# Impact and Cost Benefit Analysis

## Safety

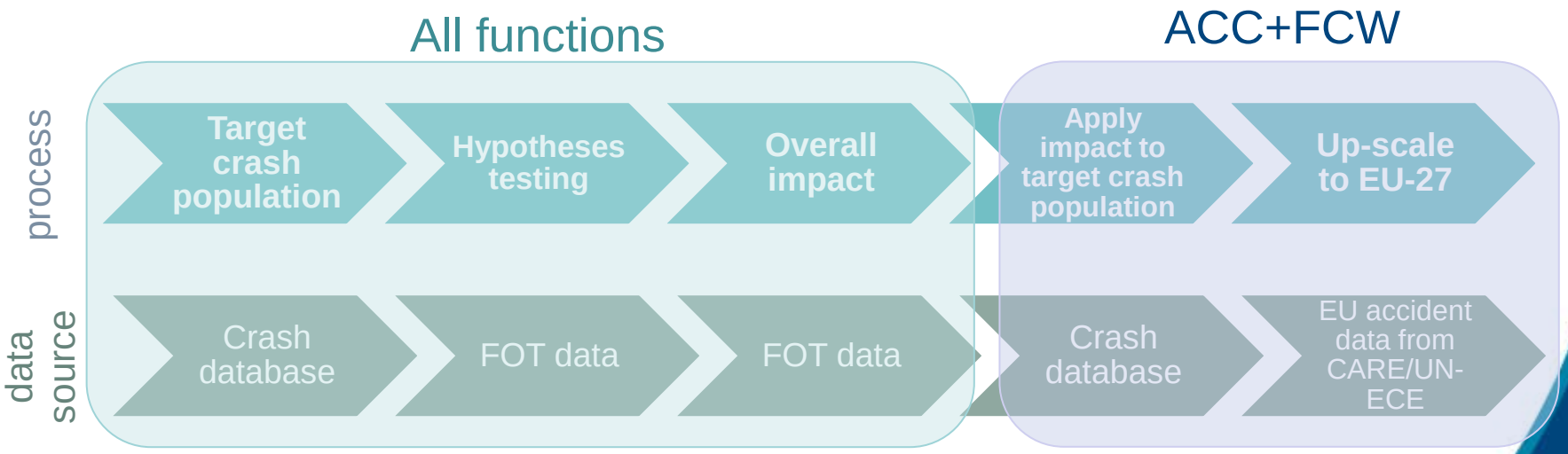
**Lucas Malta**
Volvo Group Trucks Technology

Final Event
26-27 June 2012
Autoworld, Brussels


www.eurofot-ip.eu

# Safety impact analysis in euroFOT

Better understanding the impact of studied functions on safety






www.eurofot-ip.eu

# Hypothesis testing methodology

## Event-based analysis

- Frequency of safety critical driving situations (e.g., change in the **number** of incidents)

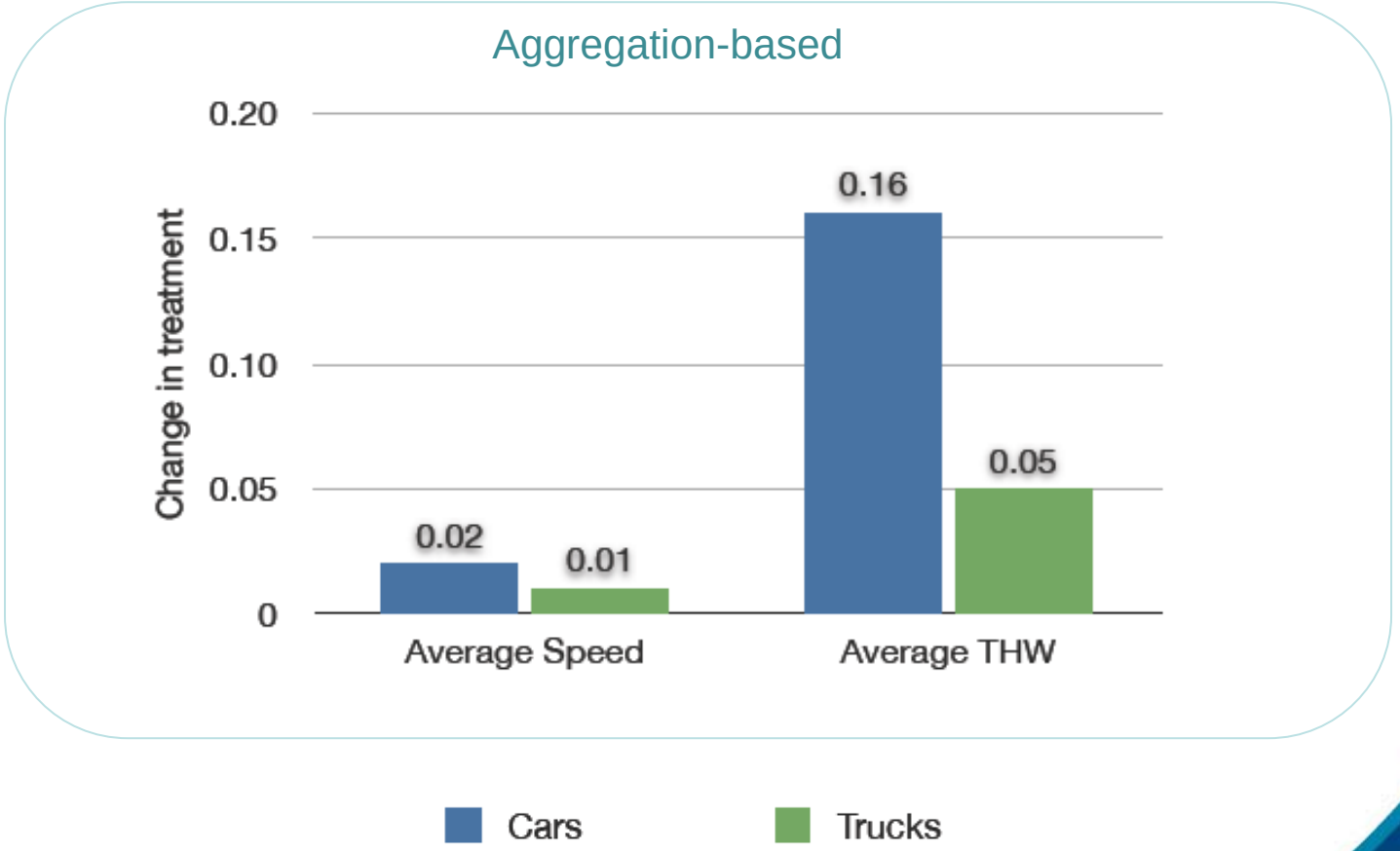
## Aggregation-based analysis

- Aggregated continuous data (e.g., change in **average** speed)

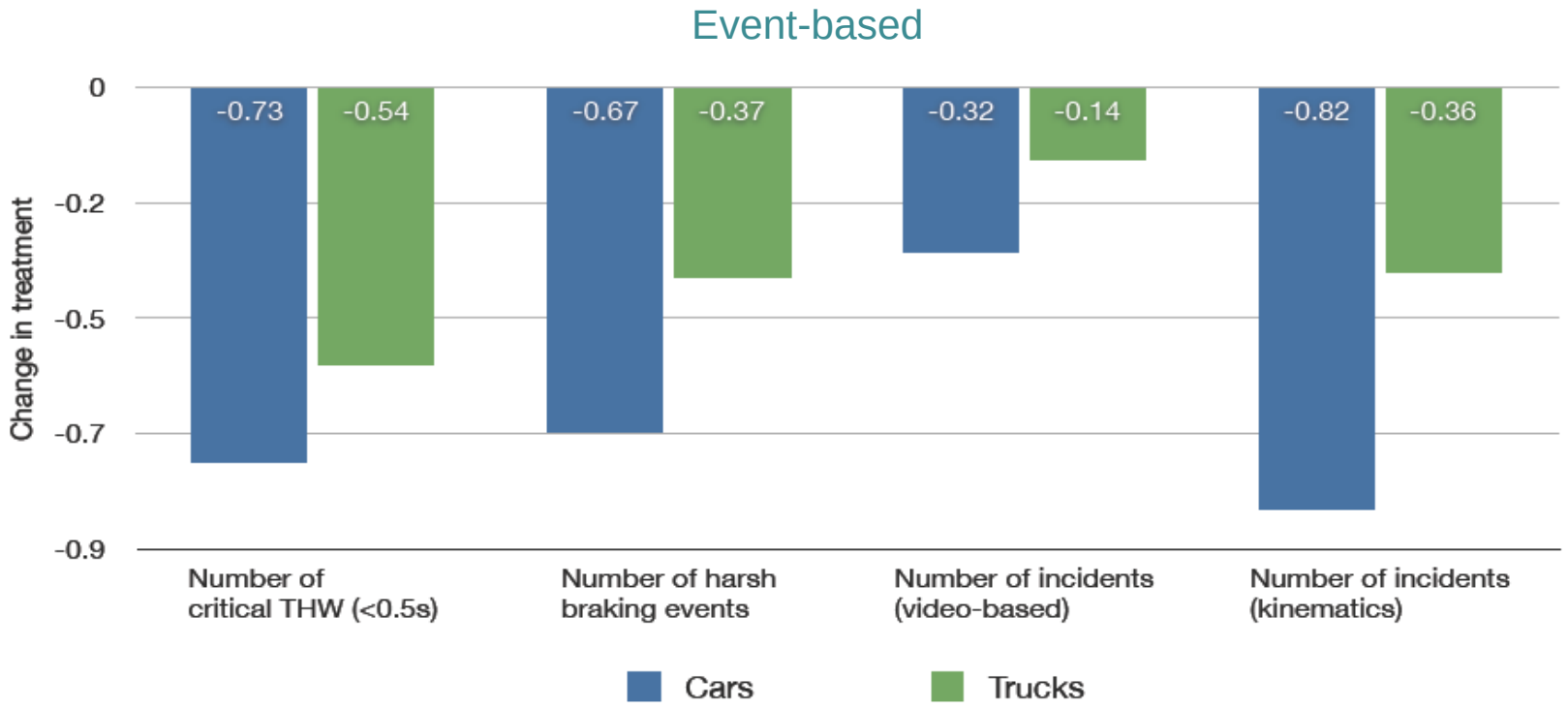
## Risk Matrix Approach

- Simulation-based (ACC+FCW only)

# ACC+FCW (motorways)



# ACC+FCW (motorways)



# ACC+FCW

## Risk Matrix Approach

- Decrease in crash involvement risk in motorways when using the bundle.

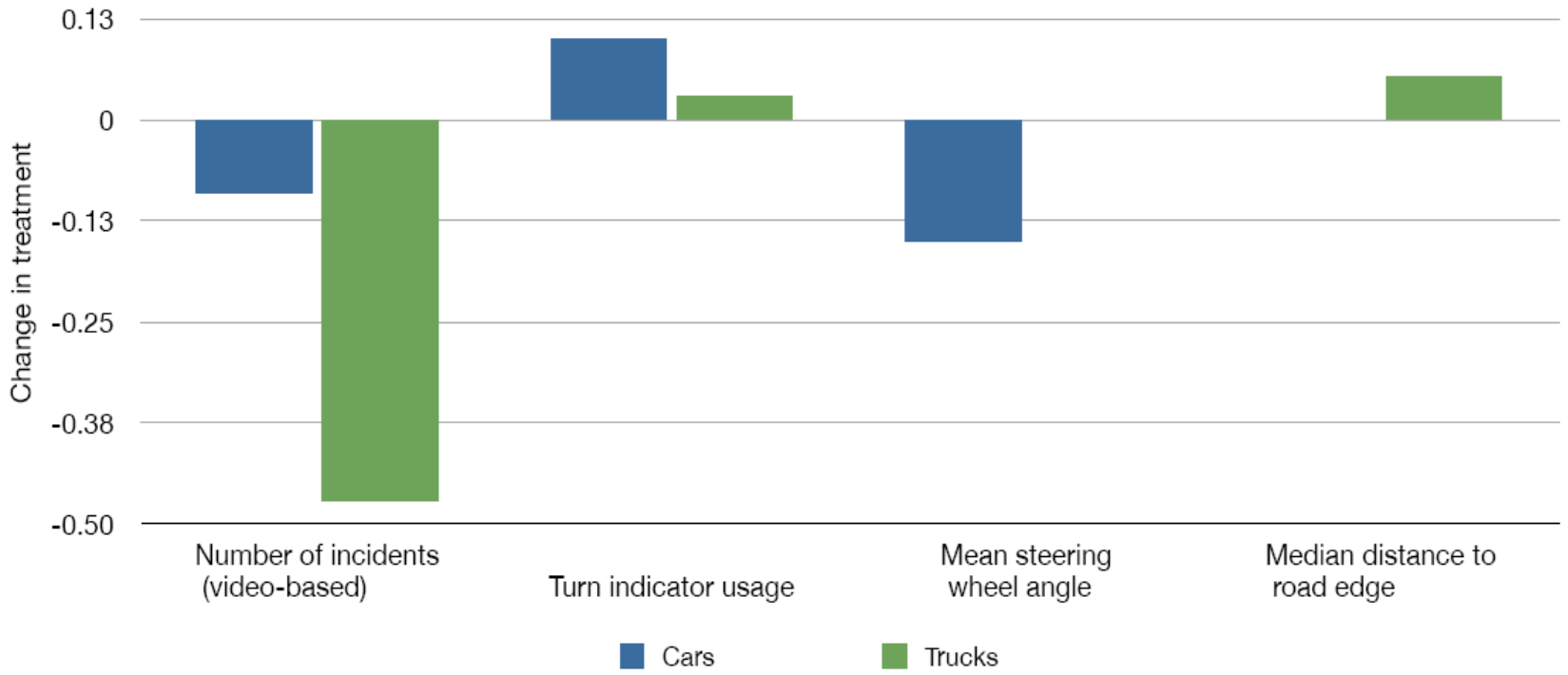
## Possible negative side-effects tested

- Increase in **visual secondary tasks** during normal driving but this difference was not found during incidents.
- No negative **side-effect on focus on forward roadway** during incidents.

# Potential benefit
# Up-scaling to EU-27

| Vehicle type | Road type | Usage (portion of the total driving in treatment) | Changes between baseline and treatment in safety related measures in the FOT data | Potential reduction in rear end crashes | Potential reduction in the injury accident population per road type in EU-27 |
|---|---|---|---|---|---|
| Passenger Cars | Motorway | 51% | 32 - 82% | 16 - 42% | 2.2 - 5.8% |
| Trucks | Motorway | 42% | 14 - 36% | 6 - 15% | 0.2 - 0.6% |

# Lane Departure Warning (+ Impairment Warning in cars)



# LDW(+IW)

## Possible negative side-effects tested

- Increase in **use of nomadic devices** during normal driving. Nevertheless, during incidents, no such difference was found.
- No influence in the amount of **night/drowsy driving** and **focus on forward roadway** during incidents.

## Up-scaling of results to EU-27

- Insufficient evidence. Further analysis is needed.

# Navigation system (built-in/mobile)

| Safety measure | Road type | Change in treatment | | | |
|---|---|---|---|---|---|
| | | Familiar | | Unfamiliar | |
| | | **Built-in Device** | Mobile Device | Built-in Device | Mobile Device |
| Incidents | Rural | -7.8% | -50.1% | 0 | 0 |
| | Urban | -8.1% | -52.6% | 0 | 0 |
| Proportion of critical THW | Rural | **S-** | **S-** | | |
| Proportion of critical TTC | | | | | |
| Hard braking | | **S-** | | | |
| Proportion of critical TLC | | | | | |
| Lane exceedances | | **S-** | | **S-** | |
| Proportion of critical THW | Urban | **S-** | **S-** | | |
| Proportion of critical TTC | | **S-** | **S-** | | |
| Hard braking | | **S-** | | | |
| Proportion of critical TLC | | | | **S-** | |
| Lane exceedances | | **S-** | | **S-** | |

Significant results (p<=0.05): Decrease S-, Increase S+

# Navigation system

## Direct effects

- Findings **contradict** previous assumptions on the safety mechanisms of the navigation system.
- Deeper understanding of the **safety mechanism** is needed.

## Indirect effects

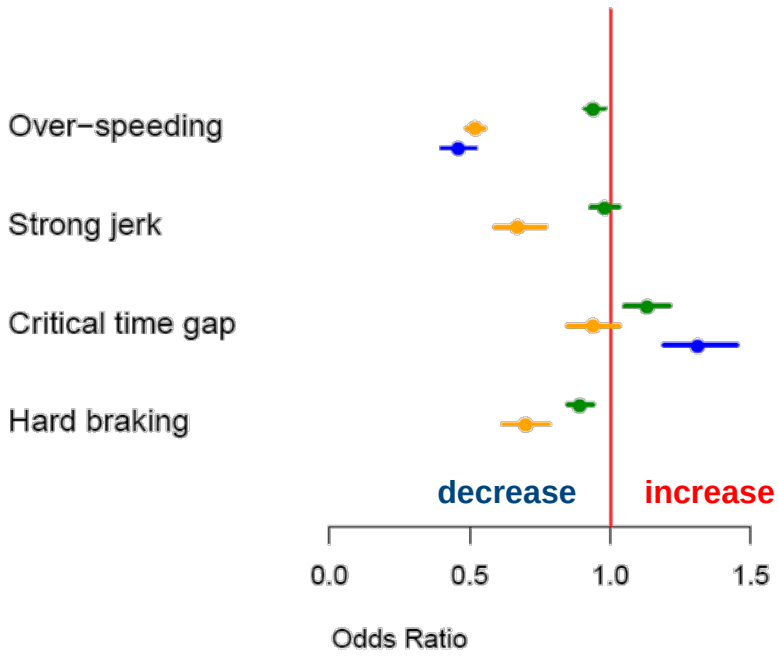
- Both systems **reduced travel time** compared to driving in the baseline condition.

## Up-scaling of results to EU-27

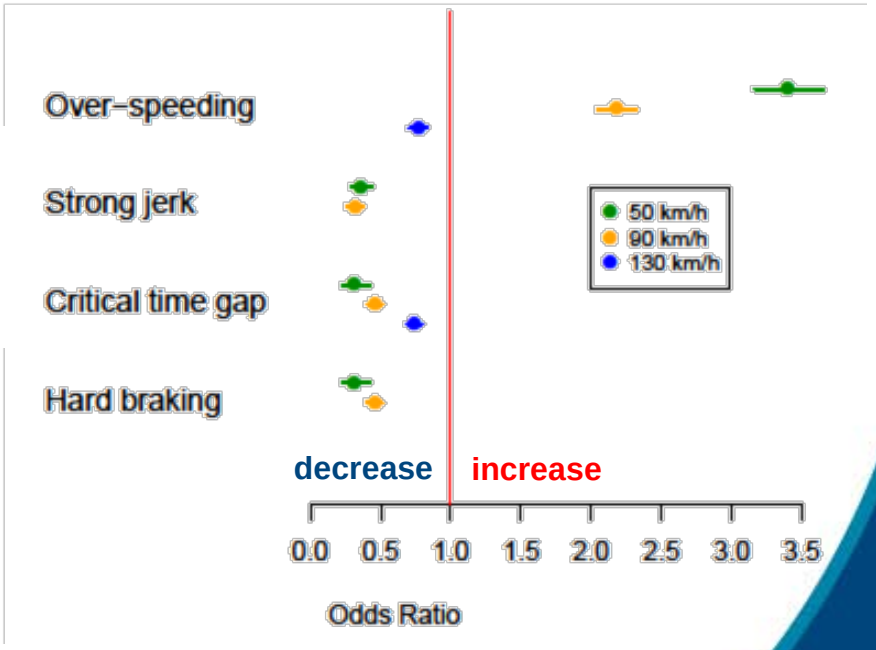
- Difficult to judge whether the measured effects can be generalized and up-scaled to EU-27.

# Speed Regulation System (SL+CC)

Event likelihood when condition changes from Baseline to **SL Active**




Event likelihood when condition changes from Baseline to **CC Active**




## Aggregation-based

- Increase in average speed for both systems in different road types.

# Speed Regulation System (SL+CC)

Both SL and CC were mainly expected to have an **effect on speed**.

Models which attempt to quantify the relationship between **speed and accidents** were considered for up-scaling.

- Negative effect with increased speed.

Up-scaling of results to EU-27

- Insufficient evidence. Different models are needed.

# Blind Spot Information System (BLIS)

Use of turn indicator decreased by 10% when BLIS was available and drivers were not simultaneously using LDW+IW.

- Drivers trust the function not to give false negatives.

Less than ten **BLIS-relevant incidents** could be identified within the analyzed data (time consuming process) → difficult to draw solid conclusions.

Up-scaling of results to EU-27

- Insufficient evidence. Further analysis is needed.

# Summary

New understanding of how studied functions affect a number of **safety indicators and driver behaviors** in the real-world.

ACC+FCW: potential reduction of rear-end crashes on motorways by **16-42%** for cars and by **6-15%** for trucks.

Analysis of how functions behave in a **multitude of conditions** (road type, road familiarity, truck weight, weather, light, etc) was conducted.

Progress on a **multi-site analysis** framework.

8 Functionalities, 28 Partners, 1000 Vehicles

1 Field Operational Test, **8 Functionalities**

28 Partners, 1000 Vehicles, 1 Field Operational Test

8 Functionalities, **28 Partners**, 1000 Vehicles

1 Field Operational Test, 8 Functionalities

28 Partners, **1000 Vehicles**, 1 Field Operational Test

8 Functionalities, 28 Partners, 1000 Vehicles

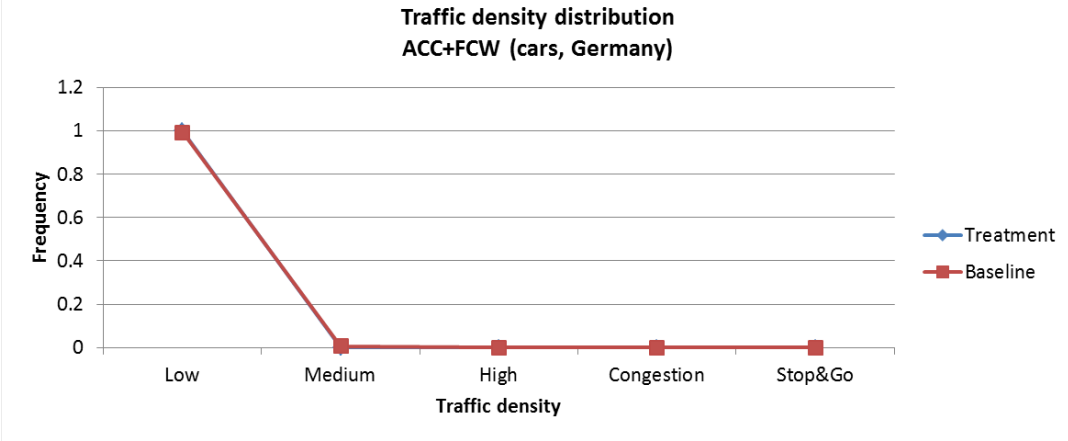
**1 Field Operational Test**

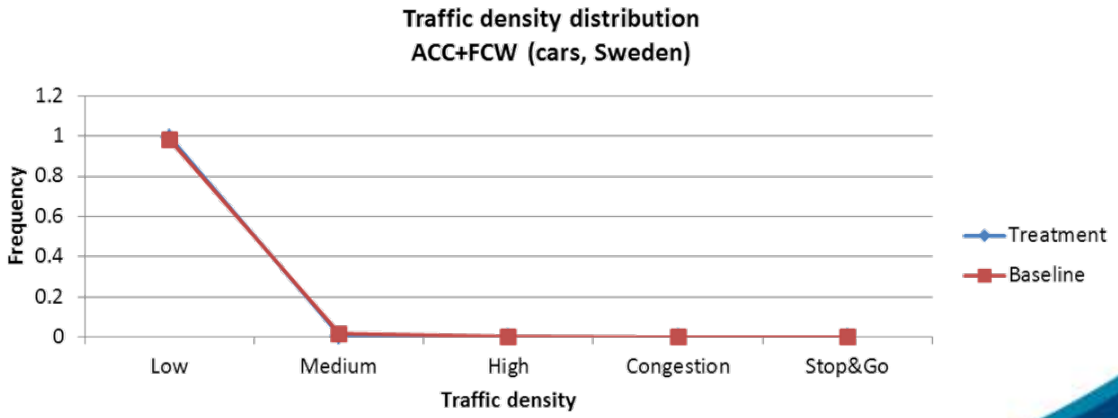

# Potential benefit – all road types

| Vehicle type | Road type | Usage (portion of the total driving in treatment) | Changes between baseline and treatment in safety related measures in the FOT data | Potential reduction in the target crash population (rear end crashes) | Potential reduction in the injury accident population per road type in EU-27 |
|---|---|---|---|---|---|
| **Passenger Cars** | **Motorway** | **51%** | **32 - 82%** | **16 - 42%** | **2.2 - 5.8%** |
| **Passenger Cars** | Rural | 31% | 32 - 45% | 10 - 14% | 0.47 - 0.65% |
| **Passenger Cars** | Urban | 19% | 32% | 6% | 0.14% |
| **Trucks** | **Motorway** | **42%** | **14 - 36%** | **6 - 15%** | **0.2 - 0.6%** |

# Data selection cars – ACC+FCW

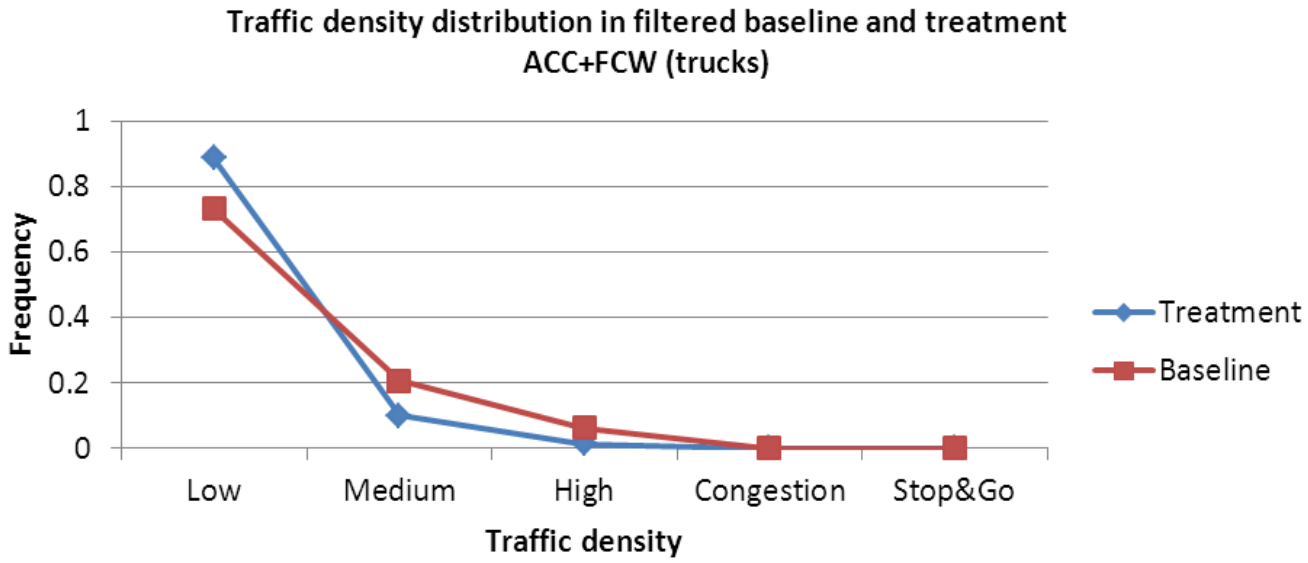
Expected speed above 60km/h, vehicle speed above 50km/h, and car-following situations. In addition, ACC OFF portions were removed from treatment. Five seconds were added after ACC shut off.



# Data selection trucks – ACC+FCW

Posted speed above 100km/h, vehicle speed above 50km/h, and car-following situations. In addition, ACC OFF portions were removed from treatment. Five seconds were added after ACC shut off.



# Navigation system

Critical THW:

proportion of time with Time Headway < 0.5 seconds

Critical TTC:

proportion of time with Time to Collision < 1.75 seconds

Critical TLC:

proportion of time with Time to Lane Crossing < 1 second