



## REPORT FOT-NET SEMINAR

### Field Operational Tests for Transportation Systems

When? 22-23 June 2010

Where? Herzlia, Israel

In collaboration with ITS Israel ([www.its-israel.org](http://www.its-israel.org)) and ILTAM ([www.iltam.org](http://www.iltam.org))

#### AGENDA

Tuesday June 22nd	Presenter	Materials
09:00 – 10:00 Welcome and introduction <ul style="list-style-type: none"> <li>• FOT-Net project</li> <li>• FOT activities in the EU</li> <li>• Introduction to FESTA</li> </ul>	Yvonne Barnard University of Leeds	<ul style="list-style-type: none"> <li>• Website: <a href="http://www.fot-net.eu">www.fot-net.eu</a></li> <li>• Copy of paper: Barnard, Y., &amp; Carsten, O. (2010). Field Operational Tests: challenges and methods. In: J. Krems, T. Petzholdt, &amp; M. Henning (Eds.) Proceedings of European Conference on Human Centred Design for Intelligent Transport Systems (pp. 323-332). HUMANIST Publications: Lyon.</li> <li>• PowerPoint presentation</li> </ul>
10:00 – 11:00 Starting a FOT Introduction to creating research questions, use cases and hypotheses <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Small groups working session on formulation of hypotheses</li> <li>• Plenary report from groups</li> </ul>	Oliver Carsten University of Leeds	<ul style="list-style-type: none"> <li>• Hand-out: Hypothesis Formulation</li> <li>• Exercise descriptions</li> <li>• Copy of paper: O. Carsten, &amp; Y. Barnard (2010). Preparing field operational tests for driver support systems: a research-oriented approach. In D. de Waard, A. Axelsson, M. Berglund, B. Peters, and C. Weikert (Eds.) (2010). <i>Human Factors: A system view of human, technology and organisation</i>. Maastricht, the Netherlands: Shaker Publishing.</li> </ul>
Coffee break		
11.15 – 12.30 Defining Performance indicators <ul style="list-style-type: none"> <li>• Short intro</li> <li>• Working groups</li> <li>• Plenary report from groups</li> </ul>	Yvonne Barnard University of Leeds	<ul style="list-style-type: none"> <li>• Exercise descriptions</li> <li>• PowerPoint presentation</li> </ul>
12.30-13.15 Data acquisition and data management <ul style="list-style-type: none"> <li>• Solutions and tools for data collection</li> <li>• Plenary discussion</li> </ul>	Oliver Carsten University of Leeds	<ul style="list-style-type: none"> <li>• PowerPoint presentation</li> </ul>
13.15-14.15 Lunch		
14.15 – 15:45 FOT study design <ul style="list-style-type: none"> <li>• Specification of, selection of and communication with participants</li> <li>• Experimental environment</li> </ul>	Eline Jonkers TNO	<ul style="list-style-type: none"> <li>• Exercise description</li> <li>• PowerPoint presentation</li> </ul>

<ul style="list-style-type: none"> <li>Organizing and maintaining a vehicle fleet</li> <li>Working session on study design</li> </ul>		
15.45-16.00 break		
16.00 – 17.00 The stony road to successful FOTs <ul style="list-style-type: none"> <li>Lessons learned</li> </ul>	Oliver Carsten University of Leeds	<ul style="list-style-type: none"> <li>PowerPoint presentation</li> </ul>
17.00 – 17.15 Closure <ul style="list-style-type: none"> <li>Conclusions on day 1</li> </ul>	Yvonne Barnard University of Leeds	
<b>Wednesday June 23rd</b>		
09:00 – 09:30 Welcome and short wrap up day 1	Eline Jonkers TNO	
09:30 – 10:30 Stakeholder analysis <ul style="list-style-type: none"> <li>Who are the stakeholders</li> <li>Stakeholders' interests and influence</li> <li>Stakeholders' role in the FOT</li> <li>Working session and/or case on stakeholder analysis</li> </ul>	Eline Jonkers TNO	<ul style="list-style-type: none"> <li>Exercise description</li> <li>PowerPoint presentation</li> </ul>
10:30 – 12:00 Evaluation [ <i>plenary / small groups</i> ] <ul style="list-style-type: none"> <li>Evaluation of FOTs</li> <li>Working session on penetration rates and scaling up</li> <li>Experiences from FOTs</li> </ul>	Martijn van Noort TNO, Oliver Carsten University of Leeds	<ul style="list-style-type: none"> <li>2 PowerPoint presentations</li> </ul>
12:00 – 12:30 Closure <ul style="list-style-type: none"> <li>Conclusions on day 2</li> </ul>		

## Report

On June 22<sup>nd</sup> and 23<sup>rd</sup> 2010 a FOT-Net seminar was organized in Herzlia, Israel, on invitation from ITS Israel, an associated partner in FOT-Net, and in collaboration with ILTAM. The objective of this seminar was to make Israeli traffic and transport experts acquainted with the FESTA methodology and the European work on Field Operational Tests, and to strengthen the relations between FOT-Net and Israel.

The central issues in this seminar were:

- The work going on in FOT-Net
- The FESTA methodology
- Research questions, hypotheses and performance indicators
- Data acquisition and data management
- Study design
- Real-life experiences from FOTs
- Stakeholder analysis
- Scaling up of the results and impact
- Simulation

Around 25 participants from Israel from different stakeholder groups attended the seminar.

The first day started with a welcome from Moshe Salem from ILTAM and Eran Reuveni from ITS Israel. An introduction to the FOT-Net project, the FOT-Net website and the FOT wiki, and the FESTA methodology was given by Yvonne Barnard (University of Leeds). The first topic, research questions and hypotheses, was introduced by Oliver Carsten (University of Leeds), followed by an exercise in small groups, where participants formulated research questions and hypotheses for three (imaginary) systems. Yvonne Barnard introduced the topic of Performance Indicators. The working groups next defined indicators for the hypotheses generated earlier. The exercises showed that it is possible to generate a wide range of different hypotheses. In a FOT it is necessary to make a selection, depending on the importance of the effects to be studied. Choosing the appropriate performance indicators depends not only on the question what data are needed to test the chosen hypotheses but also on available budget and sensors. The outcomes of the discussion groups can be found in the appendix. The last topic of the morning was Data acquisition and data management, presented by Oliver Carsten, in which he showed several options for data acquisition tools, with different price ranges and capabilities. Data storage and data protection were other topics addressed.

After lunch, Eline Jonkers (TNO) gave a presentation on how to develop a study design, followed by an exercise in small groups where participants discussed the study design for the systems from the exercises done in the morning. The day was concluded by a presentation from Oliver Carsten in which he illustrated the "stony road to successful FOTs" with real-life examples from a Speed Adaptation FOT in the UK.

On the second day Eline Jonkers gave a short introduction to the FOT-Net project and the FESTA methodology. After this, she moved on to the Stakeholder analysis, where a practical methodology was introduced for performing a stakeholder analysis. A stakeholder analysis gives more insight: who are the stakeholders in and around a FOT, what are their interests and influences, and how to deal with the stakeholders. The session on stakeholder analysis was concluded by an exercise in small groups, where the participants worked on a stakeholder analysis for the systems introduced the day before.

After the coffee break, Martijn van Noort (TNO) gave a presentation on scaling up of FOT results. A FOT has outcomes on the vehicle level, like speeds and headways. From these data, society level effects (fatalities, time savings) need to be obtained. The step between the vehicle level and the society level is scaling up. Difficulties about scaling up are for example a different geography and time period, interaction between users and non-users, missing FOT data, nonlinearity in penetration rates, etc. In an exercise, the participants tried to find solutions to specific scaling up problems for different cases/systems.

After the exercise, the scaling up problem was illustrated by two examples: Oliver Carsten presented the ISA (Intelligent Speed Adaptation) example, and Martijn van Noort the EuroFOT example. Based on the discussions a clear need for "proof and quantification of effects" was expressed by the participants.

The seminar ended by some concluding words from Han Zwijnenberg (TNO) and Eran Reuveni (ITS Israel), who were both very positive about the 1,5-day. Organizers, presenters, and participants were all thanked.

The sessions at the seminar were rated positively by the participants. The participants contributed very actively, and discussions in the small groups were animated. During the day many questions were asked and issues discussed. Participants were especially interested in the experiences from FOTs, which could help them in developing their own FOTs. We concluded that with this seminar, the Israeli participants felt that they now belong to the wider FOT(-Net) community. For the FOT-Net partners it was a very interesting meeting and we learned a lot about the needs and ideas on FOTs in Israel.

## Tasks and results from the small group discussions

### Exercise Research questions and Hypotheses and Exercise Performance Indicators

#### ***Group Tasks Research questions and Hypotheses***

1. Identify three research questions for the system
2. For each research question, identify two hypotheses (i.e. 6 in total)

#### ***Group Tasks Performance Indicators***

3. What data would you need to collect to address each of your 6 hypotheses?
4. How could you measure these performance indicators?

### **Group 1**

#### **Nomadic device: find and book parking places for disabled drivers**

This uses a navigation system or smartphone with special navigation software for disabled drivers. When performing destination entry (except for home as the destination) disabled drivers are asked if they wish to book a parking space reserved for the disabled. The software handles the booking over a mobile phone link (books the space and the time based on expected arrival time) and the driver is then guided to the space.

Research question 1: Will the system improve disabled drivers parking space availability?

Hypothesis 1.1: The system will improve X% on average search time for a parking space.

Performance Indicators and data collection: Search time, position of the car, time of engine shut down (to define end-result of parking)

Hypothesis 1.2: More disabled drivers will find a parking space.

Performance Indicators: Log-book, questionnaire, GPS position

Research question 2: Will the system improve the utilisation of all parking spaces?

Hypothesis 2.1: The number of occupied parking spaces will increase.

Performance Indicators and data collection: sensors on parking spaces, number of occupied/available spaces (or a sample), counted by FOT-employees

Research question 3: Will the system distract the driver?

Hypothesis 3.1: Drivers with the system have their eyes less on the road and more on the system.

Performance Indicators and data collection: Questionnaire, data from eye-movements camera, observer in the car

Hypothesis 3.2: Drivers with the system will have more alarms from other systems in their car.

Performance Indicators and data collection: count of alarms

Research question 4: How will the system affect other disabled drivers who do not have the system?

Ideas from the plenary discussion:

Other research question: Does the system improve overall mobility of disabled people?

For finding out whether disabled drivers drive shorter distances because they don't have to search for a free space: look at GPS data, look at the route the disabled driver took to the parking space, calculate the length. However, for this you have to know when the driver started to search for a parking space. Maybe he/she could indicate this him/herself.

Alternative hypothesis: Drivers will keep their eyes more on the road, because they don't have to look out for free spaces.

## **Group 2:**

### **ADAS: Lane departure warning that works when white lining is poor**

This uses various sensor algorithms including the map, high-quality GPS image processing to determine lane boundaries and lane alignment even when white lines are poor or absent.

Research question 1: Does the system improve driver safety?

Hypothesis 1.1: Users of the system will have less events of lane departure

Hypothesis 1.2: Users of the system will have less crashes/near crashes

Performance Indicators and data collection: Number of lane departures, self-reporting data, video, number of crashes and near-crashes, proxies to crashes: accelerations/G-force, airbag information, seat-belt information

Research question 2: What is the technical effectiveness of the system?

Hypothesis 2.1: The system works well with poor lining

Hypothesis 2.2: The system has a low rate of false alarms

Performance Indicators and data collection: GPS: GIS map, Video: road data, alerts logging

Research question 3: What are the behavioural impacts of the system?

Hypothesis 3.1: The system will decrease alertness to lane keeping by drivers

Hypothesis 3.2: The system will confuse drivers and increase distraction

Performance Indicators and data collection: Eye-tracking data, eye gaze direction, lane keeping, number of correct alerts, drivers' reactions

## **Group 3:**

### **Cooperative: Cooperative system warning for shockwaves on the motorway up to 4 km ahead**

Roadside equipment (e.g. loops, video) combined with V2I (vehicle-to-infrastructure) communications is used to detect shockwaves. Thus vehicle data can be used to detect shockwave conditions. Warnings of shockwaves in the moving traffic ahead are broadcast by wireless communications (e.g. GSM, GPRS) to traffic approaching the shockwave area.

Research question 1: How does the system affect flow (per hour)?

Hypothesis 1.1: The shockwave amplitude will go down (the smoothness will go up)

Hypothesis 1.2: The variation of speed will go down, because drivers will decelerate more smoothly

Hypothesis 1.3: Shockwaves will move forward because traffic will flow at higher concentrations

Hypothesis 1.4: Average speed will be higher and throughput higher because of fewer shockwaves

Hypothesis 1.5: Information will cause drivers to divert to other routes

Research question 2: How does the system affect safety?

Hypothesis 2.1: Tel Aviv drivers will ignore the warnings because they like to drive fast (there is a need for variable speed limit enforcement)

Research question 3: How does the system affect comfort?

Research question 4: How does the system affect fuel consumption?

Research question 5: Is the impact of the system different by day and night, weekend, and different weather conditions?

Performance Indicators and data collection: Collisions/near collisions, full stops, sudden braking, lane changes, backward wave propagation speed, amplitude stability, speed profile of individual vehicles, speed differences between vehicles, accelerations, jerks. For density: distance between vehicles. For flow: time headway. Aerial photography, point measurements.

Questions: in-vehicle systems: use a sample or all vehicles? How many vehicles are equipped?

Questions and ideas from plenary discussion:

How to distinguish controlled from uncontrolled lane departures?

You need to equip the road and a large number of individual vehicles. A solution to bring together a large number of equipped vehicles is to organise an event (e.g. a lunch at a nice place) for the FOT participants.

#### **General remarks from the plenary discussion:**

- It may sometimes look as if there is more emphasis on negative than on positive effects of the system, you should not miss important positive effects.
- A special focus may be needed on difficult situations: what do drivers do when the system does not work well?
- How to prioritise hypotheses? Some solutions are:
  - Give consortium partners a fixed number of points they can allocate to their favourite hypotheses, and use the hypotheses with most points.
  - Look at the interests of the different stakeholders.
  - Consider the budget and resources that are needed for the measures to test the hypotheses. Some equipment can provide data for many hypotheses.
  - Iterate the process of defining hypotheses and performance indicators and consider the trade-offs.
- You can do part of the study with a driving simulator or test-track.
- Use mature systems and start the FOT after a feasibility/pilot study. Be sure that the systems are reliable. However, FOTs have also been done with immature systems.

## Exercise Study design

### Problem description - FOT Study design

You wish to do a Field Operational Test for the systems that were introduced this morning. You are responsible for the study design of the FOT. You have a couple of things to think about regarding participants and study environment. Answer the following questions:

- What design do you choose?
  - "Within" subjects design (same group of participants drives first without system and second with system)
  - "Between" subjects design (group of participants drives without system and another group of participants drives with system)
- What kind of participants do you want in your FOT?
  - What are inclusion or exclusion criteria?
    - For example age, gender, socio-economic variables, ...
  - How are you going to find these participants?
  - If you don't have much choice in choosing your participants what kind of influence does this have and how are you going to deal with this?
- How many participants would you need? (make a guess)
- What kind of study environment do you want in your FOT?
  - Geographical location?
  - Road type?
  - Weather conditions?
- How are you going to exclude or include certain circumstances?

### **Group 1: Nomadic device: find and book parking places for disabled drivers**

What design do you want to choose?

Within subject design (same group, different scenarios)

What kind of participants?

Criteria - age, gender, different disabilities, need for parking (use questionnaire)

How to find them?

Social security, IDF, Transportation Department

How many?

50-100 participants for 3 months (driving with and without system).

Environment?

Urban location (Tel Aviv)

Weather conditions should be measured

### **Group 2: ADAS: Lane departure warning that works when white lining is poor**

Design:

1. Between (snow, fog, ...)

2. Within (before, after)

For both designs, counterbalanced, two groups of participants:

- a. Drives with, without, with system
- b. Drives without, with, without system

Both groups drive for 6 months, 150 people per group

Environment:

Road-type is inter-urban (rural roads with no separation) (narrow shoulder width)

Weather:

Snow, fog, rain, night, poor lining (create controlled environment), sand

Participants:

Professional and non-professional participants, male and female, different age and experience level

Assumption when deciding on sample size: lane departure is a frequent event

Matrix for types of participant:

	Professional		Non-professional	
Male	young	old	young	old
Female	young	old	young	old

Estimation of participants needed: around 300

### **Group 3:**

#### **Cooperative: Cooperative system warning for shockwaves on the motorway up to 4 km ahead**

Design:

Before and after with control study (under slim Israeli budget)

Vehicles:

Number of equipped vehicles

Number of non-equipped vehicles

All vehicles installed with:

- GPS
- Speed measurements
- Acceleration/braking loggers
- Distance to vehicle in front (with radar, laser, Mobileye)

Environment:

Road type: a motorway with recurrent congestion

Weather: does not matter in Israel

Participants:

Inclusion criteria is driver travels through the selected road section regularly

Both genders, all ages

## Stakeholder exercise

### **Group 1: Nomadic device: find and book parking places for disabled drivers**

Level 1:

- service provider
- municipality of Tel Aviv
- Ministry of transport (1 or 2)

Level 2:

- User association of handicapped people
- Data provider (2 or 3)
- Provider infrastructure (2,3)

No level (level 3):

- Association of shop owners
- Telecom providers
- Parking space providers

### **Group 3: Cooperative: Cooperative system warning for shockwaves on the motorway up to 4 km ahead**

Level 1:

- road operators
- system providers (product + communication + information + infrastructure)
- users: private, fleets, professional drivers

Level 2:

- Road safety authority/ministry of transport
- Research institute
- Road traffic information providers

Level 3:

- Environment organisations/bodies
- Insurance/towing services (garage)
- Car clubs

## Evaluation exercise

### **Group 1: Shockwave management cooperative braking**

FOT data -> driver behaviour model -> simulation

- Time headway
- Brake reaction time
- Accelerations/decelerations
- Capabilities of the car

- Road friction
- Weather
- Vehicle dynamics model

## Group 2: Emissions manager

Penetration rate	Emission reduction
12%	-2.3 CO2
40%	....
60%	....
80%	
100%	

Take into account: (3 D model)

Dimension 1:

- Road type
- Headway
- Structure

Dimension 2: congestion levels (low, medium, high)

Dimension 3: penetration levels

Results: expected reduction in emission level