Naturalistic Driving
DaCoTA – wp6
Data Collection Transfer and Analysis

Transport Research Arena

Athens April 25th, 2012

Niels Bos wp-leader

SWOV Institute for Road Safety Research, the Netherlands

Transport Project co-financed by the European Commission, Directorate-General Transport and Energy

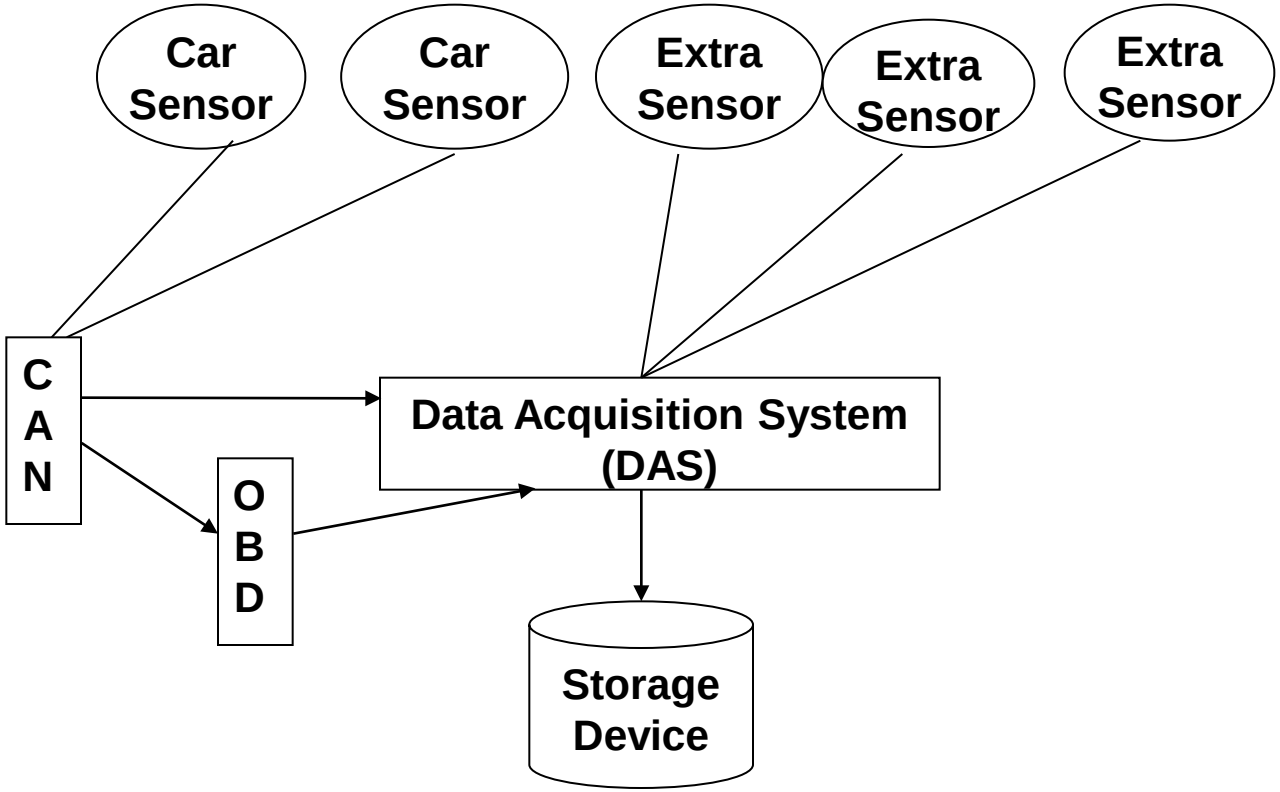
Contents

- What do we need? Methods
- Naturalistic Driving – Research and Monitoring Scale and technology
- DaCoTA wp6 - Driver Behaviour Monitoring through Naturalistic Driving Observations

Methods

- Disadvantages of many methods:
  - Retrospective, when it already happened
  - In an un-natural environment
  - Self reported behaviour
- How do we really drive?
  - Not influenced
  - ‘Being present’ as a researcher
- ICT ‘break through’
  - Sensors
  - Camera’s
  - Data-storage (including video)
  - Data-mining

Typical instrumentation



Naturalistic Driving

- (Automated) Observational method
- Natural (driving)behaviour of the participant is observed, in their natural environment
- Uncontrolled
- Huge amount of information → linked indicators

- Compare groups (odds ratio) or Case-crossover design (within)

Monitoring versus Research

- Research ("why is it happening") is intended to determine increased risk of a certain behaviour comparable to Blomberg curve on alcohol

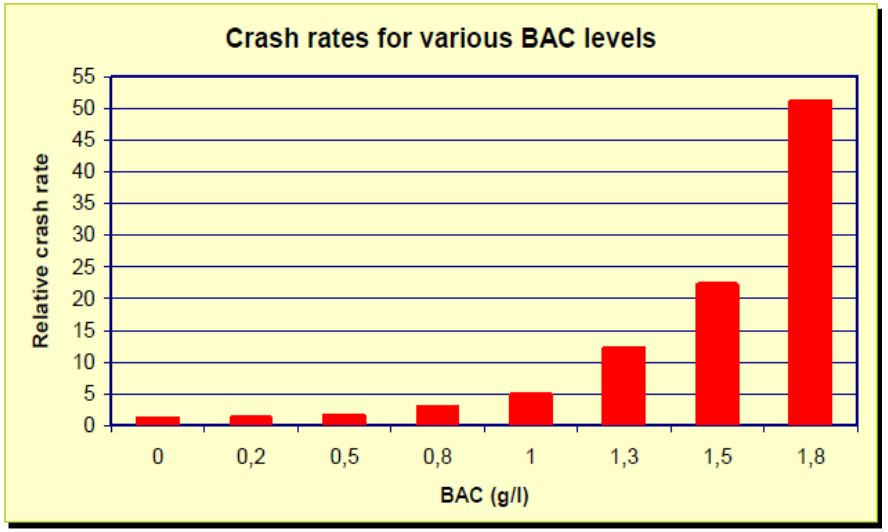


Figure 2. *Crash rates for various BAC levels (Blomberg et al., 2005)*

- Monitoring ("what is happening") intends to describe the prevalence of certain behaviour, such as
  - the percentage of kilometres driven with a BAC level above 0,5‰ or above 1,3 ‰, by day of week and age of driver
  - the percentage of trips in which excessive speeding occurs, by age & gender of driver

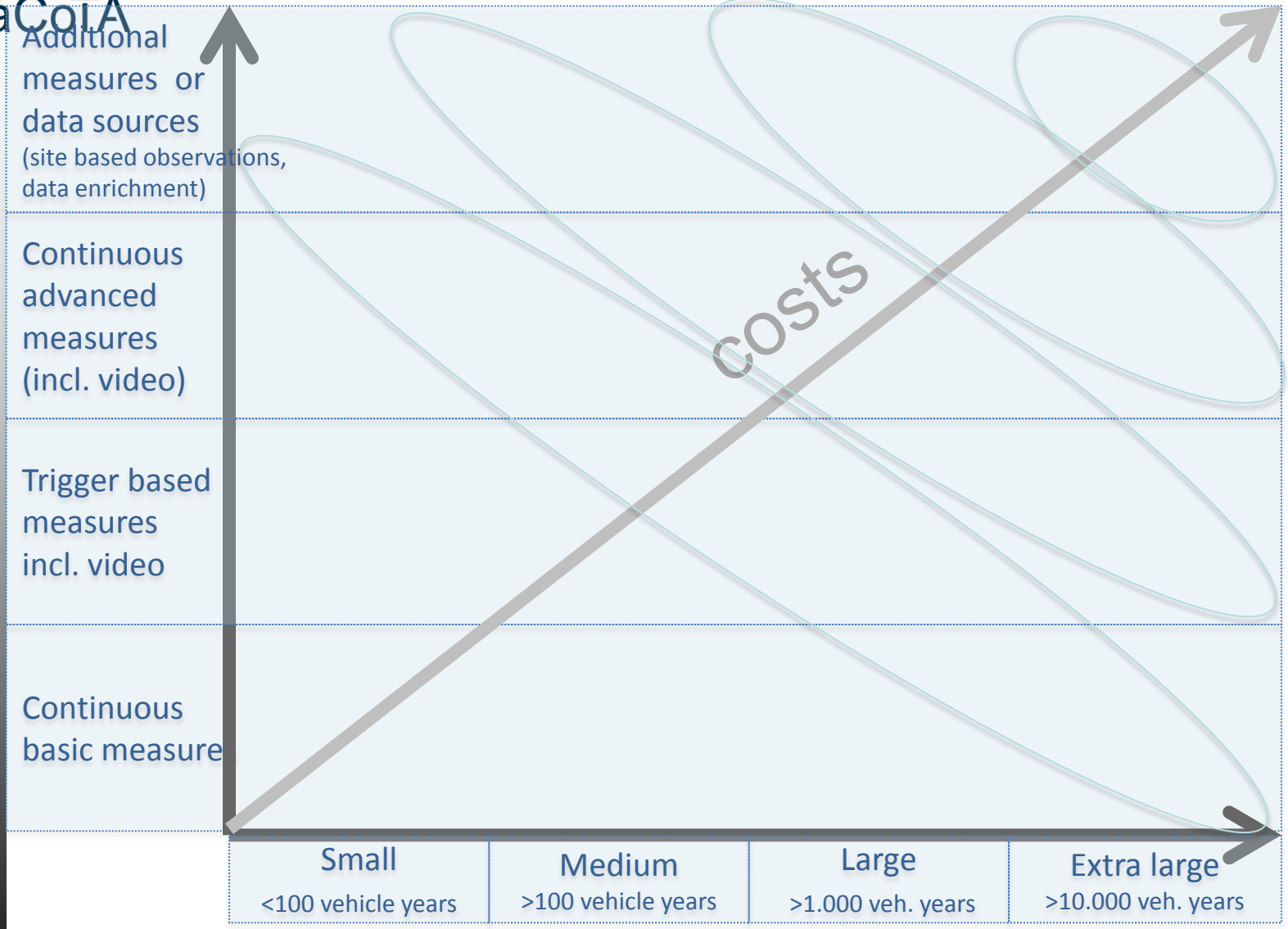
FOT-net, Orlando, October 2011

To Study

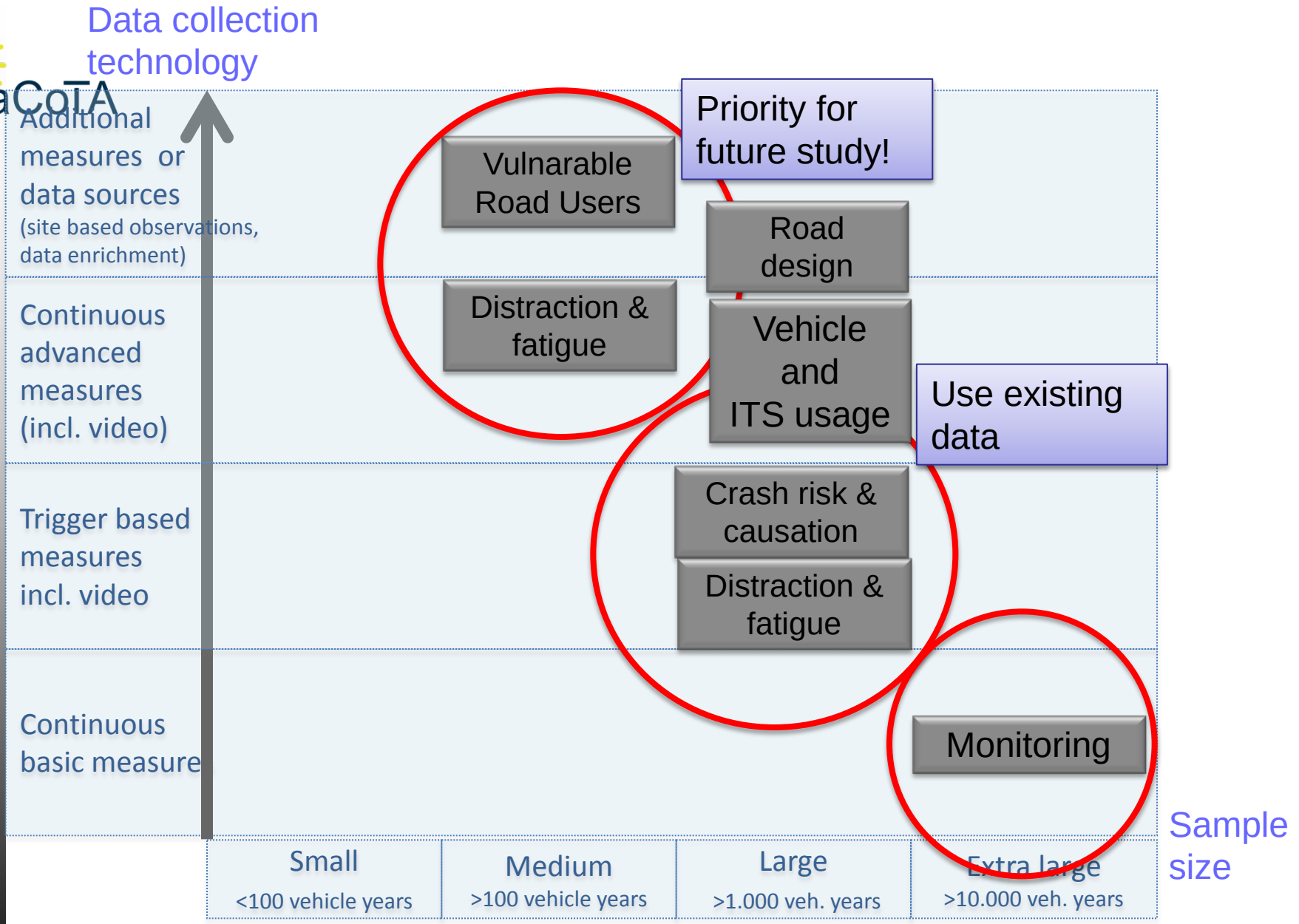
- **Large scale road safety monitoring**
  basic vehicle measures without any video is sufficient
- **Crash risk and crash causation**
  trigger based recording would be valuable
- **Distraction and inattention**
  continuous video data is required
- **Vulnerable road users**
  continuous video data is required and additional data desired
- **Vehicle and its usage**
  continuous video data is required
- **Road design**
  continuous video data is required and data enrichment is desired

DaCoTA

Data collection technology



DaCoTA


Data collection technology
Additional measures or data sources (site based observations, data enrichment)
Continuous advanced measures (incl. video)
Trigger based measures incl. video
Continuous basic measure
Vulnarable Road Users
Priority for future study!
Road design
Distraction & fatigue
Vehicle and ITS usage
Use existing data
Crash risk & causation
Distraction & fatigue
Monitoring
Small
<100 vehicle years
Medium
>100 vehicle years
Large
>1.000 veh. years
Extra large
>10.000 veh. years
Sample size

WP6 - Driver Behaviour Monitoring through Naturalistic Driving Observations

We want

- better data, more data
- more efficient data collection
- better comparability

To

- better analysis, measures, policy

Tasks

1. Definition of Naturalistic Driving observations within ERSO
2. Study Design
3. Small Scale practical study
4. Implementation plan for Large Scale Naturalistic Driving research within ERSO

Timing: task 1 is finished, tasks 2 and 3 drafts finalised by May 2012, task 4 in November 2012

6.1 Monitor normal driving behaviour

Representative sample of drivers / vehicles
unobtrusive, simultaneous measurement

- Risk exposure data (RED)
  - vehicle type (model, year, …)
  - driver type (age, gender, experience, …)
  - trip variables (day, hour, road type, duration, …)
  - map match (GPS locations)
- Safety Performance Indicators (SPI)
  - descriptive (speed)
  - speeding, DRL, protective systems, headway, lane behaviour
- Incidences
  - near crashes, critical situations, successful avoidance?

Near Crashes in DaCoTA

- Full video or triggered video is too costly
  - Only triggers from vehicle parameters
  - Certain types go undetected, because no vehicle reaction is present
  - No verification, high level of trigger values can minimise false positives

  → count of events (+ situation and background of vehicle & driver)
- National: having a set of ND vehicles, equip a subset with additional devices (video) to verify and detect other types of near crashes

Task 6.2 - Study Design

- Small scale design
  - Analysis plan, derive indicators (SPI, RED, NC) from the data by algorithm.
  - Data gathering, reduction, retrieval, cleaning, storage (secured)
  - Database development
  - Ethical issues
- The Study design will use results of the pilots
  - Sampling and weighing, maintenance of the sample

Task 6.2 - Ethical issues

- Liability
  - Mounting DAS may not have any consequences
- Privacy
  - Data protection in the vehicle, during transfer, database storage
  - Insurance when DAS or complete car stolen
- Legal
  - Ownership of data: in case of an incident, authorities may not use ND data as proof

→ **informed consent**, insurance, procedures

Other drivers, passengers, sound, video, also persons outside the vehicle

Participant selection

- Sample size
  - How big is inter-human & inter-vehicle variation?
  - How big is the trip variation of the same participant?
- Country comparisons
  - Equal number or % of drivers?
- Representative sample
  - No requirements on age of driver, vehicle
- Selection bias
  - Ethical issues
  - Annual kilometres
- Sample maintenance (participants grow older)

Data

- Terabytes of data
- Time line; different devices may have different sample frequencies – synchronisation
- Finding an event in the data
- Response times

Focusing on speed SPI

For Safetynet

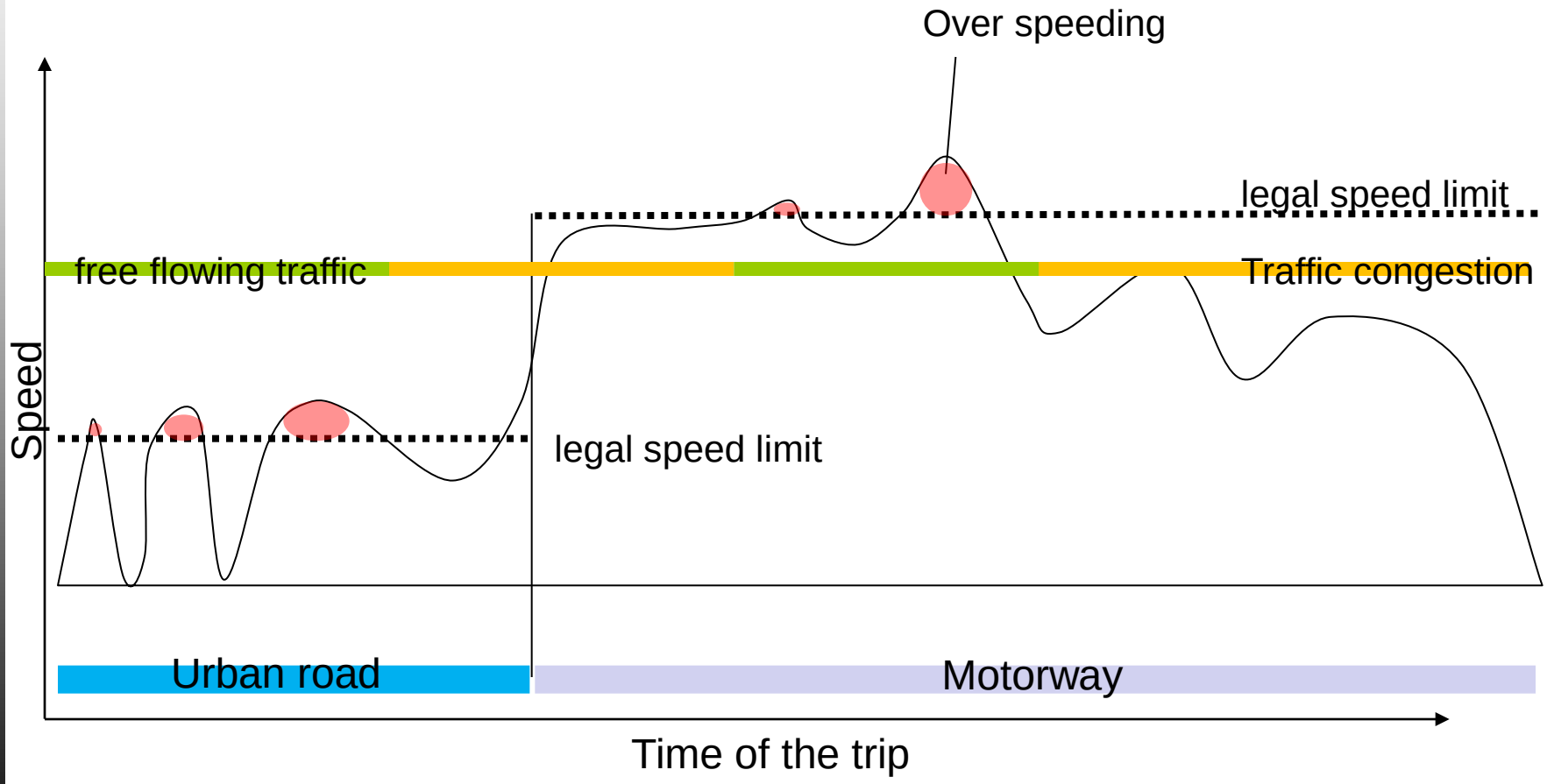
- Data on instantaneous speed of **vehicles at a point**
- A sampling procedure to select a restricted set of **locations** representative of the **network**
- Choice of observation period
- Measure of speed in reasonably free flowing traffic conditions
- Specific speed indicators
- Indicators disaggregation by road type, speed limit, vehicle type, period of day and period of the week

For NDO

- Speed variations **during the trip of a driver**
- A sampling procedure to select a restricted set of **drivers** representative of the **population**
- Choice of observation period
- **Filtering** of the vehicle speed to keep only free flowing conditions
- Specific speed indicators
- Indicators disaggregation by road type, speed limit, driver type, period of day and period of the week

Illustration: ND Data linked to speed

ND Data measured during a specific trip



Task 6.3 Small scale Pilots

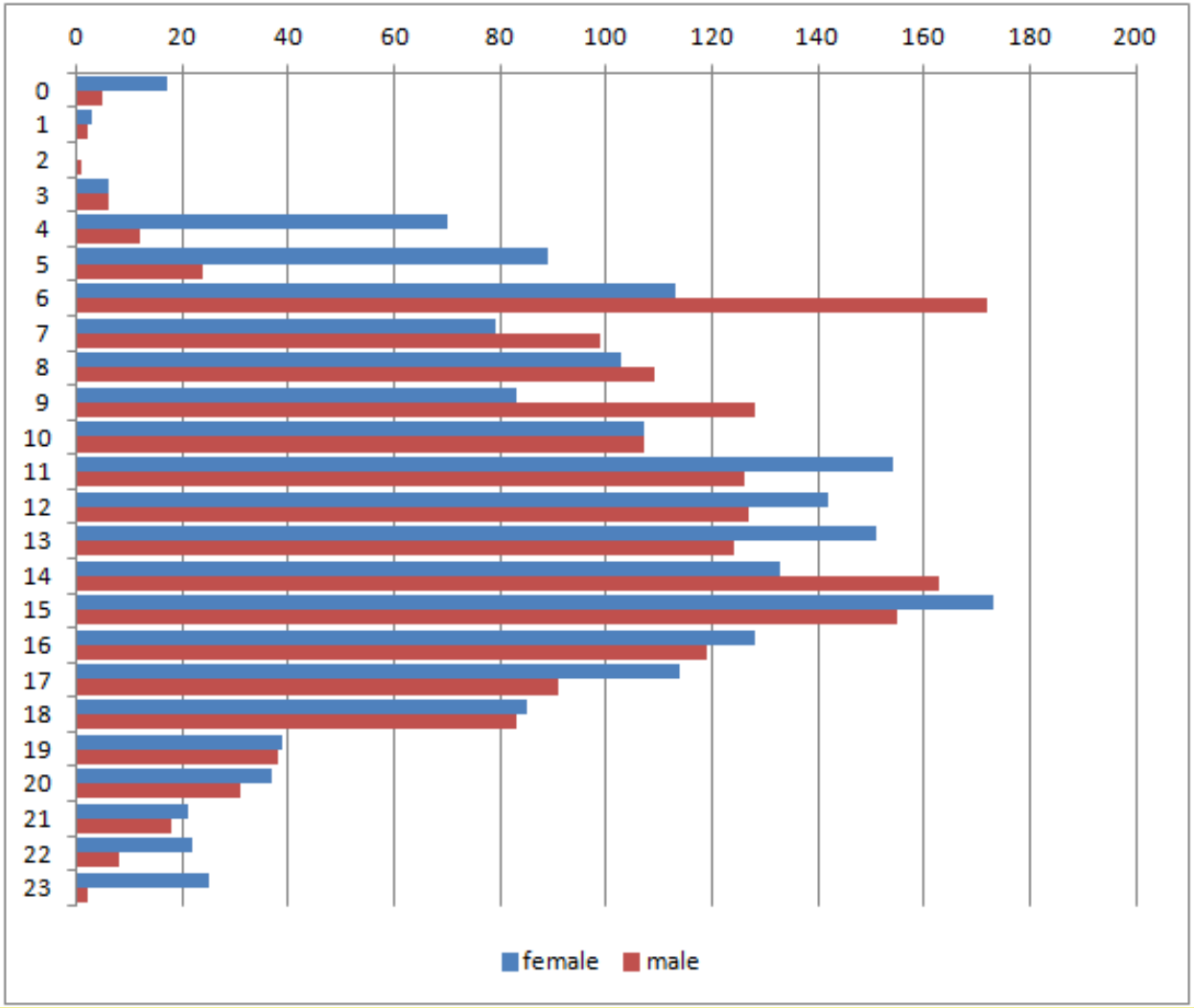
- Feasibility of data gathering, practical and technical
- 2 small scale studies (Austria and Israel)
  - Variables, equipment, ethical issues
  - Each country, 10 car drivers * 6 months
- Collection of
  - Data on speed behaviour, daytime running lights, seatbelt usage, lane keeping, headway
  - Data-logbook of drivers' identification (-10%), trip duration, length, timing, location, stratify road types and vehicle types
  - Certain manoeuvres/parameters as proxy for near crashes
- Additional data collection UK
  - Mobile phone

Methods for data-gathering

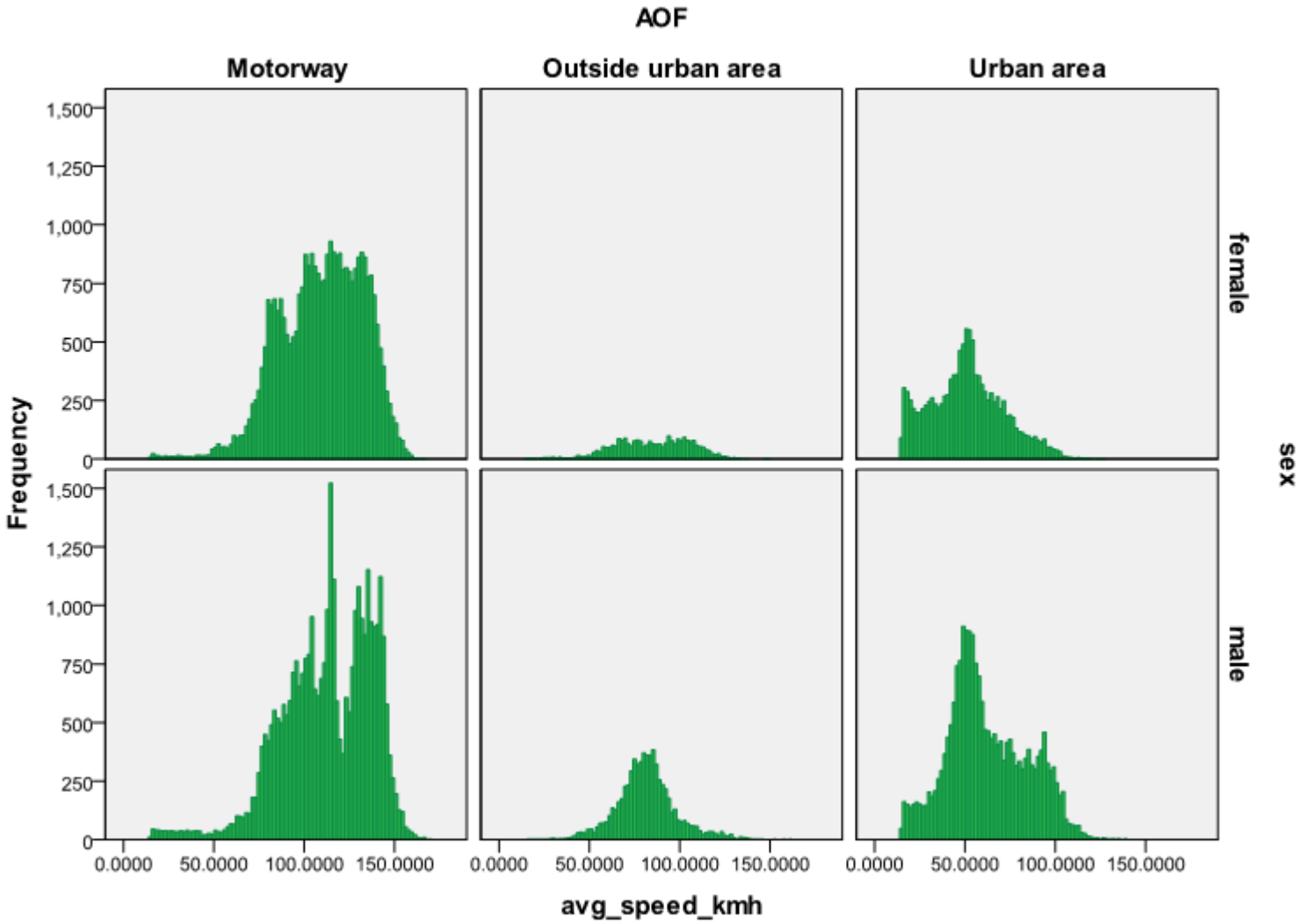
Data acquisition system

- Austria
  - pdrive system®
  - pdrive light
- Israel
  - Greenbox & Mobileye, using TrackTec
  - Various car makes and models
- UK
  - analysis of AT video data
  - smartphone with GPS

Austria: trips over the day by gender



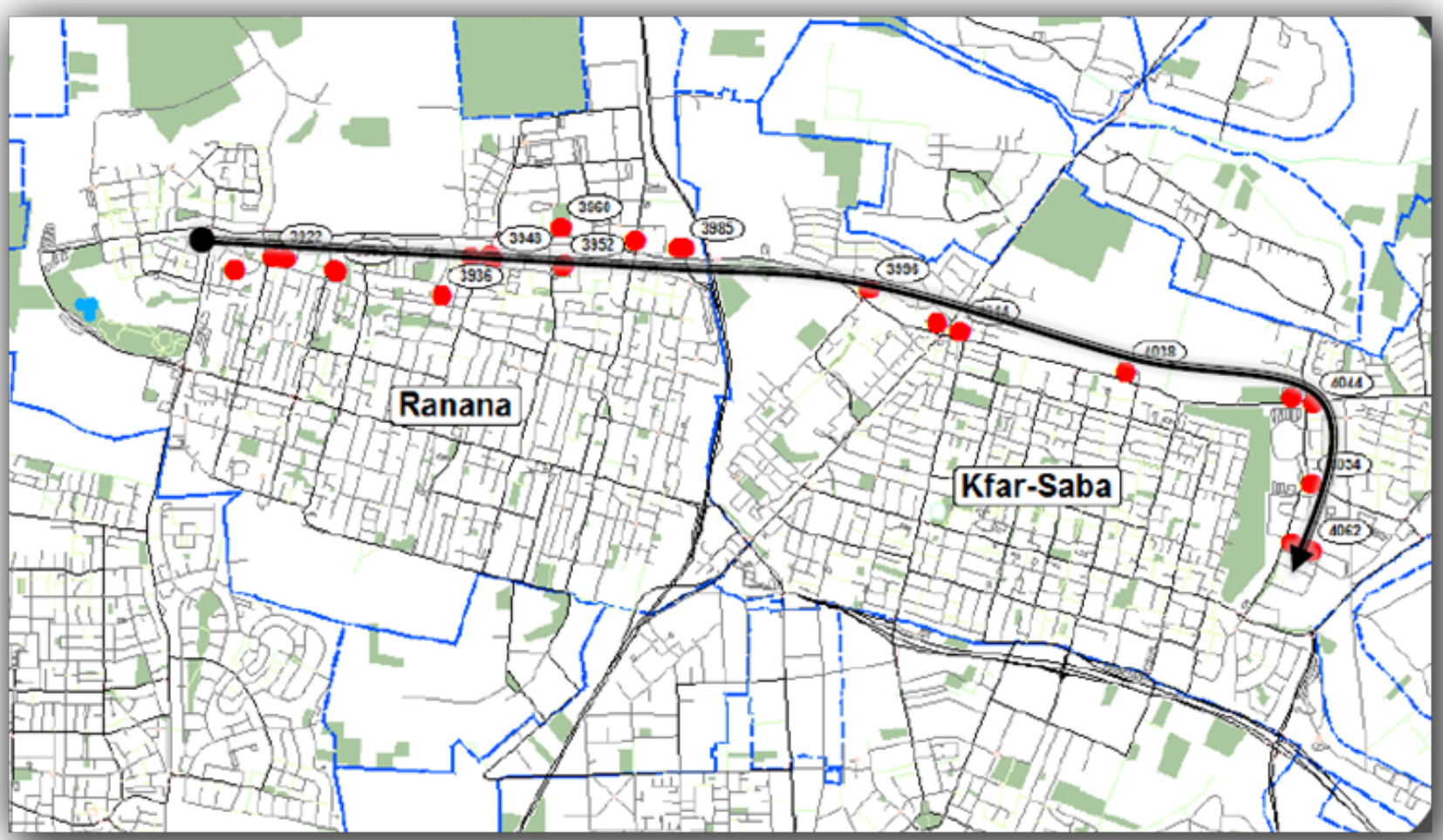
Austria: speed per road type/sex



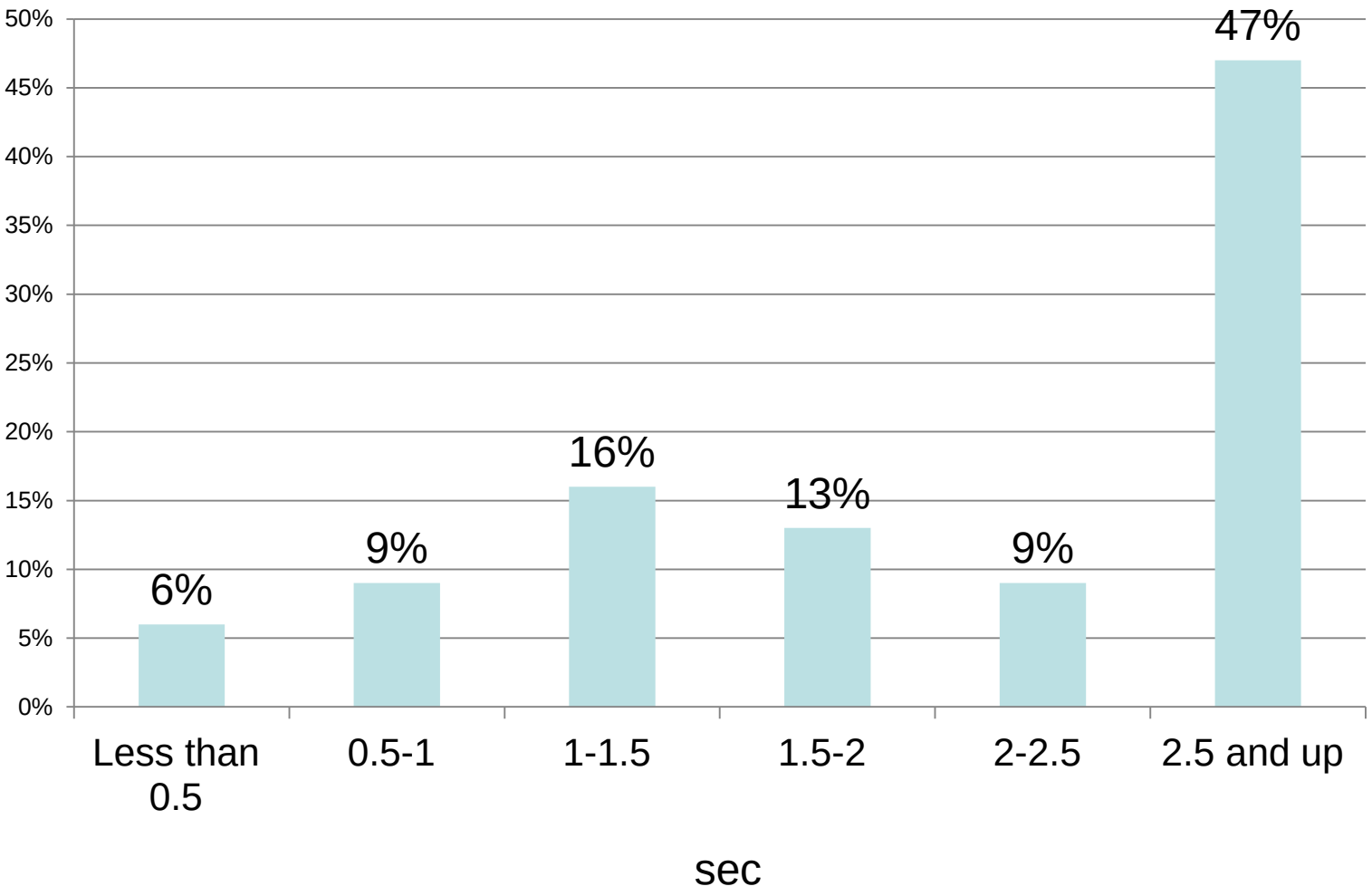
Israel: general results

Time-Based Measurement		**180,499**	**64%**
Event-Base Measurement	**Cut off Warning**	**46,503**	**16%**
	Headway warning	**16,491**	**6%**
	Night and Dusk Indication	**15,234**	**5%**
	Lane Departure Warning	**14,324**	**5%**
	Forward Collision Warning	**8,303**	**3%**
	Light warning	**2,136**	**1%**
Total		**283,490**	**100%**

Israel: road matching



Israel: headway distribution



Differences and “Added value”

- Unique to DaCoTA / ND
  - Continuity of data gathering
  - Scale, representative and comparable
  - Simultaneous measurement
  - Focus on SPIs and Mobility
  - Risky behaviours occur in normal driving
  - Map-matching possible
  - Processing of data into useful safety indicators

Summary

- ERSO = data driven knowledge on road safety in EU
- DaCoTA = use and enhance ERSO
- WP6 = feasibility to fill ERSO with indicators derived from Naturalistic Driving: RED, SPI, NC
  - Monitoring ←→ Research
  - Limited set of near crashes by vehicle triggers
  - Large scale, continuous monitoring, prevalence of risky behaviour
- Technically it is feasible; profit ← → investment
- Follow up after 2012?

DaCoTA

Thank you for your attention

More information on
www.dacota-project.eu

Name	**Niels Bos**
Email	Niels.Bos@swov.nl
Organisation	SWOV
Address	Duindoorn 32,
Leidschendam	The Netherlands
Tel.	+ 31 70 3173 313