntelliDriveSM programme includes research on technical issues, policy and non-technical issues, and safety, mobility and environmental application areas. Testing, certification, and stakeholder engagement/outreach are also significant programme components. USDOT maintains an IntelliDriveSM test bed in Michigan in partnership with Michigan DOT and Oakland County, Michigan, to enable ongoing IntelliDriveSM related testing by any public or private entity.

The IntelliDrive SM Logo is a service mark of the U.S. Department of Transportation.
Naturalistic Driving Studies and Naturalistic FOTs

Naturalistic Driving observation refers to studies undertaken using unobtrusive observation when driving in a natural setting. Both, Naturalistic Driving Studies and Naturalistic FOTs use this type of observation. Naturalistic Driving observation is a new approach among already applied traffic research methods.

In Naturalistic Driving Studies (NDS), the driver becomes unaware of the observation as the data collection is organised as discreet as possible and preferably drivers use their own vehicles. The data is used to study the relationship between driver-, vehicle-, and/or environment factors with crash risk.

NDS provide information that is difficult or even impossible to obtain by other research methods. For example, analyses of crash statistics or in-depth crash investigation can hardly provide information about behavioural issues preceding a crash (e.g. on risk factors such as distraction and fatigue). Observations by means of vehicles with visible instruments or simulators do not encourage the test subjects to behave in a normal (naturalistic) way, since they are generally well aware of the experimental conditions. Experience shows that during the naturalistic observations which use the subjects’ own car equipped with monitoring devices, drivers quickly forget the presence of cameras and sensors, allowing the study of real-world conditions driving behaviour.

Compared to NDS, Field Operational Tests are using quasi-experimental methods (e.g. comparing data from baseline and treatment phase, i.e. data collected with systems switched off and on) and aim at evaluating certain functions (e.g. driver assistance systems). If NDS and FOTs are regarded as two ends of a continuum, Naturalistic FOTs are lying somewhere in between. They are using unobtrusive observation in a natural setting to evaluate the relationship between driver-, vehicle-, and/or environment factors with crash risk, driving behaviour, and the effectiveness of driver assistance functions. Thus, Naturalistic FOTs combine elements of both NDS and FOTs.

The naturalistic driving observation as a method requires heavy resources in terms of samples and duration (in order to assure the appearance of crashes and near crashes in the data collected). Thus, also large resources for data gathering, data storage, data reduction, and analysis are needed. Therefore, it is of crucial importance to ensure that such a study is broadly supported and that the results can serve many purposes.

In particular in the US, many Naturalistic Driving Studies have been conducted so far (for example the 100 cars study, the Commercial Vehicle Operation study and the ongoing Strategic Highway Research Programme - SHRP2). For Europe, it is a relatively new field. Forerunner is Sweden with SAFER, the Vehicle and Traffic Safety Centre at Chalmers University, where activities in particular aim at further elaborating a Naturalistic FOT methodology. The most prominent project in this regard is SeMiFOT (Sweden-Michigan Field Operational Test) which focused on further developing the Naturalistic FOT method into a powerful tool for a) accident research, b) evaluation of safety, efficiency, and usage and acceptance of driver assistance systems, and c) countermeasure innovation and development. SeMiFOT has provided valuable input for the methodology used in – among others – the two currently ongoing pan-European FOT projects euroFOT and TeleFOT.

The data collected in SeMiFOT – which was finished in 2009 – will be further analysed in the continuation project SeMiFOT2. Main research topics are exploring new statistical approaches for the analysis of Crash-Relevant Events, e.g. extreme value theory, further analysis of the impact of visual behaviour and the development of events-prevented simulation techniques.
Swedish SeMiFOT on naturalistic driving

The Sweden Michigan project SeMiFOT ran from January 2008 to December 2009 and gathered the automotive industry, the Swedish Road Administration, and academia around the development of the Naturalistic FOT method, combining elements from both Naturalistic Driving Studies and Field Operational Tests.

SeMiFOT focused on the tools in the methodology chain (data acquisition - data storage - data analysis) needed to perform a Naturalistic FOT. These tools were evaluated on a number of selected in-vehicle and cooperative systems. The requirements for large scale FOTs were analysed.

Thirty-nine primary and secondary drivers made 12,571 trips in 14 vehicles, during a data collection period of over 6 months. The following safety systems were included across a mix of vehicles: Adaptive Cruise Control, Forward Collision Warning with Emergency Brake, Lane Departure Warning, Blind Spot Information System, Electronic Stability Control, and Impairment Warning.


On the European level, two projects need to be mentioned here: The 2BeSafe NDS, which is the first one to collect data on powered two-wheelers on a large scale (and in four European countries). And the PROLOGUE project that aims at giving recommendations and providing an outline for a large-scale naturalistic study in Europe.

To conclude, although NDS and Naturalistic FOTs might aim at different purposes (understanding the factors leading to accidents/incidents versus evaluating ITS applications) there certainly is a close link on the Naturalistic methodology part where both types of projects share common issues of data acquisition, data storage, and data analysis.
100-Car Naturalistic Driving Study

100-Car Naturalistic Driving Study’s main goal was to provide vital exposure and pre-crash data necessary for understanding causes of crashes, supporting the development and refinement of crash avoidance countermeasures, and estimating the potential of these countermeasures to reduce crashes and their consequences.

Sponsored by the US National Highway Traffic Safety Administration and the Virginia Department of Transportation, and performed by the Virginia Tech Transportation Institute, the study gathered an unprecedented level of detail concerning driver performance, behaviour, environment, driving context and other factors that were associated with critical incidents, near crashes and crashes for 100 drivers across a period of one year. The event database that was created during the 100-Car Study can be useful for a variety of purposes, for example, evaluation of risky driving behaviour and crash risk, calculation of relative risk of engaging in secondary tasks, and evaluation of driver response to lead vehicle brake lights.


SHRP2

Naturalistic driving

In 2005, the United States Congress created the second Strategic Highway Research Program (SHRP 2) to address the challenges of moving people and goods efficiently and safely on the nation’s highways. SHRP2 is administered by the Transportation Research Board of The National Academies, and the research programme is carried out through competitively awarded contracts to qualified researchers in the academic, private, and public sectors. SHRP2 addresses four strategic focus areas: the role of human behaviour in highway safety; rapid renewal of ageing highway infrastructure; congestion reduction through improved travel time reliability; and transportation planning that better integrates community, economic, and environmental considerations into new highway capacity.

The naturalistic driving study which is part of SHRP2 investigates ordinary driving under real world conditions in order to make the driving experience safer. 3000 volunteer drivers will take part and will have their cars fitted with cameras, radar, and other sensors to capture data as they go about their usual driving tasks.

The European Union has become a driver of FOTs, recognising the importance of having common methodologies and comparable results, which will be more credible to consumers and businesses than isolated initiatives. Since 2009, euroFOT and TeleFOT, two pan-European FOTs, have been running, with test sites across the EU. More such EC-funded FOTs are in the pipeline, on cooperative mobility and low carbon mobility.

Moreover, several European countries had already started to organise field tests on a smaller scale, encouraged by national governments. In Sweden, the government has done a lot to promote Intelligent Speed Adaptation (ISA) or Speed Alert. The objective of the ISA trials has been to spread information about the technology, its benefits and to test user acceptance. Faced by some reluctance of the automotive industry for the compulsory ISA, the government conducted another study called MOTION, whose main objective is to encourage suppliers of mobile services to offer Speed Alert services in the near future.

In the Netherlands, investments in and large-scale testing of vehicle systems are in line with the Dutch Policy Framework for Utilisation, which looks into the best possible management of given traffic demand over a given road infrastructure supply. In the case of the Dutch AOS FOT, the Dutch Ministry for Transport conducted it to receive concrete answers on issues such as the effect of systems on safety and efficiency of road transport and on how drivers use the different systems. They hope that positive results can be used to stimulate the use of driver assistance systems in the Netherlands.

Also local authorities can play a crucial role. Cities are facing ever-growing challenges when it comes to making urban mobility more sustainable. An increasing number of them are looking at the potential of new technologies and ITS to reduce congestion and improve accessibility, air quality and road safety. The main driver for cities to sign up to pilot and field tests lies with the ambitious policy targets they have set themselves.

Outside Europe, Japan has been a forerunner in FOTs. Through the IT New Reform Strategy, the Japanese government has committed to 15 priority measures, one of which is to have the world’s safest road traffic environment, reducing the number of road traffic fatalities under 5,000 by 2012. To this end, the Japanese government has been calling for a widespread deployment of “cooperative driving support systems”. Within this context, branded as the “ITS Safety 2010” initiative, various field operational tests on cooperative systems have been carried out. In the US, FOTs are generally carried out via a top-down approach from the government. The objectives of the US Field tests are thus more uniform and primarily answer the needs of the policy framework.

In conclusion, FOTs can be conducted for various reasons, using different approaches. In some cases, they are mainly driven by transport policy, in others they are used more as a marketing tool.
FESTA Methodology:
Consolidation and promotion of a common FOT methodology

To improve significance, visibility, comparability and transferability of available FOT results at the national and European level, a common European FOT methodology has been developed. The FESTA project funded by the European Commission developed a handbook on FOT methodology, which gives general guidance on organisational issues, methodology and procedures, data acquisition and storage, and evaluation.

The FESTA V depicts the FOT Chain that covers the steps that need to be carried out during a FOT. The large arrows that form the “V” indicate the time line. The first steps, which include setting up a goal for the study and selecting a suitable research team, and also the last steps that include an overall analysis of the systems and functions tested and the socio-economic impact assessment, deal with the more general aspects of a FOT and with aggregation of the results. The further down the steps are located on the FESTA V, the more they focus on aspects with a high level of detail, such as which performance indicators to choose, or how to store the data in a database. Ethical and legal issues have the strongest impact on those high level aspects, where the actual contact with the participants and the data handling takes place.

During the FOT-Net activities, experts involved in current FOTs provided feedback and raised several issues and problems in relation to the use of the FESTA methodology. As FESTA should be seen as a living methodology, FOT-Net has gathered these inputs. Lessons learned from projects such as euroFOT, TeleFOT, SeMiFOT and PROLOGUE on different types of FOTs will be taken into account for this update. euroFOT and TeleFOT have both taken the FESTA methodology as a guide to their activities. Naturalistic driving studies will receive particular attention as it is a field relatively new to Europe.

After the collection of experts’ inputs and experiences with FESTA, FOT-Net will consolidate this feedback and proceed with a first revision of the FESTA handbook. At a second stage, the most difficult issues and topics that have not yet been treated in-depth, will be followed-up with the creation of thematic Working Groups. Topics of the Working Groups will include: Data analysis, Events and incident definition, Legal and ethical issues, Impact assessment and scaling up and Data sharing.

Special emphasis will be placed on FOTs for cooperative systems, as European FOT projects will soon be conducted in this area.

The (revised) FESTA methodology will be explained and further discussed during specifically focussed FOT-Net seminars. These will cover issues such as:

- Interpretation and presentation of results at the end of a FOT
- Practical issues around starting up a FOT of Cooperative systems, defining research questions, hypotheses and performance indicators
- Explanation of the FESTA methodology for newcomers
- Comparing results from different FOTs and re-use of data
- Tools for gathering and analysing data, especially in FOTs of cooperative systems
Pictures:

- p6: NHTSA
- p9, left: VTI
- p14: Peek Traffic

All other pictures provided by FOT-Net partners and FOT projects mentioned.
The FOT-Net Consortium

FOT-Net gathers stakeholders from the public and private sectors. The consortium consists of steering members (contracted partners) and associated partners. For the full list of partners, see http://www.fot-net.eu/en/partnership/

The consortium is open to active participation from the FOT community.

Join us now!

More information
For more information on the network, please visit www.fot-net.eu or contact the project coordinator:

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