PROmoting real **L**ife **O**bservations for **G**aining **U**nderstanding of road user behaviour in **E**urope

PROLOGUE

Recommendations for a large-scale naturalistic driving study

Based on PROLOGUE deliverable D4.1

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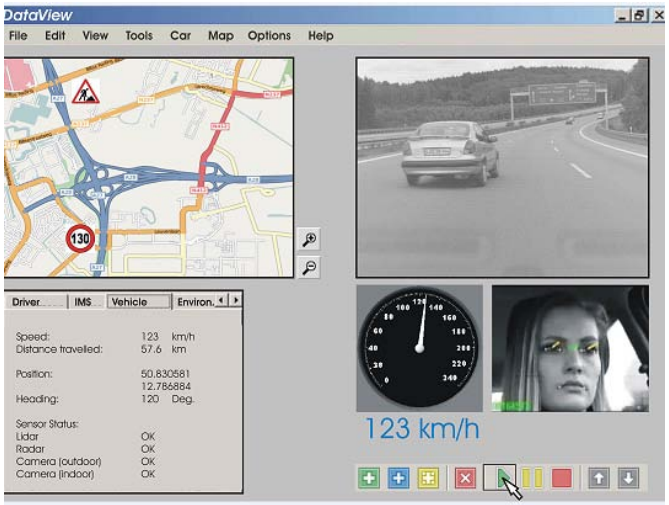
SEVENTH FRAMEWORK PROGRAMME

Outline of presentation

- What is meant by a „large-scale“ study?
- Purpose and added value of European large-scale ND study
- Research topics
- Methodological considerations of large-scale ND study
  - Study design, driver/vehicle sampling
  - Participant recruitment
  - Indicators and measures
  - Data acquisition and data handling
- Legal, ethical and privacy protection issues
- Cost considerations



What is a „large-scale“ ND study?

- **It is not** a series of different studies in different regions, using different methodologies and addressing different research questions
  - Total size of the database is not the criterion

- **Common elements** is a necessary requirement for defining *one large-scale study* as different from a series of unrelated studies
  - If different subprojects, the total knowledge base must exceed the sum of the parts
  - What should the common elements be?
  - What are the different options?

Background: Previous ND studies

- Previous large-scale naturalistic driving (ND) research, mainly in the U.S.
  - 100-car study
  - SHRP2
  - Various FOT studies
  - Large-scale data collection by recording equipment vendors (e.g. DriveCam)

Why a European ND study? Added value

- Large database for analysing crash-related behaviour
  - Previous studies too small (except SHRP2)
- Comparisons across countries
- Studying implications for environment and traffic management
- Vulnerable road users

- Combining in-vehicle and site-based observation data
- More advanced equipment for unobtrusive behaviour recording
- Methods for long-term monitoring of safety performance indicators

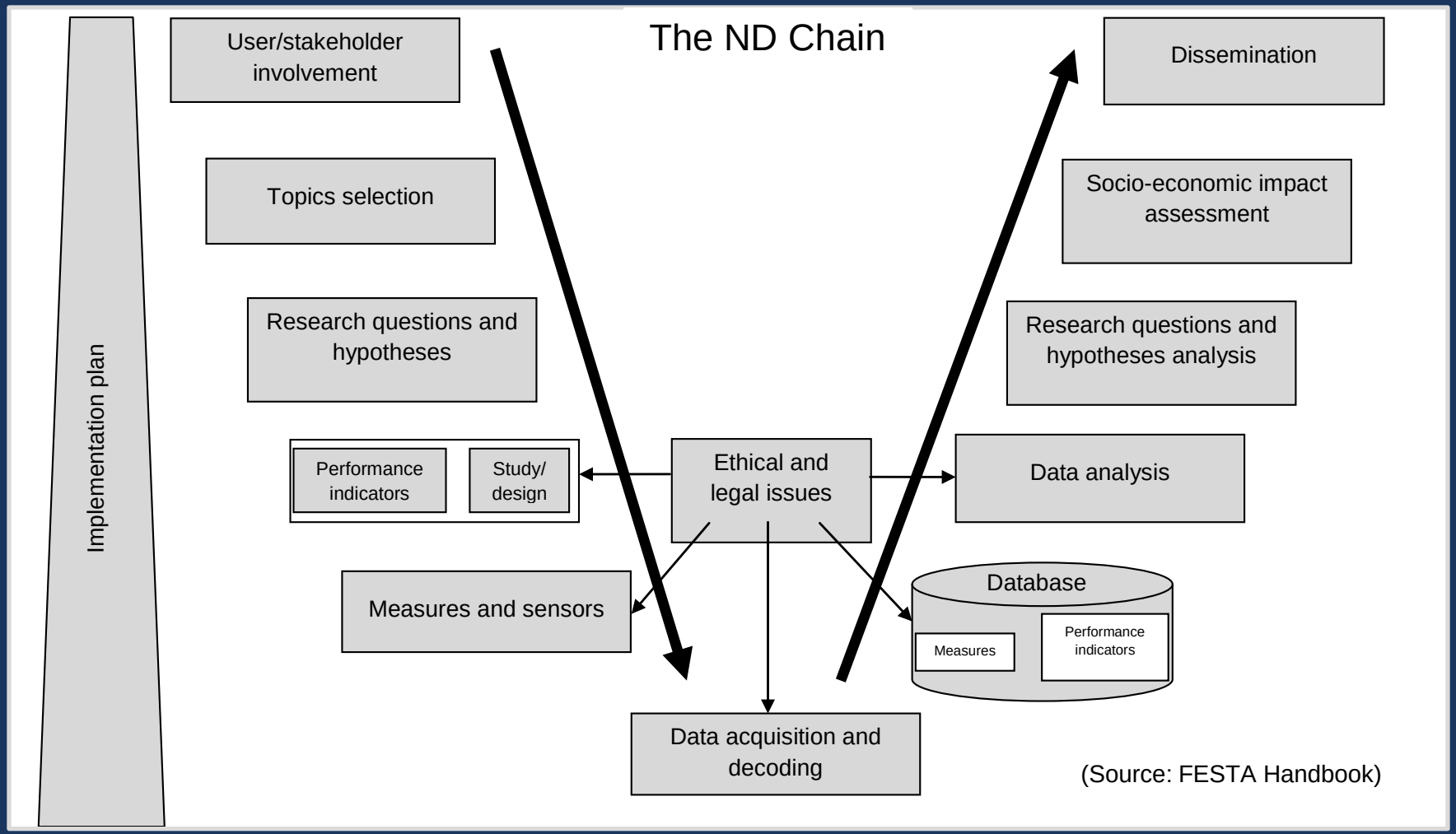
Purposes

- Two different strategies
  1. Large database for subsequent analyses of post-hoc research questions - implicit assumptions about research topics
  2. Study focusing on a limited number predefined research questions

- Choice of strategy has implications for study design
  - Strategy 1 → random sampling to obtain representativity
  - Strategy 2 → targeted sampling guided by research hypotheses

- Combining 1 and 2 is recommended
  - Stratified sample:
    - Large random sample of general driver population
    - Over-sampling of specific driver/vehicle categories, regions, etc., based on research questions

Phases in large-scale ND study: FESTA „V“ modified



Research topics and questions

- Main area is road safety
- Additional areas are environmental effects and traffic management issues
- On which topics is ND expected to contribute most?

Research topics matrix

Driver-related categories	Driving conditions					
	General research topic or question	Driver background factors and trip characte-ristics	Road sys-tem, road environment, ambient conditions	Vehicle design, equipment and condition	Interaction with other road users; traffic volume	Combina-tion of two or more conditions
Distraction and inattention Fatigue, sleepiness, other impairments Decision-making, errors, driving style/ performance Lane change, lane position, lane keeping Speed and acceleration	Specific research topics and questions					

Research topics matrix, cont'd

Driver-related categories	Driving conditions					
	General research topic or question	Driver background factors and trip characte-ristics	Road sys-tem, road environment, ambient conditions	Vehicle design, equipment and condition	Interaction with other road users; traffic volume	Combina-tion of two or more conditions
Gap acceptance and headway Aggressive driving, compliance with regulations Learning Multiple behaviours/ states, interactions	Specific research topics and questions					

Research questions: Safety

- Not all road safety issues can be adequately studied by ND
  - Effect of being observed
  - ND study participants probably refrain from some violations and other socially deviant behaviour
- Observation of „normal“ risk-related driver behaviour is the primary added value of ND studies
  - Self-reports may be unreliable
  - In-depth studies cannot tell what happened before the crash
  - Direct observation is necessary

Safety: Risk factors and crash surrogate measures

- Identify risk factors and quantify risk
  - Comparing behaviour crashes, near-crashes and other incidents with baseline driving behaviour
  - Exposure data for potential risk factors

- Identify crash proxies
  - Compare behaviour in crashes with near-crashes and other incidents
  - Which indicators are appropriate surrogate measures (proxies) for crashes?
  - A study containing a number of crashes is necessary
  - Once identified by a large-scale study, crash risk indicators may be used as surrogate measures in subsequent studies on a smaller scale

Environmental effects and traffic management

- Eco-driving
  - Background factors influencing driving style
  - Effects of different systems for fuel consumption feedback on driving behaviour
- Traffic management
  - Implications of lane choice and route choice
  - What are the main determinants of driver preferences regarding road types, traffic conditions, lane choice etc?
  - To what extent do drivers choose the quickest routes?
  - Effects of traffic information (signs etc.)

Study design:
Level of observation technology

Level	Basic driving parameters (e.g. speed, *g* forces, position)	Trigger-based or continuous video (driver, forward, rear, and/or side views)	Specific additional measures (e.g., eyetracking)
1 (simple)	X		
2 (advanced)	X	X	
3 (very advanced)	X	X	X

Study design: Scale of study

- Scale of study: Vehicle years
  - Number of drivers/vehicles
  - Duration of data collection
- Increasing number of drivers/vehicles and duration of study are not equivalent

Study scale and level of observation technology

Sophistication of observation equipment	Specific additional measures	Distraction and inattention Fatigue, sleepiness and other acute impairments		Distraction and inattention in relation to accidents
	Video (Continuous or event triggered)			
	Basic parameters	Speed and acceleration		Exposure
		Small (<5 vehicle years)	Medium	Large (>500 vehicle years)
		Study scale		

A three-level study

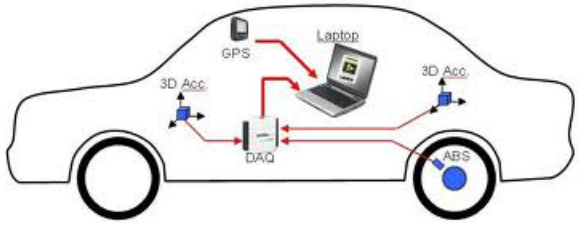
1. A large-size sample (e.g. 1000 drivers for two years) with recording of basic driving parameters
2. A medium-sized subsample (e.g. 100 drivers for two years) with additional video recording, and maybe some vehicle variables recorded from vehicle CAN-bus
3. A small sub-subsample (e.g. 25 drivers for two years) with additional advanced recording of a wide range of measures, including video, eyetracking, more CAN-bus variables, on-site recording etc.

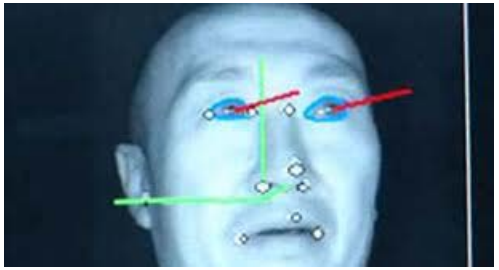
Participant recruitment

- Incentives for participants
  - Monetary compensation per time unit, plus bonus at the end (100-car study)
    - Bonus important to prevent dropout during study
  - Detailed information to participants is important (background for signing Informed Consent Form)
  - Results feedback after completion of study

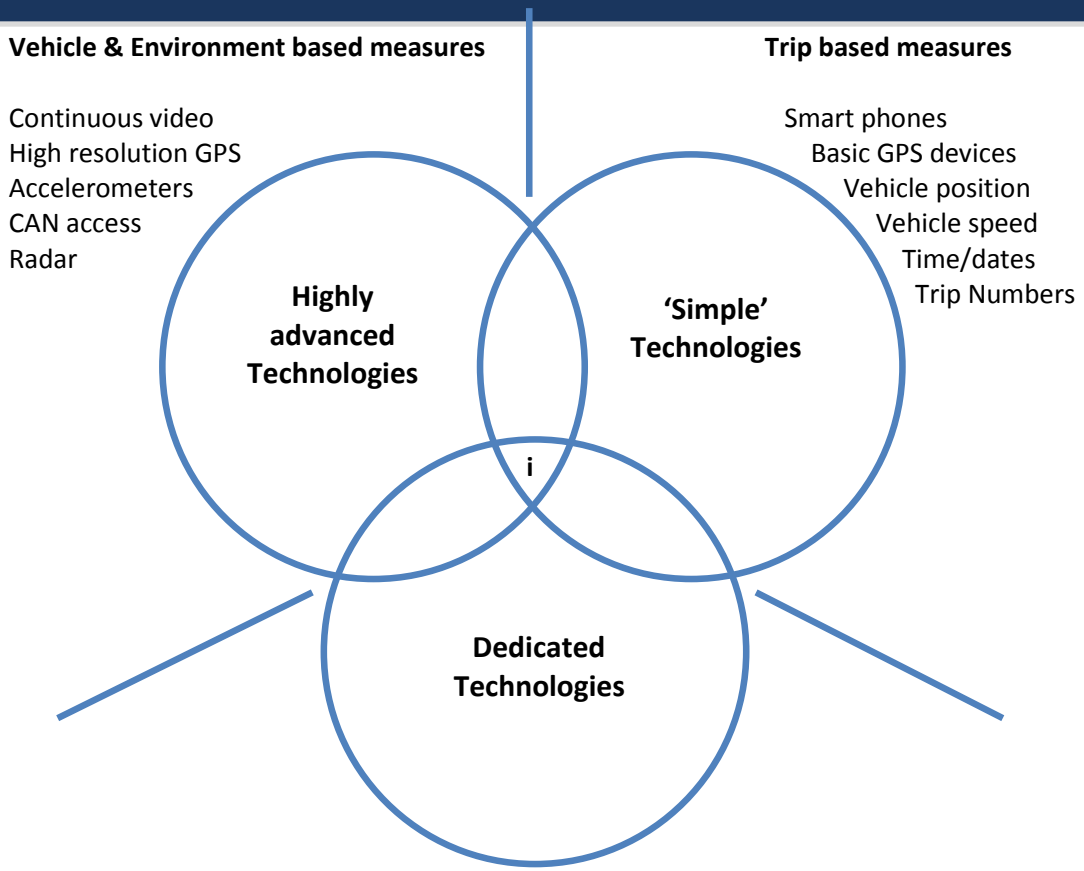
Indicators and measures

- What are the relevant performance and situational indicators?
- Which measures are important to compute those indicators?
- What kind of equipment is needed?





Measures and technology



Data collection and transfer
Requirements and recommendations

- Requirements/Recommendations
  - Unobtrusive recording
  - Equipment must not interfere with normal function of vehicle
  - Effortless transfer of data – preferably without active participation of the driver (wireless transfer is recommended when possible)

Data enrichment

- Adding various time and position coded data to the primary database afterwards
  - Vehicle
  - Driver
  - Road (environment)
  - Traffic conditions

Ethical, legal and privacy protection issues

- Drivers must be fully informed about what is recorded
- Individual participant not to be identified in public data or results
- Data not available for criminal prosecution
- Right to withdraw at any time, and to demand deletion of data
- Passengers must not be identified from video
- Sound recordings (interesting for research!) have to be masked to protect passenger privacy

- Above recommendations to be adapted to possible differences in national legislation

Cost considerations

Sophistication of observation equipment	Specific additional measures	120 K€	1 400 K€	14 000 K€
	Video Continuous or event triggered	24,5 K€	650 K€	6 500 K€
	Basic parameters	9 K€	220 K€	2 200 K€
		Small (<5 vehicle years) *e.g. 25 vehicles for 2 months*	Medium *e.g. 100 vehicles for 2 years*	Large (>500 vehicle years) *e.g. 1000 vehicles for 2 years*
		Study scale		

Deliverable D4.1

SEVENTH FRAMEWORK PROGRAMME
THEME 7 TRANSPORT

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Deliverable D4.1

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