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Measuring Risk Exposure Worldwide

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Presentation Outline

- Initial Considerations
- Overview of exposure data used worldwide
- International Initiatives
  (SafetyNet, Dacota, IRTAD)
- IRTAD Survey 2016
- Concluding Remarks

Initial Considerations

- Road Safety is a typical field with high risk of **important investments not bringing results**.
- Absence of **monitoring** and accountability limits seriously road safety performance.
- Decision making in road safety management is highly dependent on appropriate and **quality data**.
- Very often we look where the data are and **not where the problems** and solutions are.

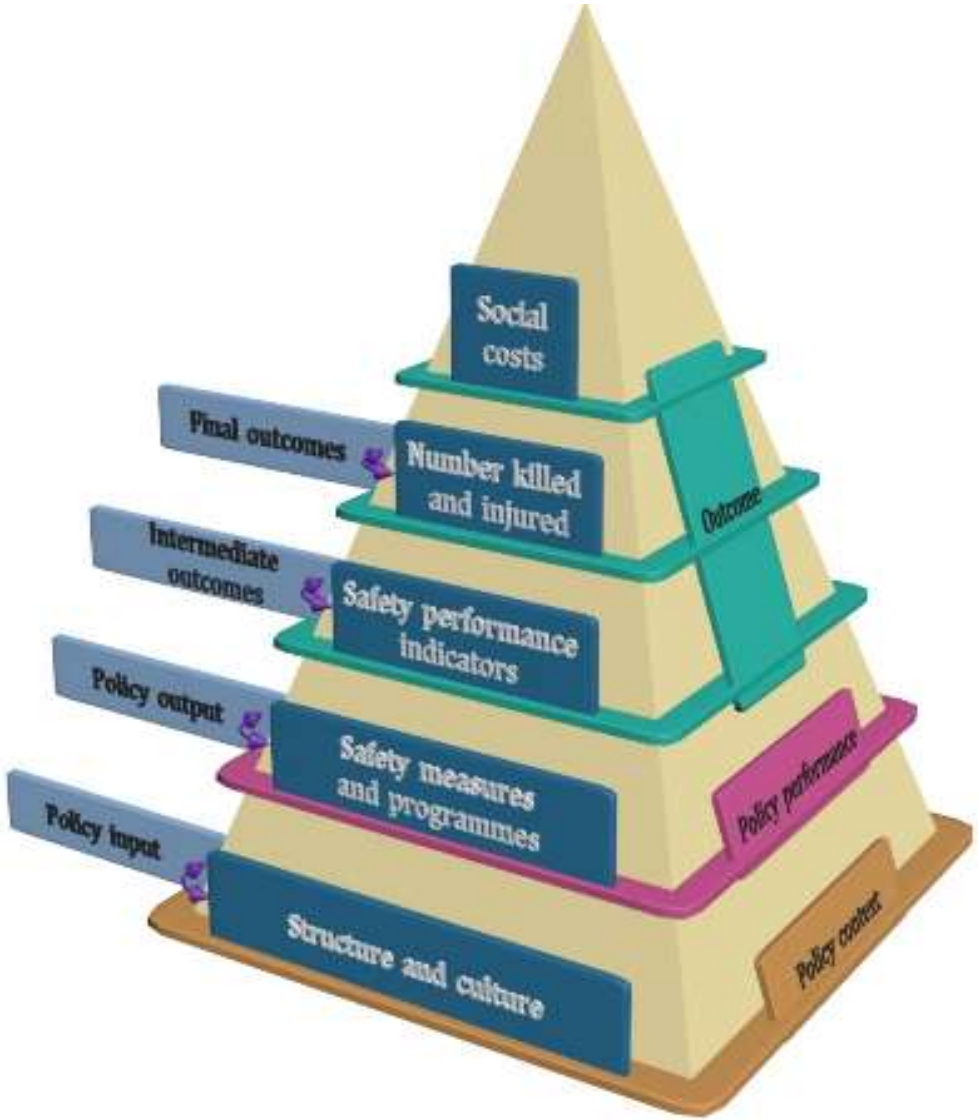
Data needed for Road Safety Decision Support

- Data to identify the problems
  - Accident data
  - Risk exposure and performance indicators

- Data to identify the solutions
  - data on measures implementation
  - data on measures effectiveness

- Macroscopic data
  - for the whole population
  - for a city, region, country, globally

- Microscopic data
  - driver, passenger pedestrian behaviour and performance
  - junction, road segment, small area performance
  - specific accident analysis data



Critical road safety data properties

- Accident data are meaningful only if they are combined with **exposure data** (accidents per km driven, per traffic characteristics, per time, etc.)
- Accident causalities are revealed when accidents are correlated with **safety performance indicators** (behaviour, infrastructure, traffic, vehicles)
- The **evaluation of safety measures** effectiveness provides valuable information, necessary for matching problems with solutions (only through appropriate accident and exposure data)
- Analysis of **high resolution** accident and exposure data reveals hidden and critical accidentg properties

The importance of measuring Risk Exposure Data

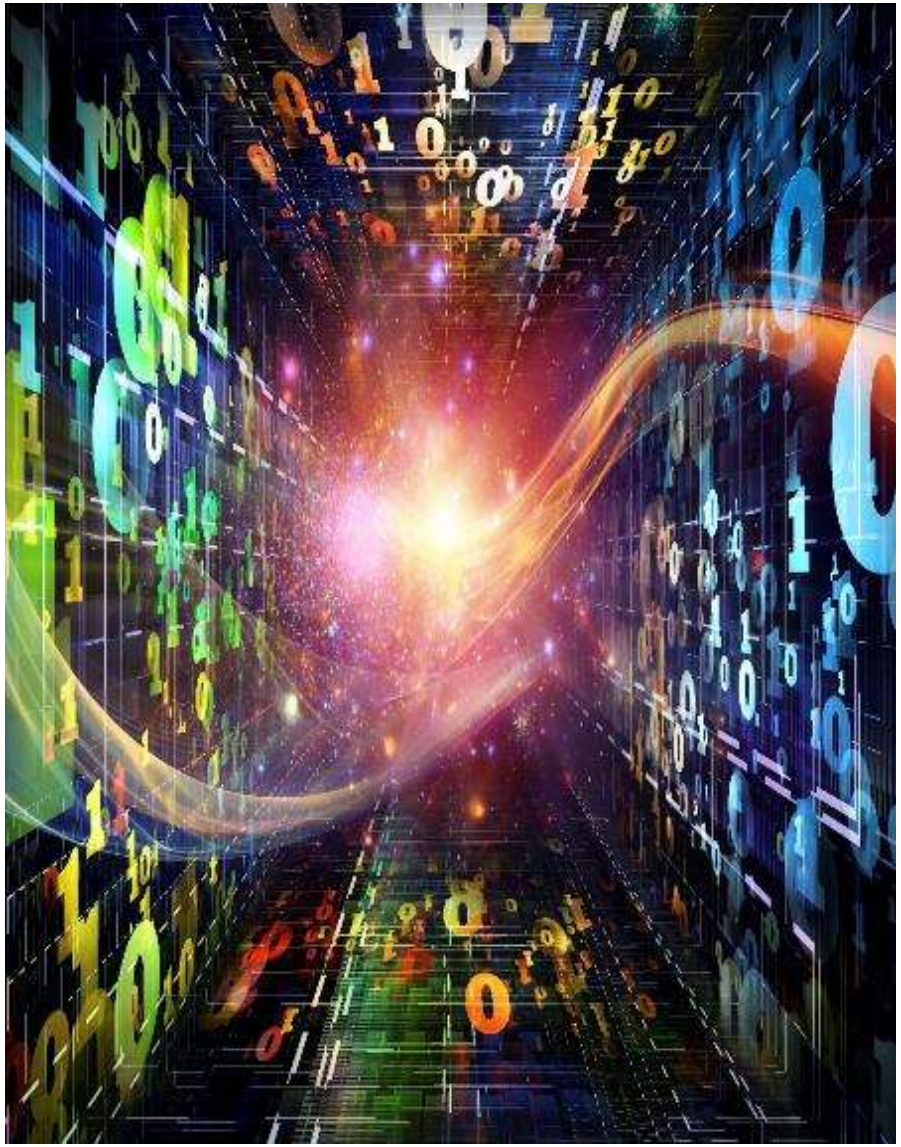
- **Exposure data** are used in order to obtain risk estimates, which are defined as the probability of being involved in a road accident.

- **Risk figures** are calculated as the number of accidents (or casualties) divided by the amount of exposure of a road user population over a time period.

- Risk figures may be **used for different purposes**, e.g. monitoring road safety problems, in-depth road accident analyses and research, road and traffic operations analyses, epidemiological analyses, international comparisons, etc.

Overview of exposure data used worldwide (1/2)

RED to collect	**Source of data**
• Population	Register/Census
• Vehicle fleet	Register
• Length of roads	Register
• Area of the country	
• Licensed drivers	Register
• Fuel sales	Commercial, tax
◦ Fuel supply	
◦ Fuel consumption	
• Vehicle kilometers	Roadside counts/Odometer readings
• Person kilometers	National Travel Surveys
• Number of trips	National Travel Survey



Overview exposure data used worldwide (2/2)

Properties of the analysed measures of exposure.

Measure of exposure	Unit		Analysis context								
	Traffic	Persons at risk	Traffic	Mobility	Road operations	Vehicle industry	Driver training	Epidemiology	Temporal variation	Regional variation	
Vehicle – kilometres	•	•	•		•				•	•	
Person – kilometres											
Road Length	•		•		•					•	
Fuel consumption	•	•	•			•			•		
Vehicle Fleet	•		•			•					
Population		•						•		•	
Driver population		•	•				•	•			
Number oftrips	•	•	•	•	•				•	•	
Time in traffic		•	•						•	•	

Measure of exposure	Disaggregation				Accuracy/errors			Other possible bias	Optimal use
	Road User category	User characteristics	Vehicle characteristics	Road characteristics	Sampling	Non-response	Measurement		
Vehicle – kilometres		•	•	•	•	•	•		
Person – kilometres									
Road Length				•				Economic influences	Developping countries
Fuel consumption			•					Pricing differences, vehicle efficiency	Aggregate level
Vehicle Fleet			•						When average distance travelled is the same
Population	•	•			•			Foreign population	Comparing health hazards
Driver population		•						Licensing framework	When average distance travelled is the same
Number oftrips	•	•	•	•	•	•	•		When average trip length and speed are the same
Time in traffic	•	•	•	•	•	•	•		

E. Papadimitriou et al. / Accident Analysis and Prevention 60 (2013) 371– 383

Risk Exposure Data - Dissagregation levels

- **Vehicle-kilometres**
  - vehicle type and age
  - by road type and area type
  - driver age and gender
- **Person-kilometres**
  - person class,
  - person age and gender
  - experience
  - nationality
  - vehicle type and age)
- **Driver population**
  - driver age and gender
- **Population**
  - age and gender
- **Vehicle fleet**
  - vehicle type
  - vehicle age
- **Road length**
  - road type and area type
  - region

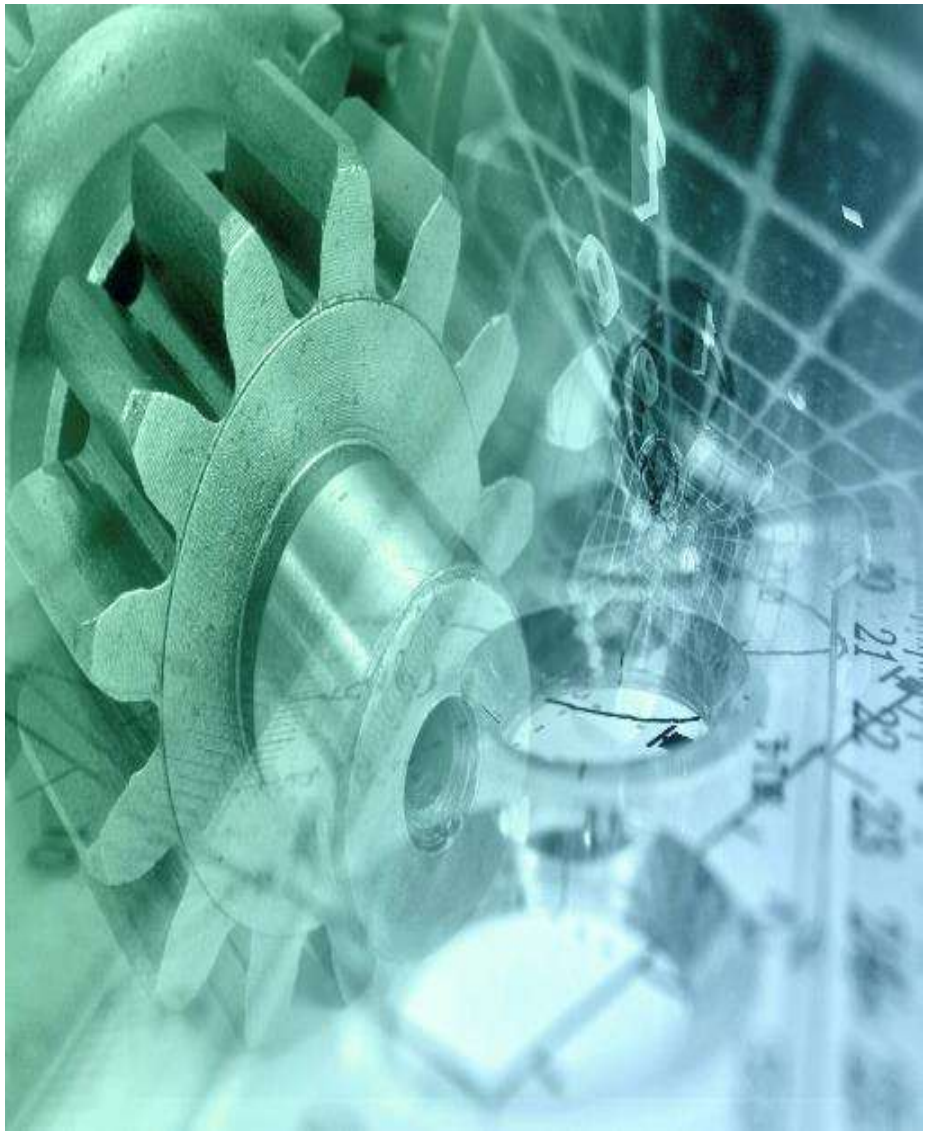
Data collection methods (1/2)

Surveys

- **Sampling issues** have to be tackled, e.g.:
  - age range, residents, survey days, boundary, stages or units, time or distance, min or max length of trip, commuting only etc.
- **Methodological issues** as systematic or random errors, one-day or multiple days, mobile persons only, panels, one person or household.
- Particular **short travels** (walking, cycling) may be underreported
- **Household activity surveys** are complex and costly to undertake.
- Household activity surveys **reflect personal travel** not the total number of vehicles on the road.

Traffic counts

- Not suitable to distribute exposure according to **person characteristics**
- Measurement points **may not be representative** of the national/regional traffic
- Problems may also be encountered in **vehicle classification**
- **Permanent traffic counters**: expensive installation and maintenance costs, limited road network coverage.
- **Seasonal traffic counters**: lack continuous observation to update changes in traffic on a regular basis



Data collection methods (2/2)

Vehicle and driver registers

- Data from such databases are known to **lead to some overestimations**:
  – Scrapped vehicles not removed from the files
  – Deceased drivers not removed from the files

Road registers

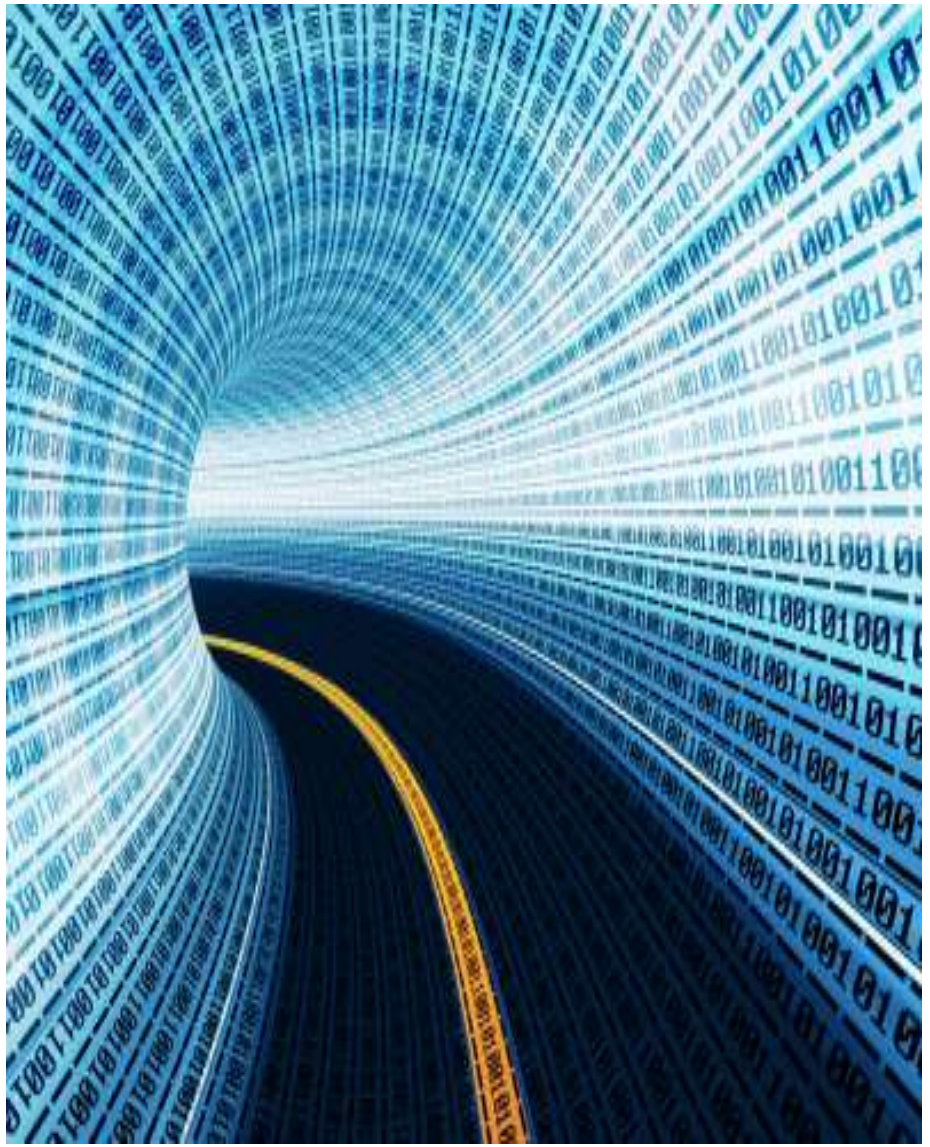
- The available information **concerns the main road** (motorways, national and rural roads etc.)
- Information on roadway geometry and regional/local road length is less available

Odometers

- Odometer readings **cannot be used at a small scale**, as travel by a vehicle is typically not restricted to the municipality that it is registered in.

Fuel sales

- Fuel sales data for a region combined with an estimate of the average fuel consumption of the fleet in the region can be used to estimate VKT for that region.
- The **smaller the region the less accurate this methodology** becomes.



International initiatives on risk exposure data

- "**SAFETYNET – The European road safety observatory**" of the sixth framework programme on transport research of the European Commission (2004-2008).

- "**DACOTA – Road Accident Data Collection Transfer and Analysis**" of the seventh framework programme on transport research of the European Commission (2010-2012).

- **IRTAD Sub Group on risk exposure data,** of the Joint Transport Research Centre of the Organisation for Economic Cooperation and Development and the International Transport Forum (Nineties-, 2016-)

SafetyNet project

- The purpose was to **assemble a new EU-based framework** for the collection and dissemination of road accident and injury data and associated information, in order to create a road safety Observatory at European level.

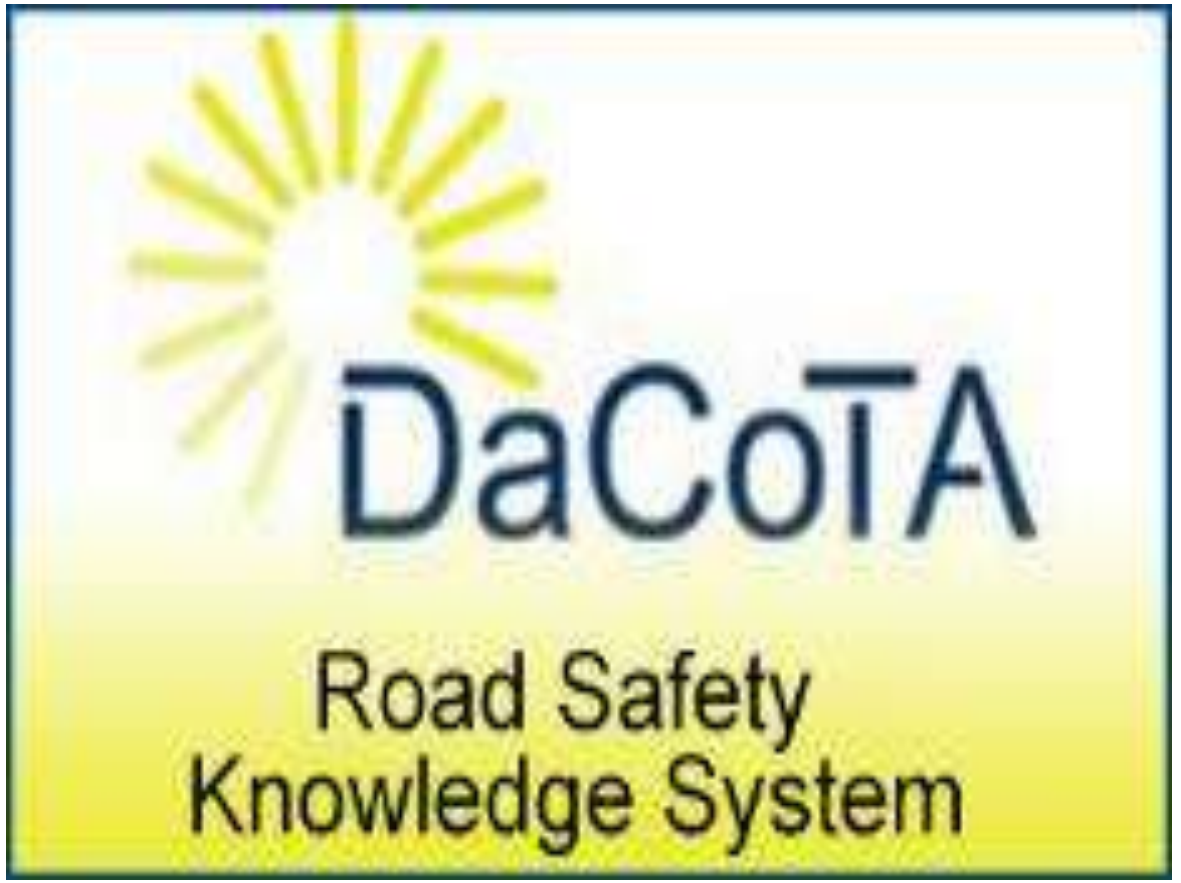
- Several **basic types of road safety data** were included: national level data, exposure information, road safety performance indicators, in-depth data and information on safety related rules.

- A dedicated Work Package on **Risk Exposure data** and another one on Performance Indicators

DaCoTA project

- The purpose was to **develop and implement new approaches to gather, structure and apply policy-related safety data** that can be incorporated within the European Road Safety Observatory (ERSO).

- DaCoTA developed and validated (among others) a **common methodology to record and analyse the behavioural and exposure data**.



Subgroup of IRTAD on risk exposure data

- **IRTAD** is an international group of road safety experts and statisticians, operated by the Transport Research Centre of the International Transport Forum at the OECD.

- A **new sub-group** was launched in 2016 to work on exposure data and is expected to provide important input through its deliverables.

- 3 working meetings of the sub-group have been held in which knowledge on **exposure data collection and analysis methodologies** has been exchanged.

IRTAD exposure data subgroup

- A **survey** was conducted on national data sources in 2016.
- Responses were received from **10 countries** (Belgium, Finland, France, Germany, Great Britain, Greece, Israel, Korea, Netherlands, Sweden)
- All countries have carried out **national travel surveys**, while only two have national mobility panel (Germany, Netherlands).
- All countries using **traffic counts technology**, have available traffic volume statistics and vehicle inspection data. Only Germany has carried out mileage survey.
- All countries have **vehicle registration data**. Insurance data are used only in few countries.
- All countries have available **population and driving licences data**, while only Great Britain dispose driving test statistics.

National approaches - Korea

- VKT data collection by **vehicle inspection**
- In 2015, **8,9 million valid samples** were selected from the inspection records (43,3% of all registered vehicles)
- The **daily average vkms** from the previous inspection until the last inspection of the vehicle is used.
- A **weighted value** is calculated by vehicle type, purpose of use, fuel of vehicle
- **Annual VKT**: multiplying the daily average vkm by 365 days and the sum of the individual vehicle value applied the weight value is the VKT for a year for all registered vehicles.
- Available VKT data for 2012-2015.

National approaches – Canada (1/2)

- **Vehicle survey** 2004-2005
- Survey **Population**: all motor vehicles registered in Canada at any time in 2005
- Buses, motorcycles, off-road vehicles and special equipment excluded
- **Sample** from the 10 provinces: 21.915 vehicles for the four quarters of 2005.
- A **two-stage sample design**:
  - All vehicles from the survey population are stratified into 78 strata according to vehicle type, jurisdiction and vehicle age. A systematic sample of vehicles (first-stage sample) is selected from the survey population.
  - In the second stage, a first reporting day within the quarter is randomly assigned to each vehicle that had been selected in the first stage.
- **Computer-Assisted Telephone Interview** (CATI) for the registered owners.
  - vehicle type
  - fuel type used
  - distance driven the previous week
  - some information about anticipated vehicle use during the following six weeks
  - current odometer reading
  - some vehicle maintenance information
  - some information on the household characteristics.

National approaches – Canada (2/2)

- Respondents are then asked to complete a **trip log**, providing information for 20 consecutive trips for light vehicles and all trips for heavy vehicles
- The following **information is recorded for each trip**:
  - start and stop dates and times;
  - start and stop odometer readings;
  - starting point and destination (light vehicles) or trip purpose (heavy vehicles);
  - number and age group of passengers (light vehicles) or number of passengers at the start and end of the trip (heavy vehicles);
  - gender and age group of the driver;
  - total cost, per unit cost and amount of fuel purchased;
  - distance travelled on roads with posted speed limit of 80 km/h or more;
  - truck configuration (heavy vehicles); and
  - dangerous goods (heavy vehicles).

Results

- Vehicle kms, Passenger kms, Fuel consumption
  - Vehicle fleet analysis
  - Geographic Analysis
  - Light Vehicles
  - Heavy vehicles
  - Trip analysis

National approaches - Finland

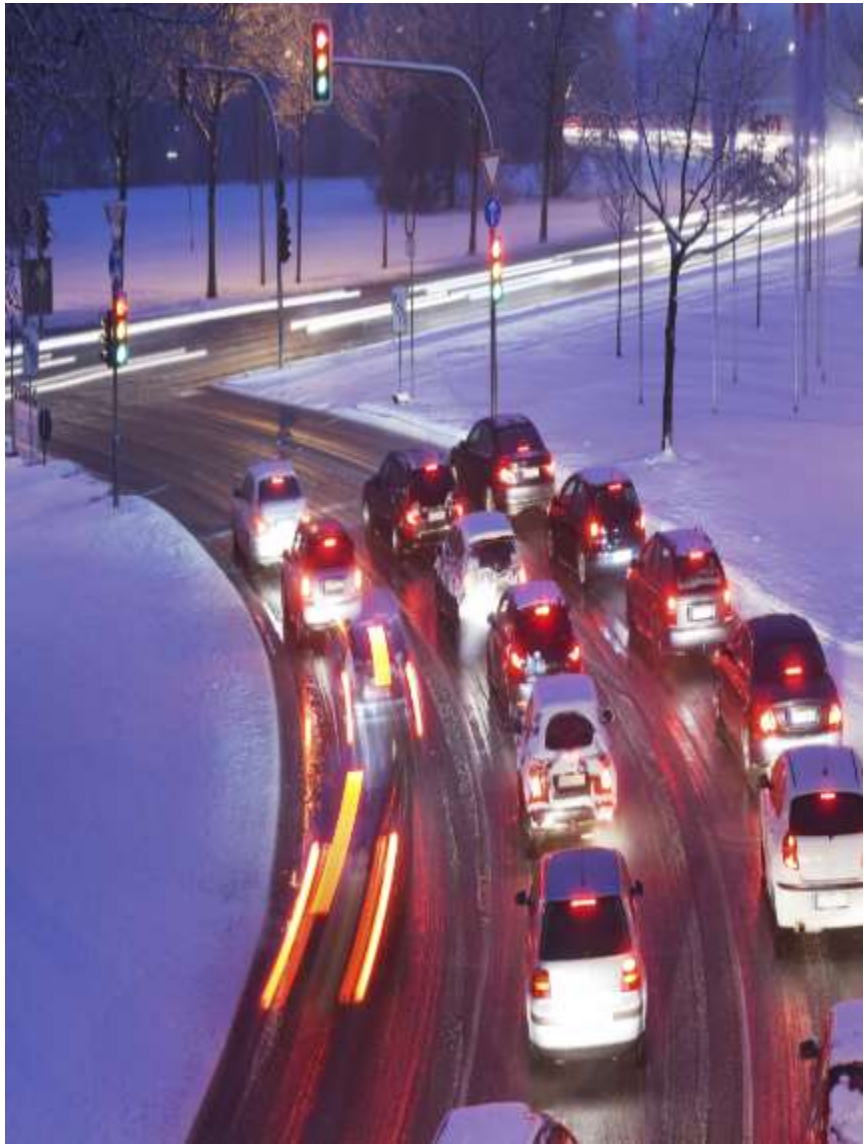
- Finnish **National Travel Survey**
- **12.000 Finns by telephone** from June 2010 to May 2011
- The **sample size** for one study day was 60-62 persons

Results

- Total trips per day and by transport mode (passenger car/non-motorised/public transport)
- Total travel distance per day and by transport mode
- Total travel time per day and by transport mode
- Total trips and travel distance per day by purpose of trip
- Trip destinations
- Children's range of mobility
- Mobility depending on living area

National approaches - Norway

- **National Travel Survey** from June 2013 to October 2014
- **60.000 persons** older than 13 years old were interviewed by telephone
- Cross-sectional survey (time method)
- The interviews were done on **two samples**:
  - The main sample: About 10.000 interviews distributed proportionally across the counties on the basis of population.
  - Regional supplements: Supplementary interviews in specific regions
- **Gross sample**: 309.000 persons
- **Net sample**: 61.400 persons
- **Response rate**: 20%
- The data material is **weighted** by gender, age, weekday and geography.



National approaches - Netherlands

1. Dutch **National Travel Survey** (OViN)
   - Sample size 40.000 respondents per year
   - Cross-sectional data collection

2. **Mobility Panel** (MPN)
   - Web-based longitudinal travel data collection
   - In July 2013, respondents from 2.500 households recorded their travel data using a **three-day travel diary**.
   - Repeated at least annually with the same respondents over the following four years.
   - Sample selection was drawn from an existing access panel.
   - Determine the short-run and long-run dynamics in the travel behavior

Comparison of National Travel Survey and Mobility Panel
Netherlands

- **Advantages of travel diary**:
  - self-completion
  - web-based
  - three-day
  - place-based (combination of activity-based and trip-based diary)

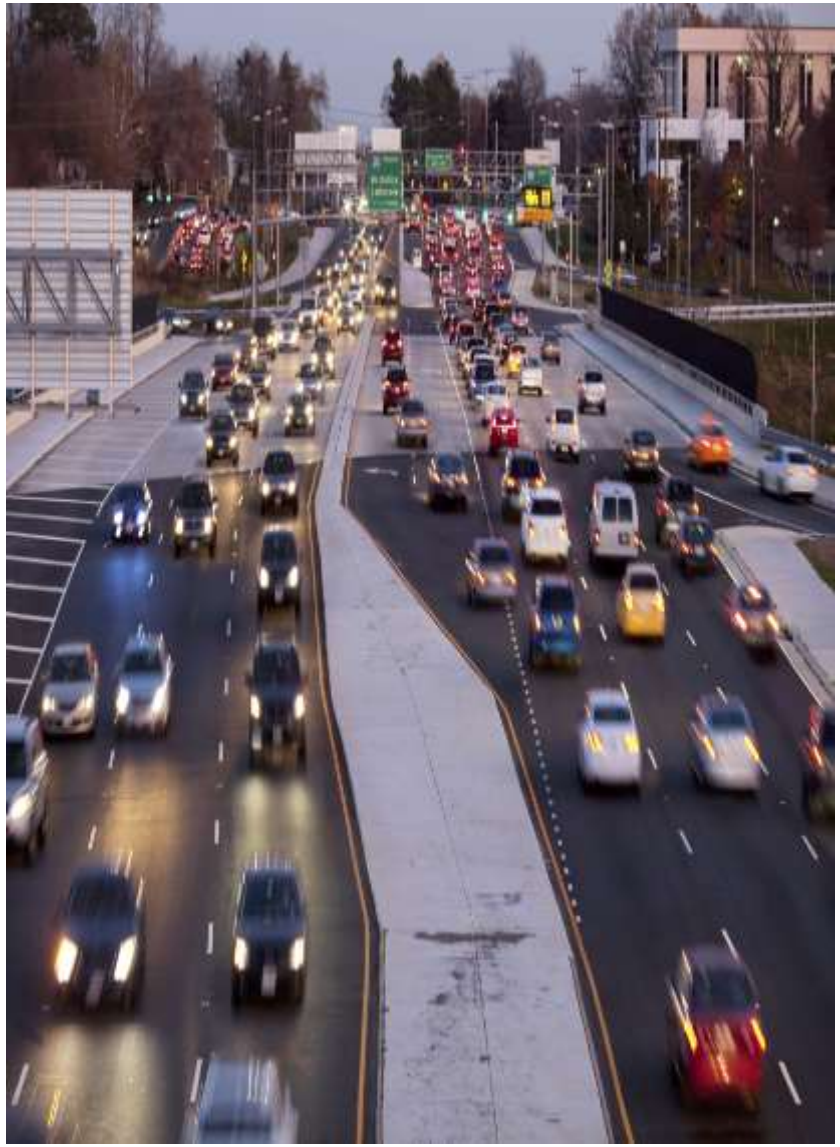
- **Disadvantages of travel diary**:
  - diary fatigue may increase during research period leading to underreporting of trips
  - non-home-based and infrequent are the first trips to be forgotten
  - web-based data collection introduces a selection bias

- **Cross-sectional data collections**: changes in travel behavior on an individual level cannot de determined

- **Day-to-day variations** in trip and response characteristics were determined from MPN

National approaches – Great Britain

- **National Travel Survey** 2016
- 6.656 households via **interviews and a 1-week diary**
- An additional 672 households participated **only in the interviews**
- Data only from interviews cannot be used for trip-level analysis
- For **estimates of households, individuals and vehicles**, unweighted samples of under 100 are not used, while samples of under 300 are used cautiously.
- For **trip and stage estimates**, samples of under 300 are not used, whilst samples of under 1.000 are used cautiously.
- Figures **below national level** require several years data to be combined
- **Measures**: person kilometres, number of trips, time in traffic



Results

- Miles and number of trips per person by transport mode, car occupancy, gender, age, personal car access, trip purpose
- Details in accident involvement and injuries sustained
- Bicycle and walk trips by age and gender
- Trips to and from school per child per year per mode
- Average trip time and length by transport mode and trip purpose
- Average time spent travelling and distance travelled by mode and trip purpose
- Frequency of use of different transport modes

Walk 21 – An example for measuring walking

- International organization **supporting and promoting walking**
- **Five key performance indicators** identified for measuring walking:
  - Share of people who have made at least one walking stage on the survey day (Whole population)
  - Average number of daily walking trips per person (Whole population/mobile persons)
  - Average daily time walked per person (Whole population/mobile persons)
  - Average daily distance walked per person (Whole population/mobile persons)
  - Mode share of walking based on stages, main mode, time, and distance

Optimal measuring risk exposure

- The most appropriate measures of exposure are **vehicle- and person-kilometres of travel.**
- Because of the difficulties in the their data collection, **registers of vehicle fleet, driving licenses and roads** are used to represent exposure.
- **Mixing survey modes**, e.g. using a supplementary web-survey or automated tracking of cars in addition to a traditional trip diary would mitigate the shortcomings of individual survey modes.
- Collect **travel information on multiple days** is recommended compared to the cross-sectional one-day travel survey, in order to capture variability of travel behavior.
- Both **mode and purpose of the trip** should be captured from the surveys, eliciting mode use information for different stages of trips.
- **Merge travel survey data as much as possible to vehicle registers** based on license numbers, technical control registers in order to obtain information on vehicles characteristics.

Concluding remarks

- The most appropriate measures of exposure are **vehicle and person-kilometers** travelled.
- **Disaggregation** of exposure data is critical and it should be compatible to the accident data collected.
- Appropriate **sampling** is budget dependent
- There is an extra need for data and risk indicators concerning **Vulnerable Road Users**.
- **Combining data collection methodologies** may lead to more accurate exposure data.

Future challenges

- **Digitalisation** opens great new possibilities for the collection of risk exposure data
- **Big data** from mobile phones, wearables and on-board diagnostics can produce a unique wealth of exposure data (pending commercial, privacy and security issues)
- New **increased net present value** of road safety data, available for early problem detection and prompt and customised decision support

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