

# *Results and lessons learned of a subjective field operational test on the Lane Departure Warning function*

Gianfranco Burzio



**CENTRO  
RICERCHE  
FIAT**

Elisa Landini



## *Joint work with:*

---

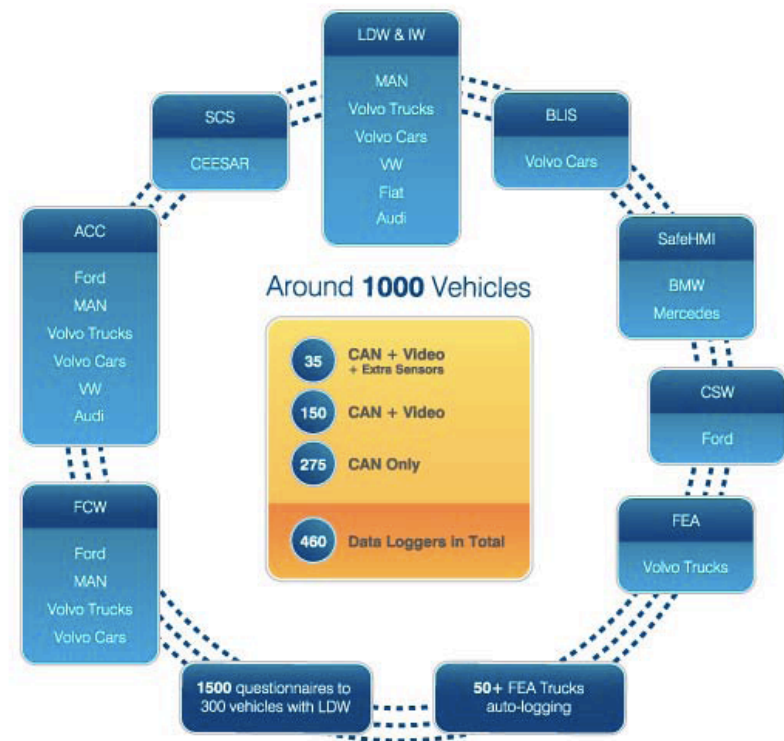
- Leandro Guidotti, Politecnico di Torino, Italy
- Guido Perboli, Politecnico di Torino, Italy
- Roberto Tadei, Politecnico di Torino, Italy
- Francesco Tesauri, Università di Modena e Reggio Emilia, Italy



# The euroFOT project

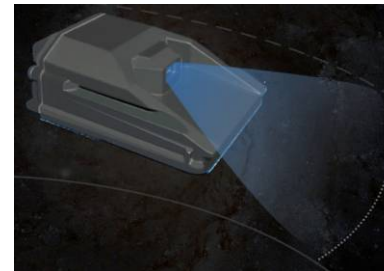
- Field Operational Test.
- Perform multiple coordinated tests of Intelligent Vehicle Systems with ordinary drivers in real traffic.
- Investigate performance, driver behaviour and user acceptance.
- Assess the impacts on safety, efficiency and the environment, based on road data.

Italian test is focused on Lane Departure Warning, with a large subjective experimental test



# The Lane Departure Warning function

- The Lane Departure Warning (LDW) in the Italian test site is available as optional on the Lancia Delta.
- LDW provides the feedback to the driver through a torque applied on the steering wheel as soon as the driver is going close or overcome a lane border unintentionally.
- The device also warns the driver, acoustically, when it detects that he/she has not the hands on the steering wheel.



# Italian test in euroFOT

- Assessment of the impact of LDW function.
- Subjective large scale test through questionnaires.
- CRF and Politecnico di Torino involved.
- FOT execution: February 2010 - September 2011.
- Passenger cars - 570 drivers recruited (1761 contacted).
- LDW group (i.e. 280 drivers with the LDW installed) and Control group (i.e. 290 without LDW).
- 9 month test per each drivers.
- No objective data acquisition system in-vehicles.
- Data collected through different questionnaires.
- Online and paper-based versions available.
- **Assessment of the users' acceptance and perceived safety.**



# Design of Experiment and questionnaire types



- Five periodical questionnaires planned to test the users' perception about the system.
- Users could also report specific events when the device has been useful (or not) to avoid dangerous situations.



# Filled-in questionnaires as example

Participant ID: L10.58435.032010 euroFOT

Compili cortesemente il questionario sottostante riportando le informazioni richieste.

### Dati demografici

ID\_dem\_1\_1 Sesso  M  F

ID\_dem\_2\_1 Anno di nascita 1968

ID\_dem\_3\_1 Qual è il suo stato lavorativo?  
 Occupazione a tempo pieno  Occupazione a tempo parziale  Pensionato   
 Occupazioni temporanee  Studente  Attualmente non occupato   
 Altro  Specificare .....

### Esperienza di guida

ID\_exp\_2\_1 In quale anno ha ottenuto la patente di guida? 1968

ID\_exp\_3\_1 Media dei km annui percorsi 15.000 km/anno

ID\_exp\_5\_1 Indichi la frequenza con cui le capita di guidare nelle situazioni sotto indicate:

ID_dir_1a_1 - In autostrada	Mal	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Spesso
ID_dir_5b_1 - Su strade rurali	Mal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Spesso
ID_dir_5c_1 - In città o su strade urbane	Mal	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Spesso
ID_dir_5d_1 - Su strade e percorsi a lei famigliari	Mal	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Spesso
ID_dir_5e_1 - Su strade e percorsi a lei non famigliari	Mal	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Spesso

ID\_dir\_6\_1 In una normale settimana di guida, quale percentuale del suo tempo di guida trascorre: (Totale 100%)  
 per raggiungere il posto di lavoro .....%  
 per attività lavorative .....%  
 nel tempo libero 40 %  
 per altro 30 %

LDW Group Questionario A 1

Participant ID: L10.58435.032010 euroFOT

### Da compilare

BAS\_dir\_1a\_1 Scenario 1:  
Curvare a sinistra a un incrocio in un momento di traffico intenso. (Si veda figura a sinistra)

ID\_dir\_1b\_1 Scenario 2:  
Nella guida di tutti i giorni

LDW Group Questionario A 15

## Event register

Date Briefly event description (use the rear for a more detailed description) .....

Driving Advisor system status at the event  Switched ON  Switched OFF  
 If switched ON:  Active  Not active  I don't know

IF SWITCHED ON Referring to the event, the Driving Advisor system  solved the situation providing the right warning  did not solve the situation

Please describe the Driving Advisor reaction and the warning provided .....

IF SWITCHED OFF You think that the Driving Advisor  could solve the situation  could not solve the situation

Which type of road were you driving on?  Urban  Extra urban  Highway

Event described happened  in back straight  in a bend  in an intersection  in proximity of road works

Manoeuvre performed at the event  Normal driving  Lane change  Going in or out in a junction

Weather condition Please tick in case of windy condition

Lighting condition  Dawn  Daytime  Sunset  Night with artificial lighting  Night without artificial lighting

Traffic situation  Light  Normal  Heavy

Speed at the event (km/h) 0 10 30 50 70 90 110 130

Your distraction level at the event was very low    very high

Your tiredness level at the event was very low    very high

Your trip started since  less than an hour  Between 1 and 3 hours  More than 3 hours

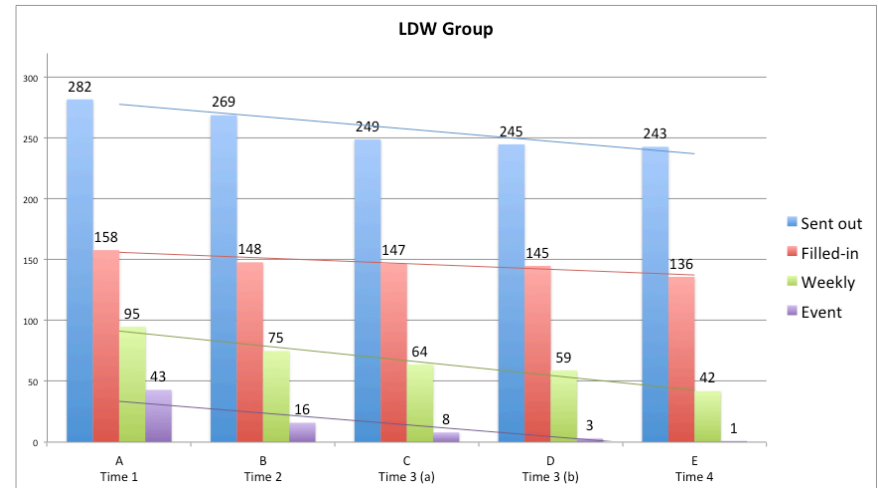
Were you using something at the event?  Nothing  Phone  Radio/CD  Air conditioning  Other

# Response rates

## LDW group

Response rate  $\approx$  57%

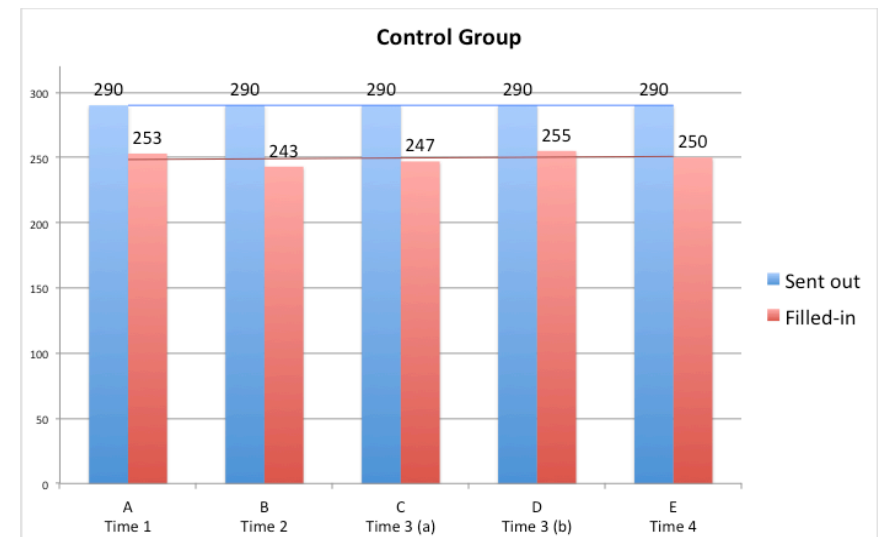
119 LDW users filled-in **all** periodical questionnaires



## Control group - CG

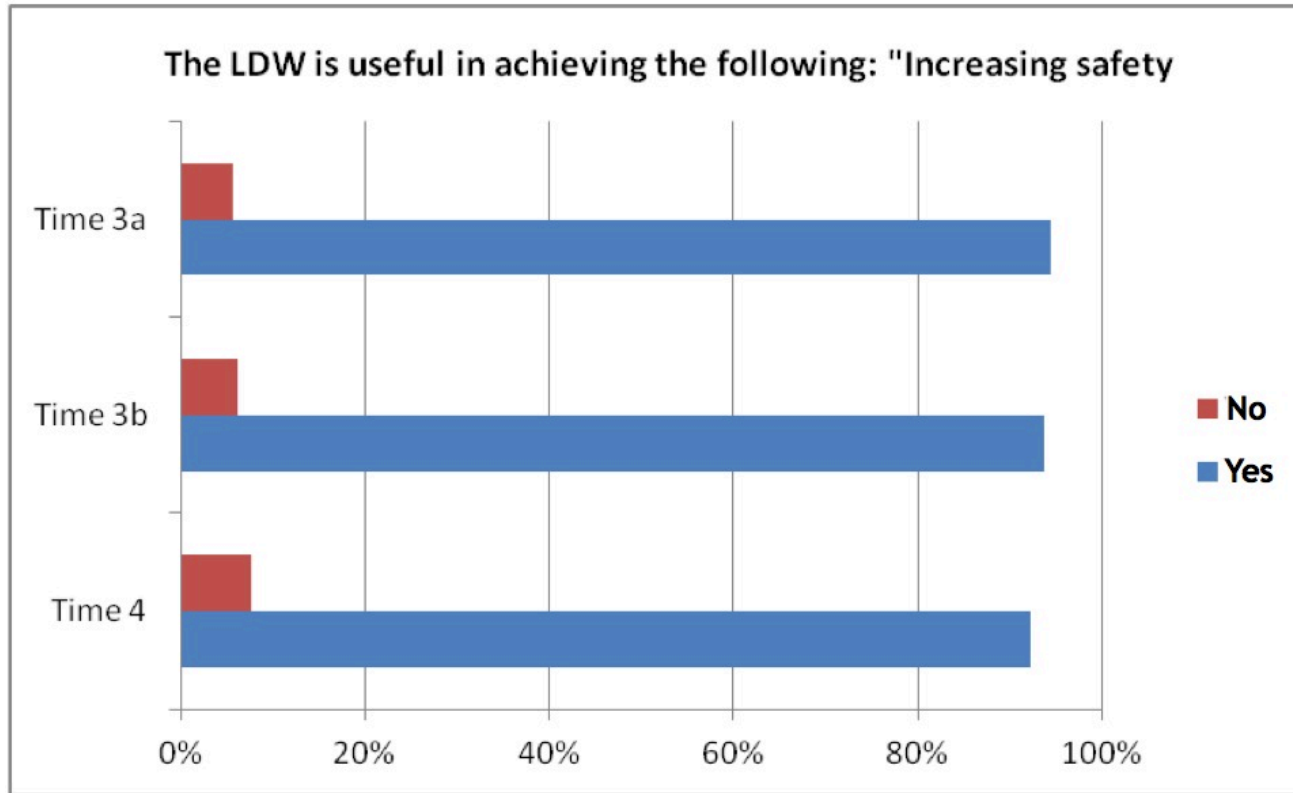
Response rate  $\approx$  86%

226 CG users filled-in **all** periodical questionnaires



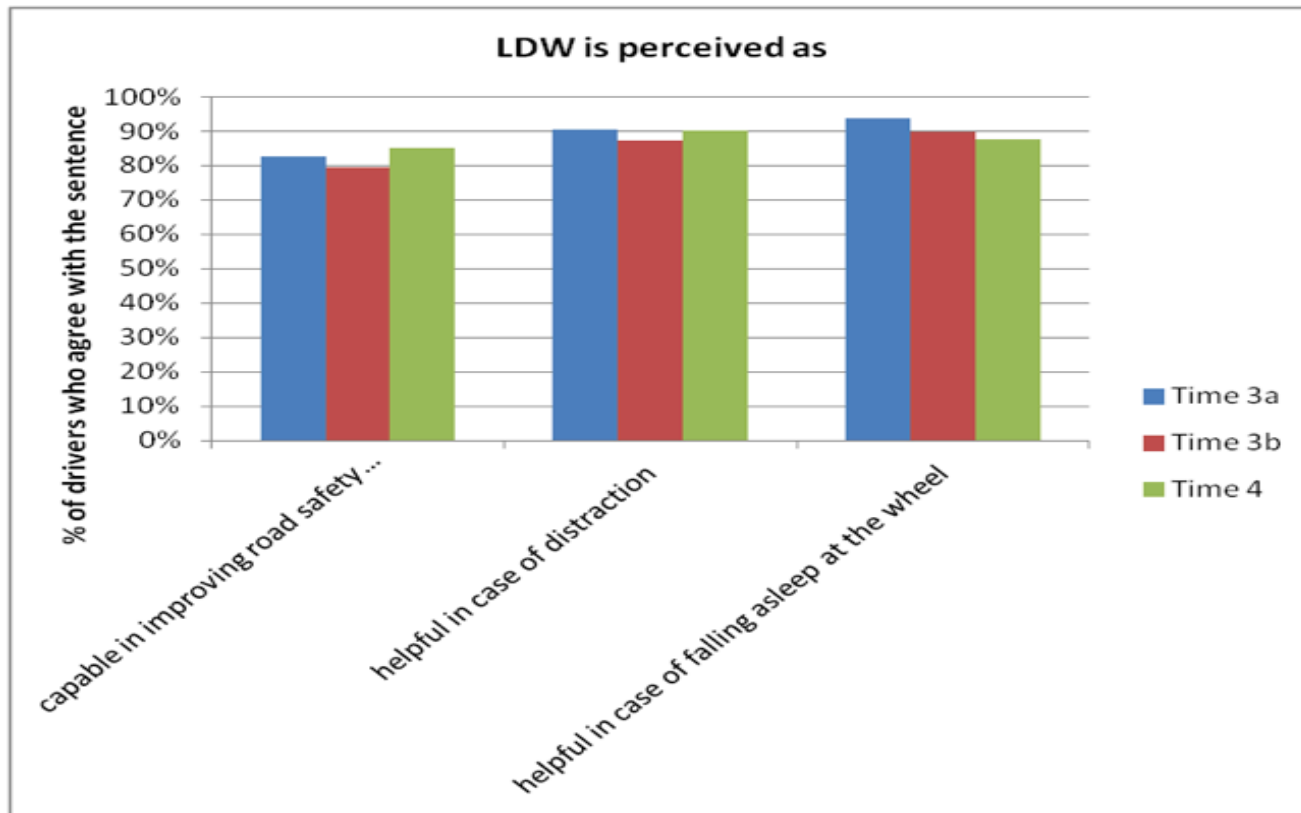


# First results - Perceived safety 1/4



More than 90% of the sample found the LDW system effective in increasing the driving safety. This perception is stable along time.

## First results - Perceived safety 2/4

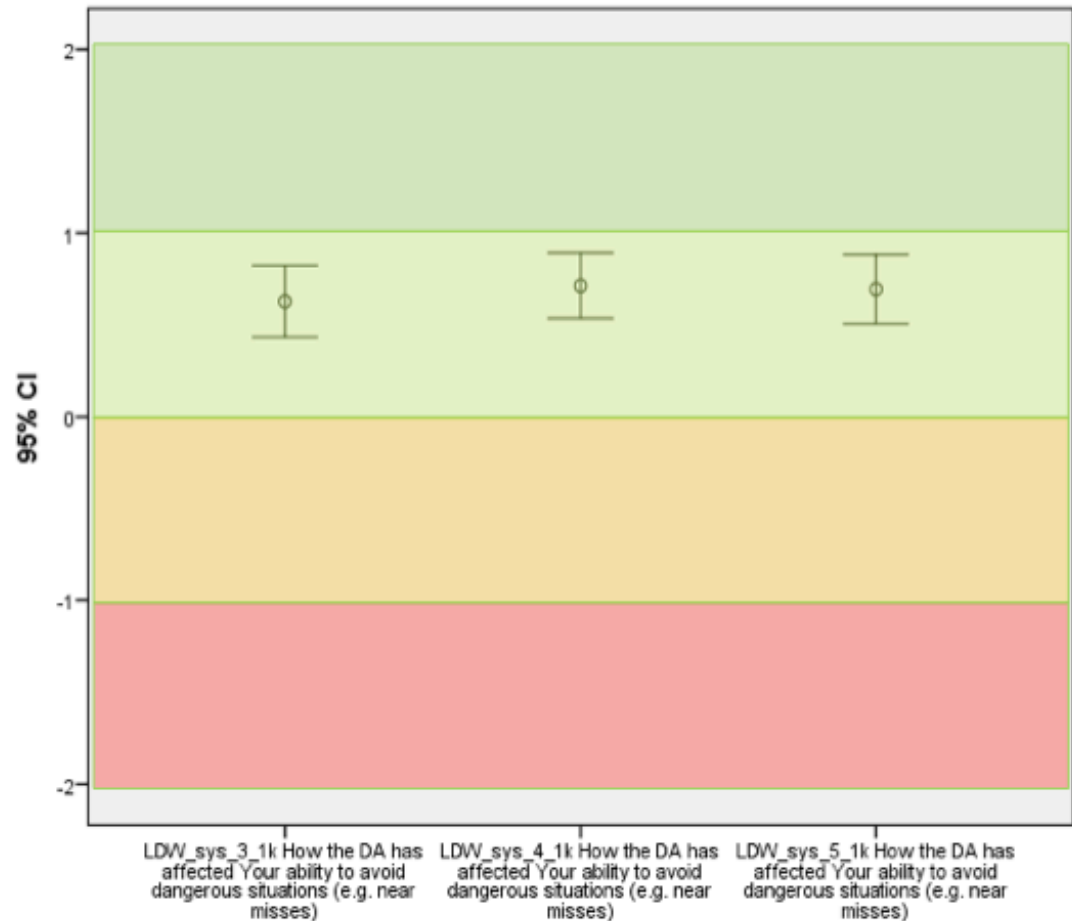


As regard the perception of road safety, most of the drivers (more than 80% at Time 4) found the LDW system able to improve it significantly. This perception is stable along time.

# First results - Perceived safety 3/4

With respect to the ability to avoid dangerous situations, subjects perceived a moderate positive impact.

The reported influence did not change significantly over time.



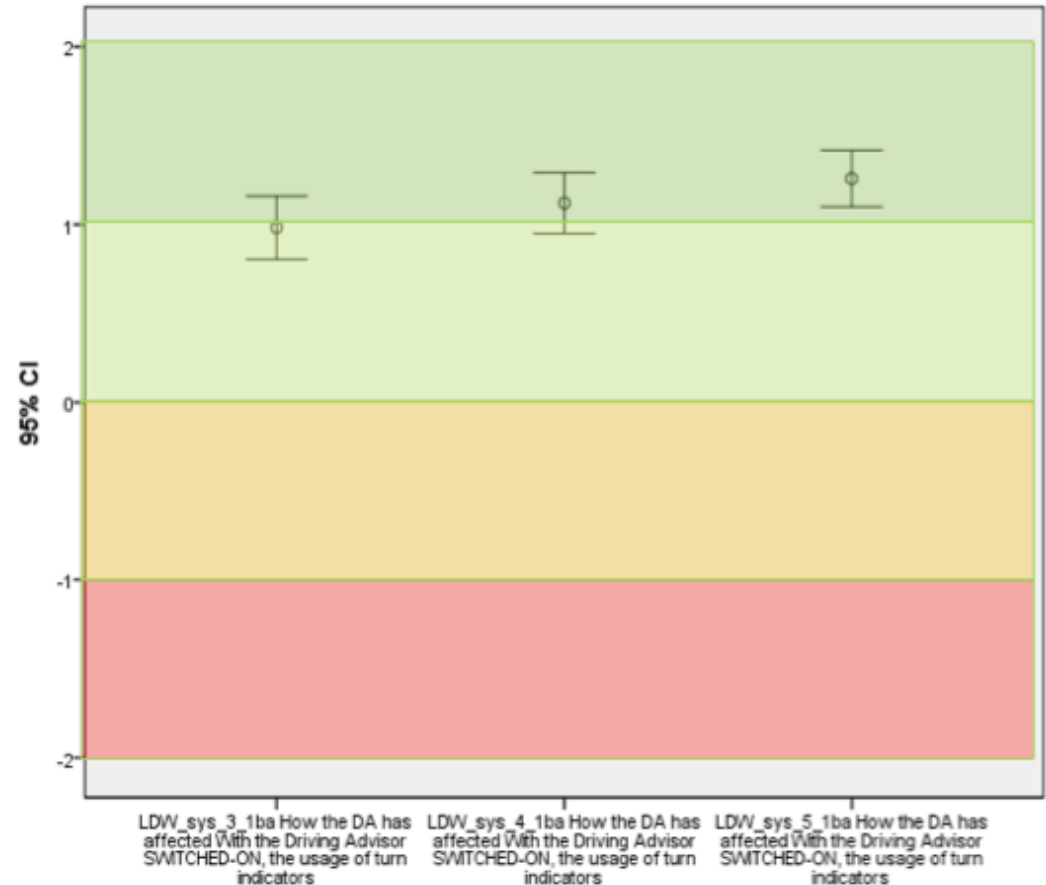
# First results - Perceived safety 4/4

Subjects recognized a positive impact of the LDW function on the correct use of turn indicators

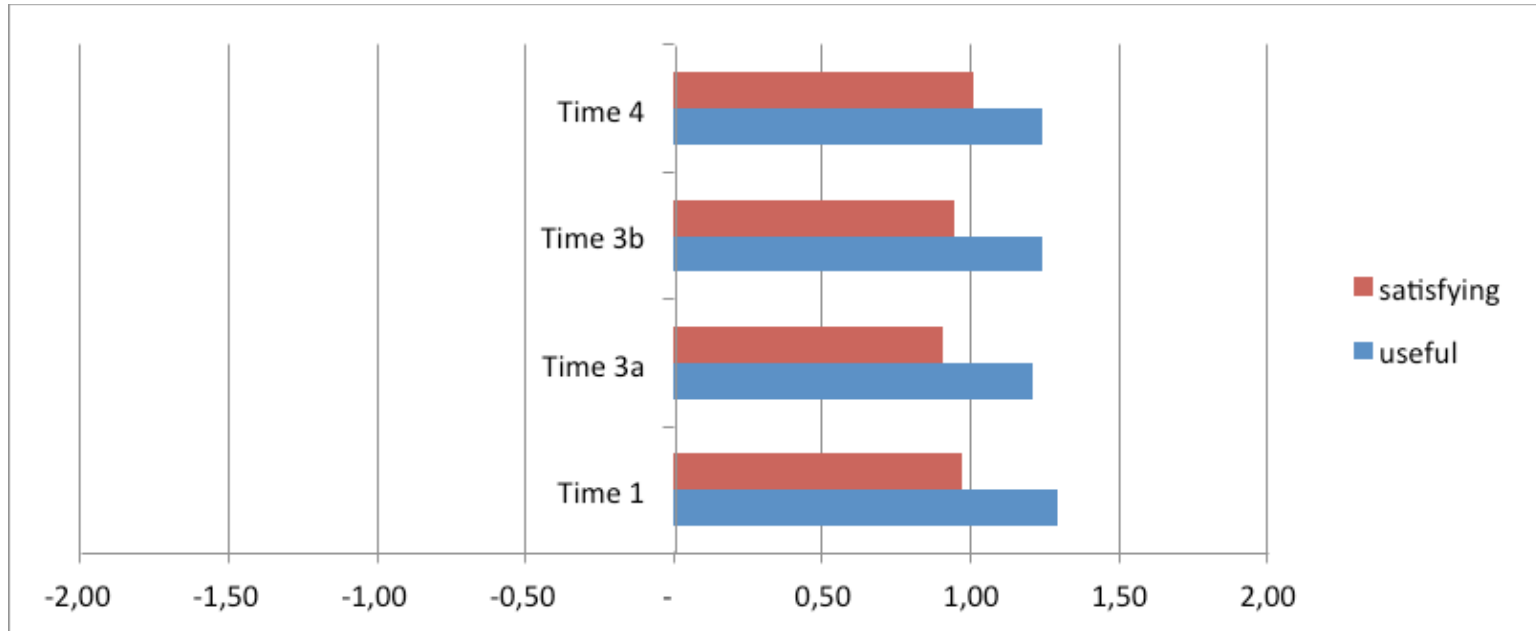
M =1.26, SD =.87 at Time 4.

This influence increased over time

F (2, 230)= 5.24, p = .006.

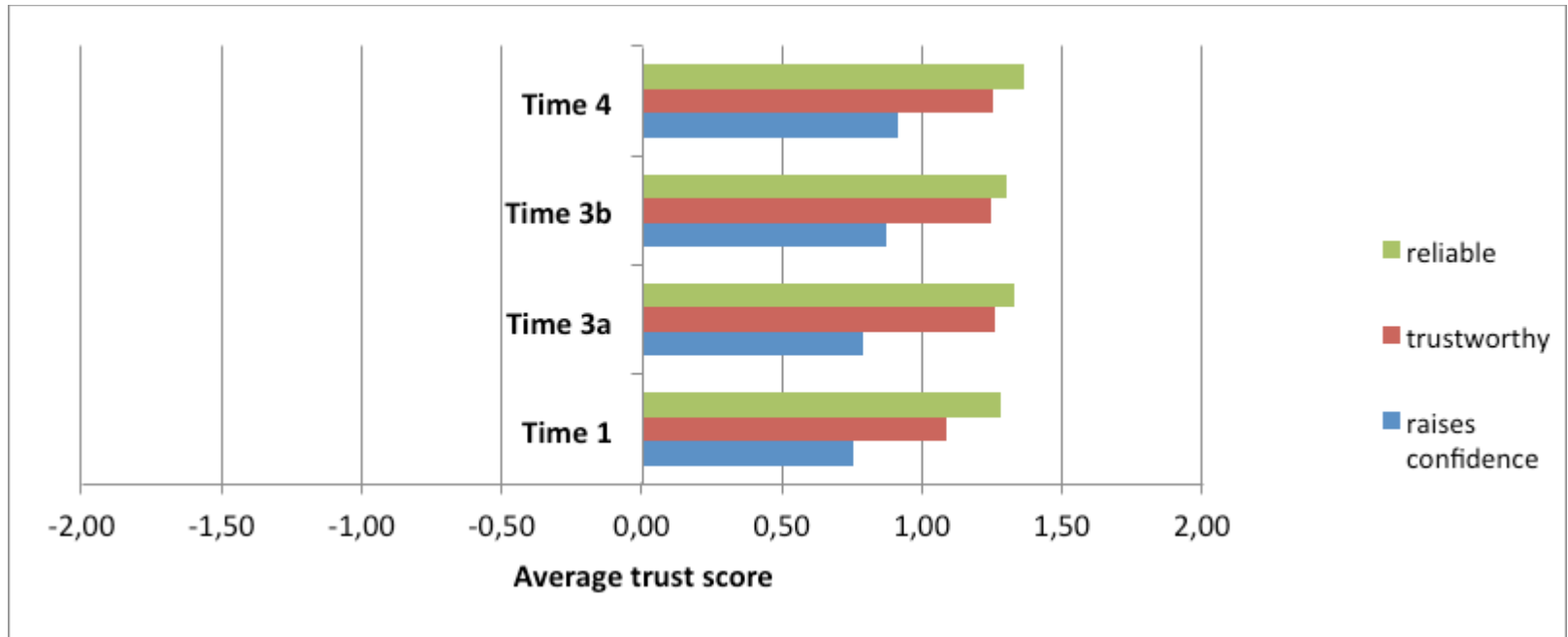


# First results - User acceptance



LDW is well accepted by users. Drivers found the system very useful and satisfying, with a prevalence of the former. These perceptions do not significantly vary over time.

# First results - Trust in the system



The three considered features (i.e. Raises confidence, Trustworthy, Reliable) of the LDW system are high and stable at all the time points. Reliability and trustworthiness have higher levels.

## *Lessons learned collected about:*

---

- Questionnaire design and planning for a large-scale test.
- Driver recruitment and pre-screening.
- Driver liaison centre.
- Day-by-day activity for a large-scale test.
- Data management tools.
- Piloting test phases.
- Hypotheses specifications and tuning of them during the FOT.



---

# Thank you for your attention!

**Contact:**

Gianfranco Burzio

[gianfranco.burzio@crf.it](mailto:gianfranco.burzio@crf.it)

