FOT-NeT
NETWORKING FOR FIELD OPERATIONAL TESTS

www.fot-net.eu

Impact Assessment

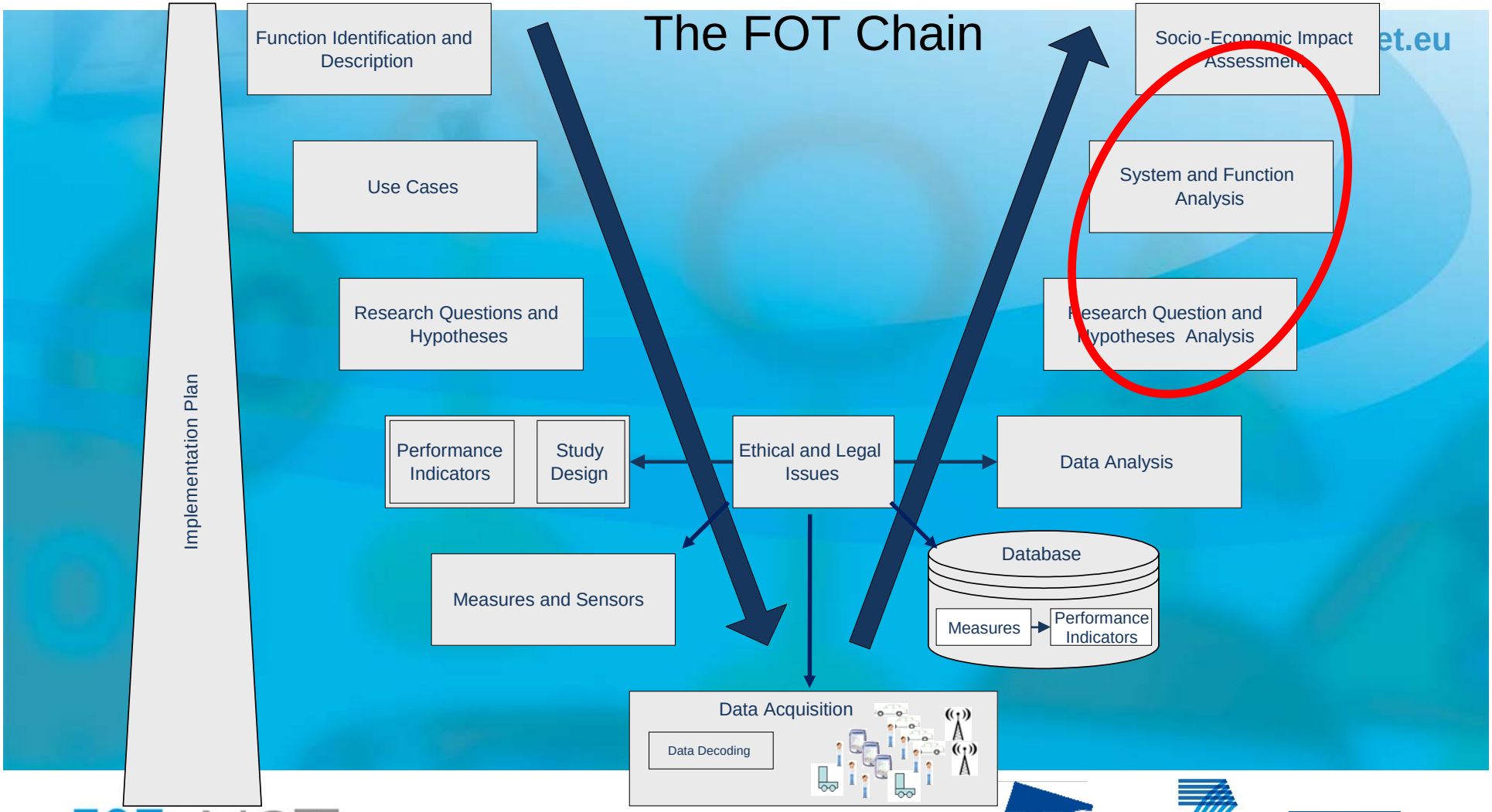
FOT-Net seminar Data Analysis and Impact Assessment

Eline Jonkers and Kerry Malone
TNO

5 October 2010, London

SEVENTH FRAMEWORK PROGRAMME

Where are we?


The FOT Chain
Implementation Plan
Function Identification and Description
Use Cases
Research Questions and Hypotheses
Performance Indicators
Study Design
Measures and Sensors
Ethical and Legal Issues
Socio-Economic Impact Assessment
System and Function Analysis
Research Question and Hypotheses Analysis
Data Analysis
Database
Measures
Performance Indicators
Data Acquisition
Data Decoding

iCars can be a useful reference

- Produced catalogue of impact assessment methods
  - **Inventory of methods**
  - **Based on earlier studies**
  - **Validation of the impact assessment studies**
- 14 methods representing six impact areas
- Indicates relevance of method for impact area and lifecycle stage
  - **Efficient method combinations**

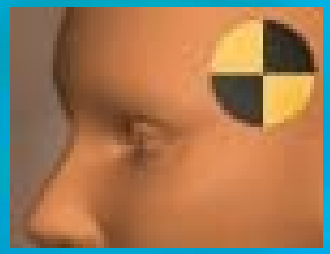
- Catalogue available on http://www.icarsnetwork.eu

What is the goal of the Impact Assessment?

- Draw conclusions about what the effect of the tested system is on
  - **Safety**
  - **Traffic efficiency**
  - **Environment**
  - **User acceptance**
  - **Personal Mobility**
  - **Policy**
  - **Business models**
  - **Etc.**

Impacts needed in Cost Benefit Analysis

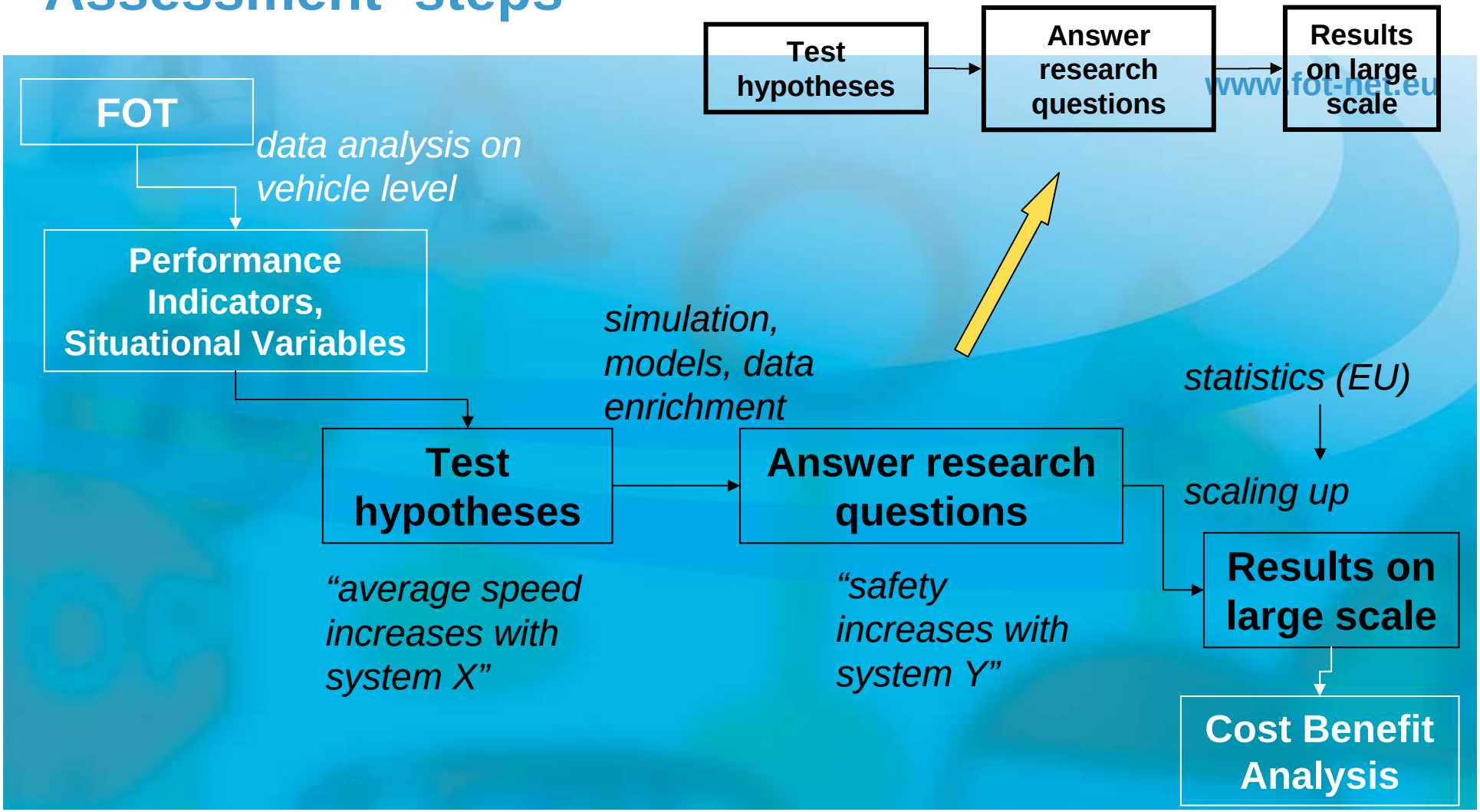
- Traffic efficiency:
  - **travel time costs: changes in travel times**



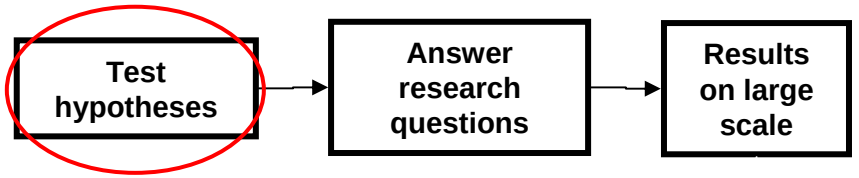
- Safety:
  - **accident costs: changes in no. of accidents (with fatalities, injuries, property damage only)**

- Environment:
  - **environmental costs: changes in emissions of NOx, PM10, CO2 (and other pollutants), noise**

Overview of FESTA Impact Assessment steps



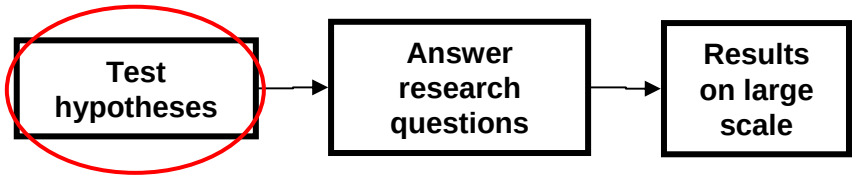
Testing hypotheses



- Using FOT data: performance indicators and situational variables

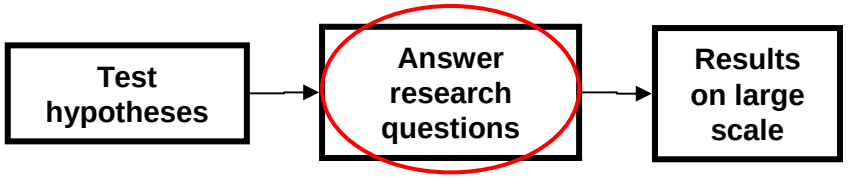
- Examples
  - System X decreases share of time headways below 1 second
  - System X increases average speed
  - System X decreases fuel consumption per km
  - Usage of system X increases over time

Testing hypotheses



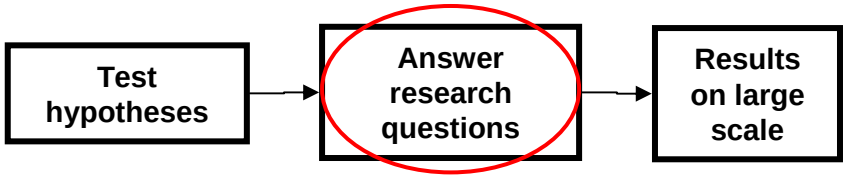
- Null hypothesis: no effect of the system on a performance indicator against an alternative
- Two samples of data: with and without the system
- Comparing the performance indicators between the samples using standard techniques such as a *t-test* on normally distributed data.

Answering Research Questions



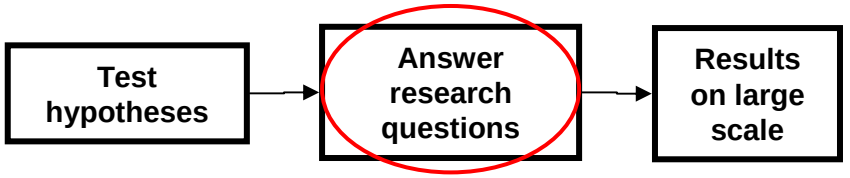
- Using FOT data: tested hypotheses, performance indicators, situational variables
- Examples:
  - **System X improves safety**
    - number of fatalities/injuries
  - **System X improves traffic efficiency**
    - travel times, delays, capacity
  - **System X improves environment**
    - Emissions, noise, fuel consumption
- For the calculation of the impacts data can be complemented with simulation, models, data enrichment

Answering Research Questions



- Cost Benefit Analysis needs **quantitative** data on society level!
- Two kinds of problems arise:
  - **FOT does not provide the right data**
    - → **needs to be converted**
  - **FOT provides answers on small scale**
    - → **scaling up needed**

Methods for Answering Research Questions



Simulation

…

Formula

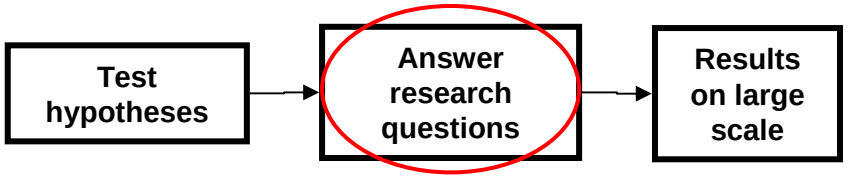
Statistics

Rule of thumb

Increase in
- Complexity
- Accuracy

Choice depends on
- Needs
- Budget
- Availability
- …

Impact on safety

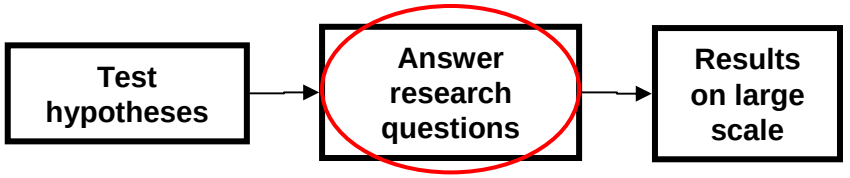


- Data from the FOT vehicles: surrogate safety measures (with and without system)
  - **Speed and speed variation**
  - **Time headways, time to collision**

→We need: change in number of fatalities and injuries compared to reference

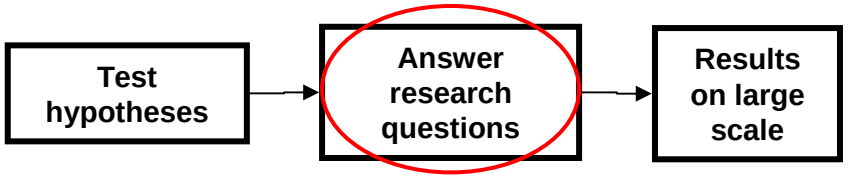
- Example: eIMPACT method (www.eimpact.eu)

Safety example



- From surrogate safety measures to impact on number of fatal accidents
- Outcome FOT (with system compared to without):
  - **Average speed: -2% (100 km/h → 98 km/h)**
- Nilsson formula: $F_2 = F_1 \cdot \left(\frac{v_2}{v_1} \right)^4$
  - ***F_1 = no. of fatal accidents without system, F_2 with system***
  - ***v_1 = average speed without system, v_2 with system***
- Result:
  - → **Decrease of fatal accidents: -8%**

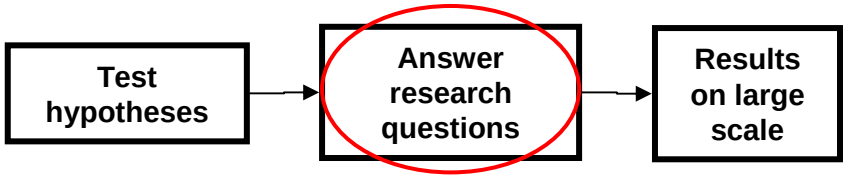
Impact on traffic efficiency



- Data from the FOT vehicles (with and without system)
  - **Speed**
  - **Time headways**
  - **Lane change behaviour**
  - **Etc.**

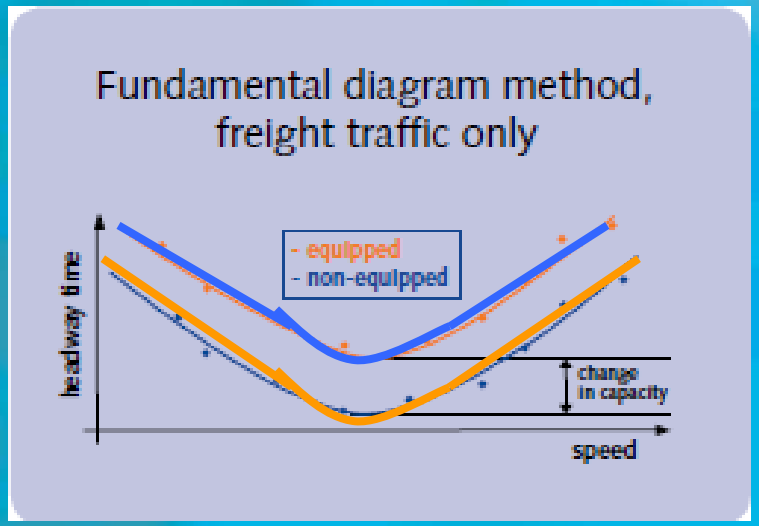
→ We need: change in travel times / delays / capacity compared to the reference

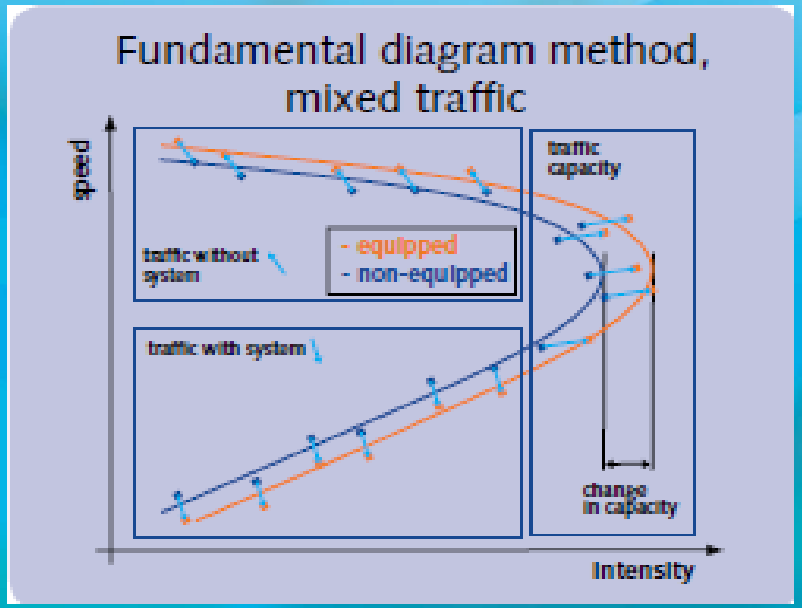
Traffic efficiency example 1



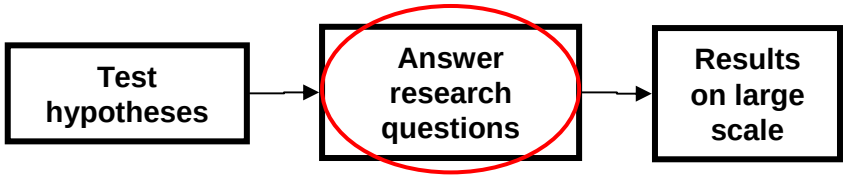
www.fot-net.eu

- From time headways to impact on capacity
- Example: Accident Prevention System for lorries

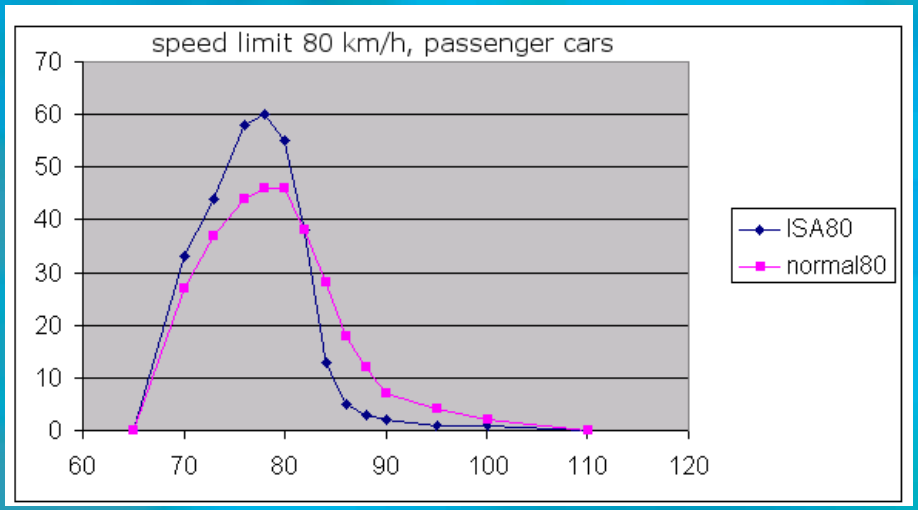


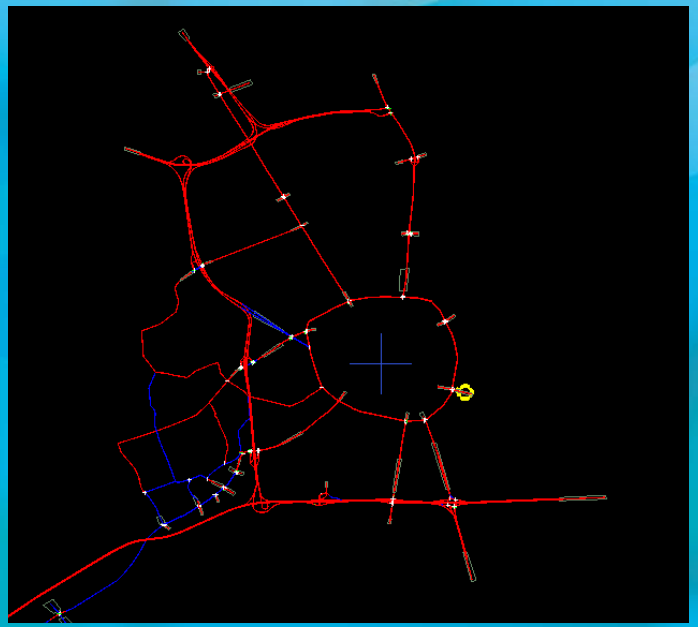


Traffic efficiency example 2

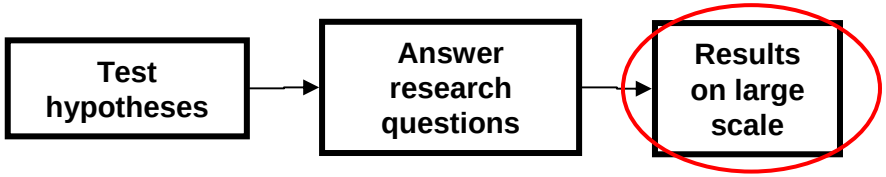


- From distribution of desired speed to impact on travel times at network level
- Example: eIMPACT SpeedAlert – using simulation tool





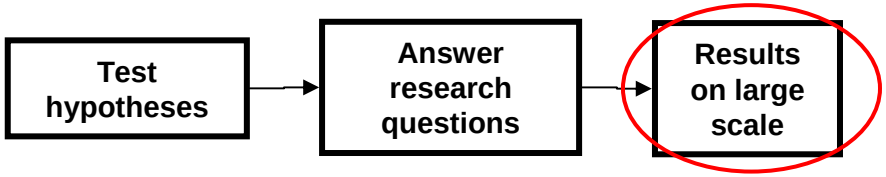
What is difficult about scaling up?



No cookbook / cut-and-dried formulas:

- Interaction between users and non-users
- Nonlinear in penetration rate (early adopters, cooperative systems)
- Different geography
- Different time scale
- Different time period (future)
- Modelling of driver behavior
- Frequency of conditions needs to be matched (traffic situations, weather, road types, …)
- Cultural differences ….

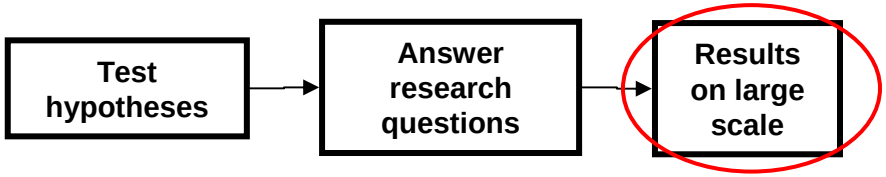
Example ITS Test Beds



www.fot-net.eu

- Not a FOT…
  - **Micro simulation of three ITS systems, coupled to a Cost Benefit Analysis**
- But it deals with the same problems as a FOT regarding scaling up
- One of the systems: a road pricing application
  - **Effects on strategic level: modality choice, departure time choice, route choice**
  - **No effects on tactical driving behaviour**

Example ITS Test Beds



www.fot-net.eu

- Scaling up of safety and environmental impacts
- Direct, with statistics
  - **From simulation: km driven per road type**
  - **From statistics:**
    - average number of fatalities & injuries per km per road type
    - average emissions per km per road type
    - km driven per road type per year (country level)

Exercise: The Assisted Driver

- Goal: to understand some of the challenges in answering research questions and scaling up
- ACC system
- Research Question: how does the system influence road safety?

Workshop

- 35 minutes group work
- 2 minute presentation by each group
- 2 minutes closure

Safety impact in The Assisted Driver study

- Circumstances in which ACC has an effect are determined:
  - **Inadequate distance to predecessor**
  - **Overtaking on the left**
  - **…**
- The accidents ACC has an effect on are selected from accident statistics
- Use and effectiveness of ACC taken into account
- Safety potential is calculated from this (with 100% penetration)

→ Outcome: 13% reduction of accidents on motorways

Thank you for your attention!

More information or want to cooperate?

www.fot-net.eu

Kerry Malone and Eline Jonkers
Kerry.Malone@tno.nl
Eline.Jonkers@tno.nl