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 accident 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)

<table>
<thead>
<tr>
<th>RED to collect</th>
<th>Source of data</th>
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<tbody>
<tr>
<td>Population</td>
<td>Register/Census</td>
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<tr>
<td>Vehicle fleet</td>
<td>Register</td>
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<td>Length of roads</td>
<td>Register</td>
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<td>Area of the country</td>
<td>Register</td>
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<td>Licensed drivers</td>
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<td>Fuel sales</td>
<td>Commercial, tax</td>
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<td>• Fuel supply</td>
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<td>• Fuel consumption</td>
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<td>Vehicle kilometers</td>
<td>Roadside counts/Odometer readings</td>
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<td>Person kilometers</td>
<td>National Travel Surveys</td>
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<td>Number of trips</td>
<td>National Travel Survey</td>
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</table>
### Overview exposure data used worldwide (2/2)

<table>
<thead>
<tr>
<th>Measure of exposure</th>
<th>Unit</th>
<th>Analysis context</th>
<th>Temporal variation</th>
<th>Regional variation</th>
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<tbody>
<tr>
<td></td>
<td>Traffic</td>
<td>Persons at risk</td>
<td>Traffic</td>
<td>Mobility</td>
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<td>Vehicle – kilometres</td>
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<td>Person – kilometres</td>
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<td>Road Length</td>
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<td>Time in traffic</td>
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### Properties of the analysed measures of exposure.

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<tr>
<th>Measure of exposure</th>
<th>Disaggregation</th>
<th>User characteristics</th>
<th>Vehicle characteristics</th>
<th>Road characteristics</th>
<th>Accuracy/errors</th>
<th>Other possible bias</th>
<th>Optimal use</th>
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<tbody>
<tr>
<td></td>
<td>Road User category</td>
<td>User characteristics</td>
<td>Vehicle characteristics</td>
<td>Road characteristics</td>
<td>Sampling</td>
<td>Non-response</td>
<td>Measurement</td>
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<td>Vehicle – kilometres</td>
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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:
  - Scraped 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


• “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.
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 be 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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