Understanding driver interactions with In-Vehicle Technologies

INTERACTION FP7 project

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Contents

- Aims of INTERACTION project
- Specificities of the project
- Design of the observation of IVT use
- Conclusions

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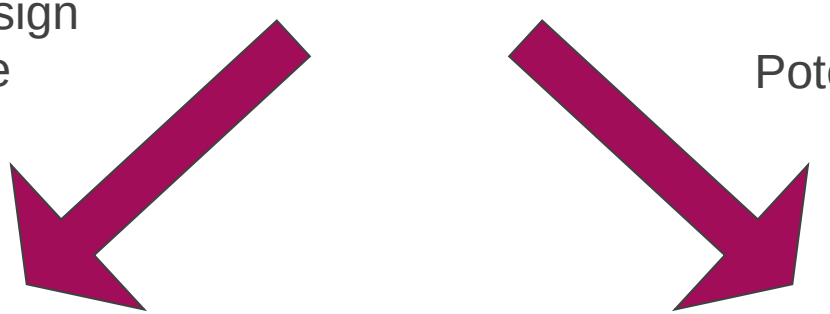
Context

In-vehicle Technologies

Ergonomic design
Correct use

Real design
Real use
Potential misuse



driver safety ++
driver mobility ++
driver enjoyment ++
driver comfort ++

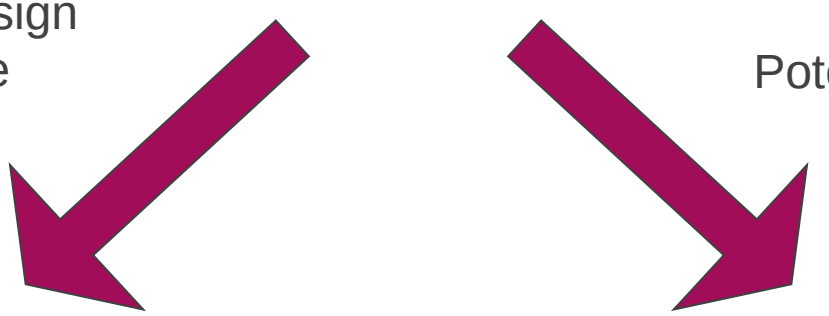
?

Research objectives

In-vehicle Technologies

Ergonomic design
Correct use

Real design
Real use
Potential misuse

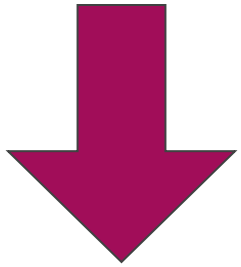


driver safety ++
driver mobility ++
driver enjoyment ++
driver comfort ++

Who are the IVT users and non users?
Where, when, how and why drivers use IVT?
What are the real effects of IVT on driving?

Major outcomes & expected impacts

- The development of recommendations for
  - The refinement of IVT design
  - The design of appropriate training for IVT users
  - The strengthening of public awareness of IVT users
  - The coherence between drivers' IVT use and legislation and enforcement practices



- The reduction of the risks of systems misuses
- The increase of benefits of IVT in road safety

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INTERACTION specificities

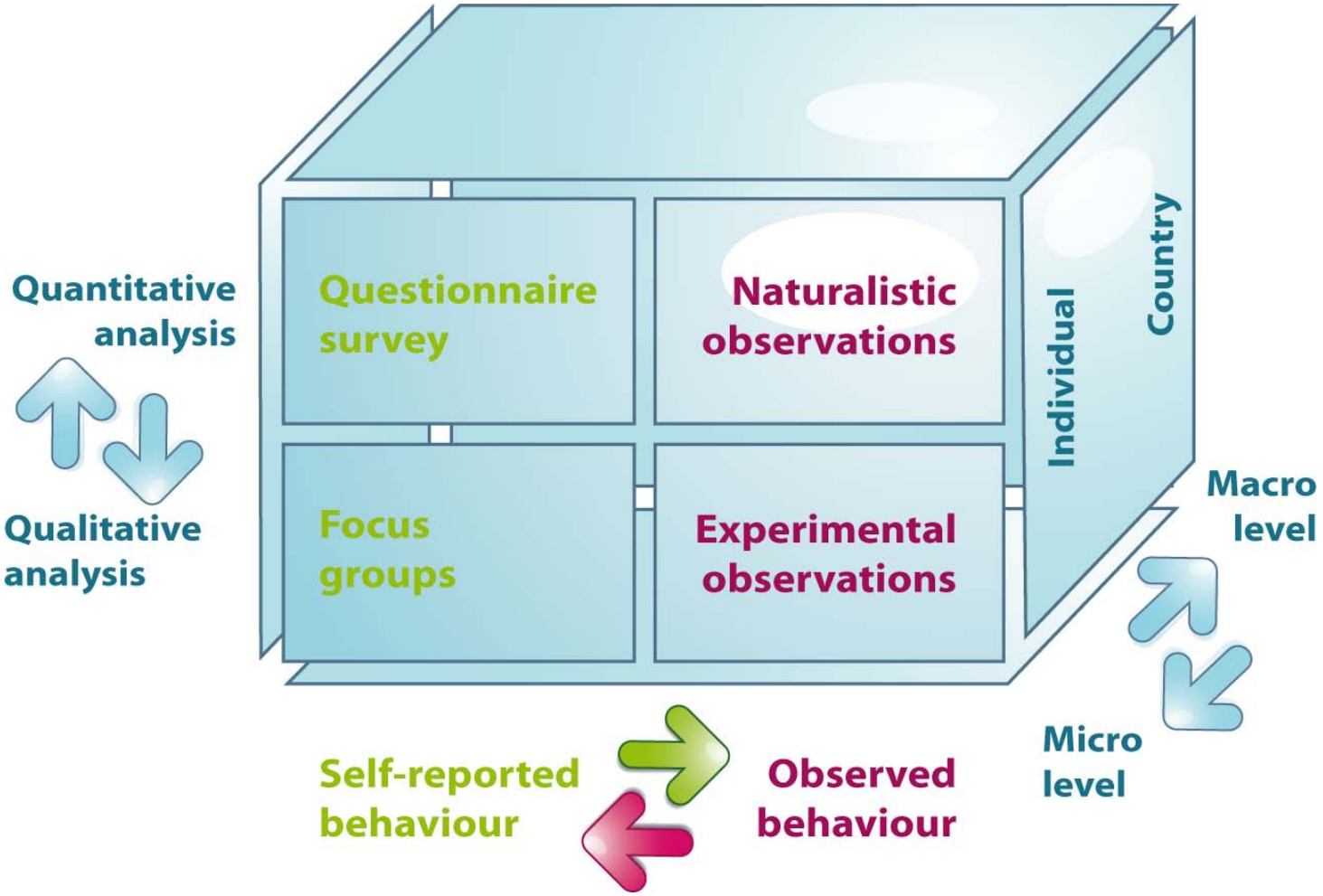
- To propose 5 dimensions of investigation of drivers' IVT use
- To implement a comprehensive research approach
- To focus on mature technologies widely available on the European market
- To perform a cross-country comparison by applying the same research methodologies in each country

Investigation of the drivers' IVT use

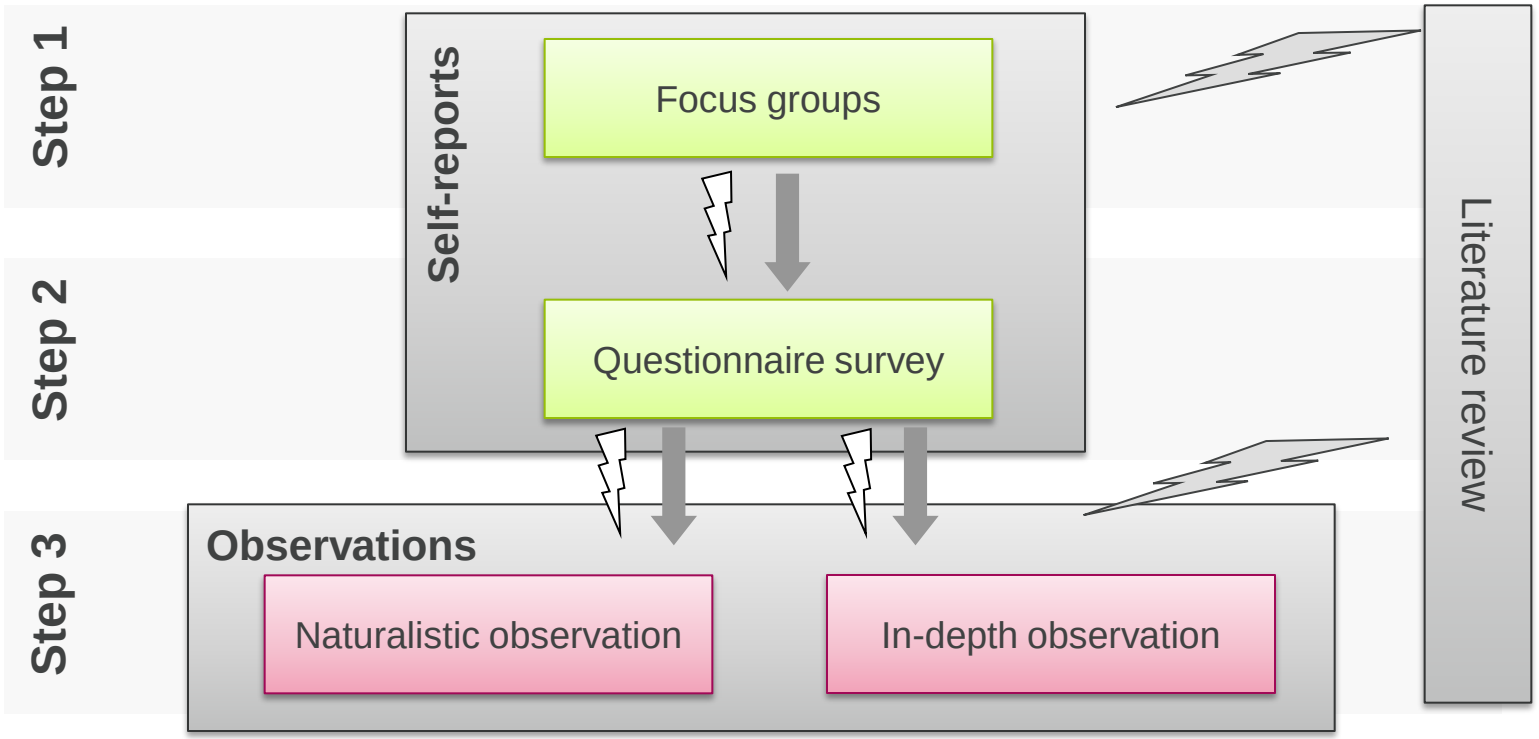
A broad question with multiple dimensions

1. The driving population using IVT on a regular or occasional basis
2. The drivers' motives to use IVT or not
3. The identification of the driving context where drivers choose or avoid to use IVT
4. The patterns of drivers' IVT
   - how drivers interact with their systems
   - how they configure them
5. The effects of IVT use on drivers' behaviour and road safety

A comprehensive research approach (1/2)



A comprehensive research approach (2/2)



Selection of four mature IVT

- Cruise Control
- Speed Limiter
- Navigation System
- Cell phone

A comparison between 8 countries

Europe

- Austria
- Czech Republic
- Finland
- France
- Netherlands
- Portugal
- Spain
- United Kingdom

From November 2008 to April 2012
(36 months)

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Design of the observation of IVT use

- Principles and complementarities of the 2 kinds of observations methods implemented
- Research questions / hypotheses to be addressed by the naturalistic observation
- Development of relevant tools for the naturalistic observation
- Experimental design of the naturalistic observation

The 2 kinds of observation methods

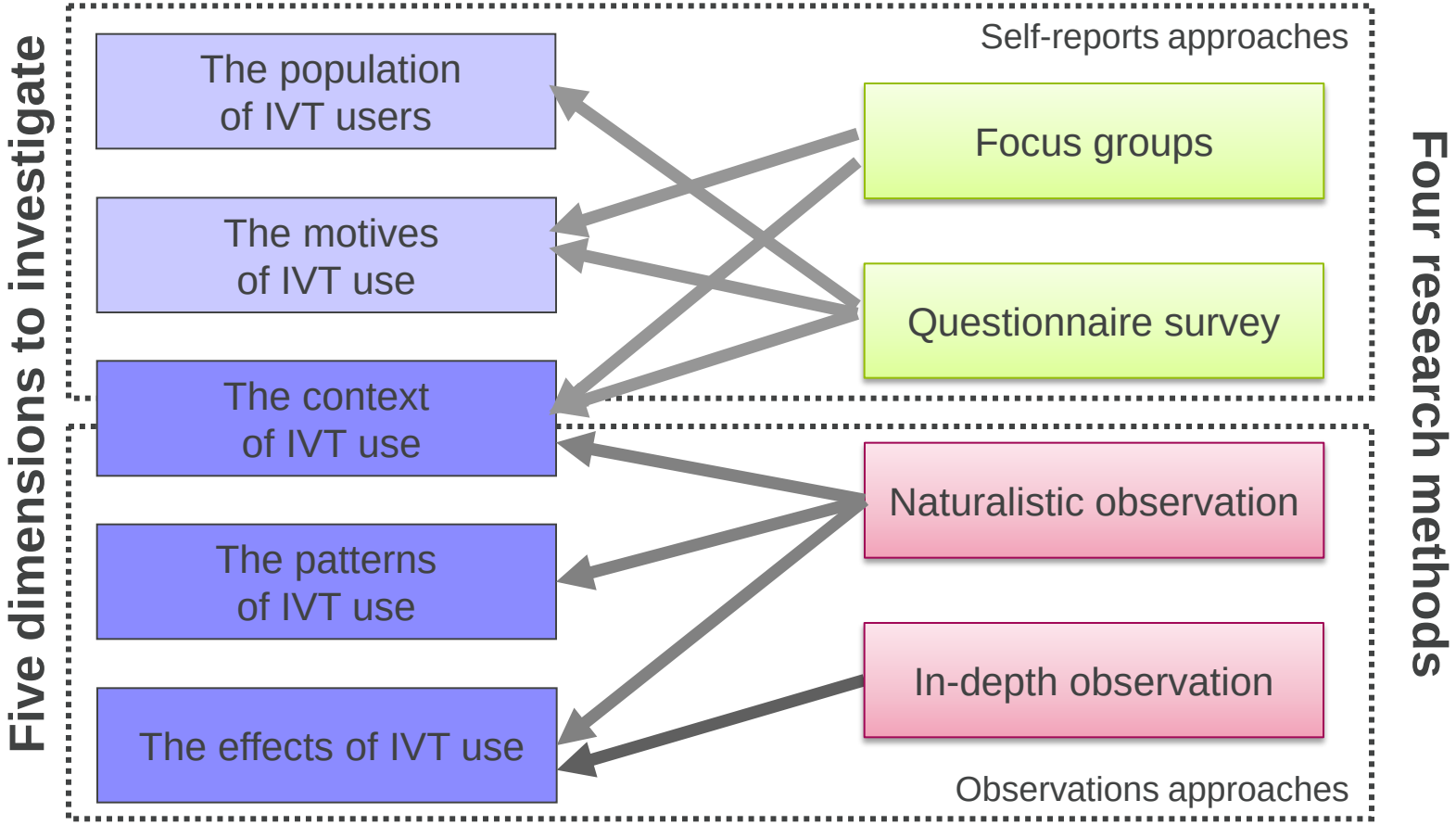
- Naturalistic driving observations
  - Behavioural observation
    - in naturalistic settings
    - in an unobtrusive way
    - out of any experimental context
  - Participants drive
    - where and when they want to cover their daily mobility needs
    - at the wheel of their own car
    - equipped with sensors and cameras

- In-depth observations
  - Behavioural observation
    - of drivers' behaviour and drivers' interactions with other road users
    - performed by two observers inside the participants' cars
    - using the "Wiener Fahrprobe" method
  - Participants drive
    - along the same standardized test route
    - in real conditions of traffic
    - two times for two experimental conditions (with and without IVT use)

General principles for the observations

- Target population
  - the population of the intensive users of IVT
- With the objectives of
  - identifying the strategies of IVT use in terms of context of use, systems settings and HM interactions
  - Investigating the long term effects of IVT use on driving behaviour
- Implementation of a baseline without IVT use
  - Not relevant for the naturalistic observation
  - Feasible for the in-depth observation

Dimensions of IVT use to investigate by the 2 kinds of observations (1/2)



Dimensions of IVT use to investigate by the 2 kinds of observations (2/2)

Naturalistic observation

	Cruise control	Speed limiter	Navigation system	Cell Phone
The context of IVT use				
The patterns of IVT use				
The effects of IVT use				

Favoring complementarities and avoiding overlapping

In-depth observation

Main research questions to address with the naturalistic observation

- Cruise control / speed limiter
  - When, where and how drivers use CC/SL?
  - Do drivers develop strategies of CC/SL use?
  - What are the real benefits on speeding?
  - Do drivers are more often engaged in dual tasks while using CC?
- Navigation system / Cell phone
  - When, where and how drivers use NS / CP?
  - Do drivers develop self-regulation behaviours by choosing appropriate driving situations?
  - Do drivers develop compensatory behaviours by increasing their safety margin?
  - What are the effects of NS / CP use on car controlling?

Generation of research hypothesis

- Following FESTA methodology
  - Research hypothesis to validate
  - Analysis principles
  - Aggregated Variables
  - Controlled factors
  - Variable factors
  - Performance indicators

Example of research hypothesis (1/2)

- Research hypothesis
  - The driving context influences the use of CC. Driver uses CC mainly on motorway and in light traffic conditions.
- Analysis principles
  - Analysis of the distribution of the kilometers (time) driven with the system engaged for the different driving contexts according to the total kilometers (time) driven with the system engaged.
- Required aggregated data
  - For each participant : Kilometer with CC engaged for each driving context
  - For each participant : Total kilometer driven with CC
- Performance indicator
  - Ratio for each participant : Km with CC in context i / Total kilometer driven with CC
- ➔ Validation of the research hypothesis
  - If ratio is significantly higher in context ‘Motorway and light traffic’

Example of research hypothesis (2/2)

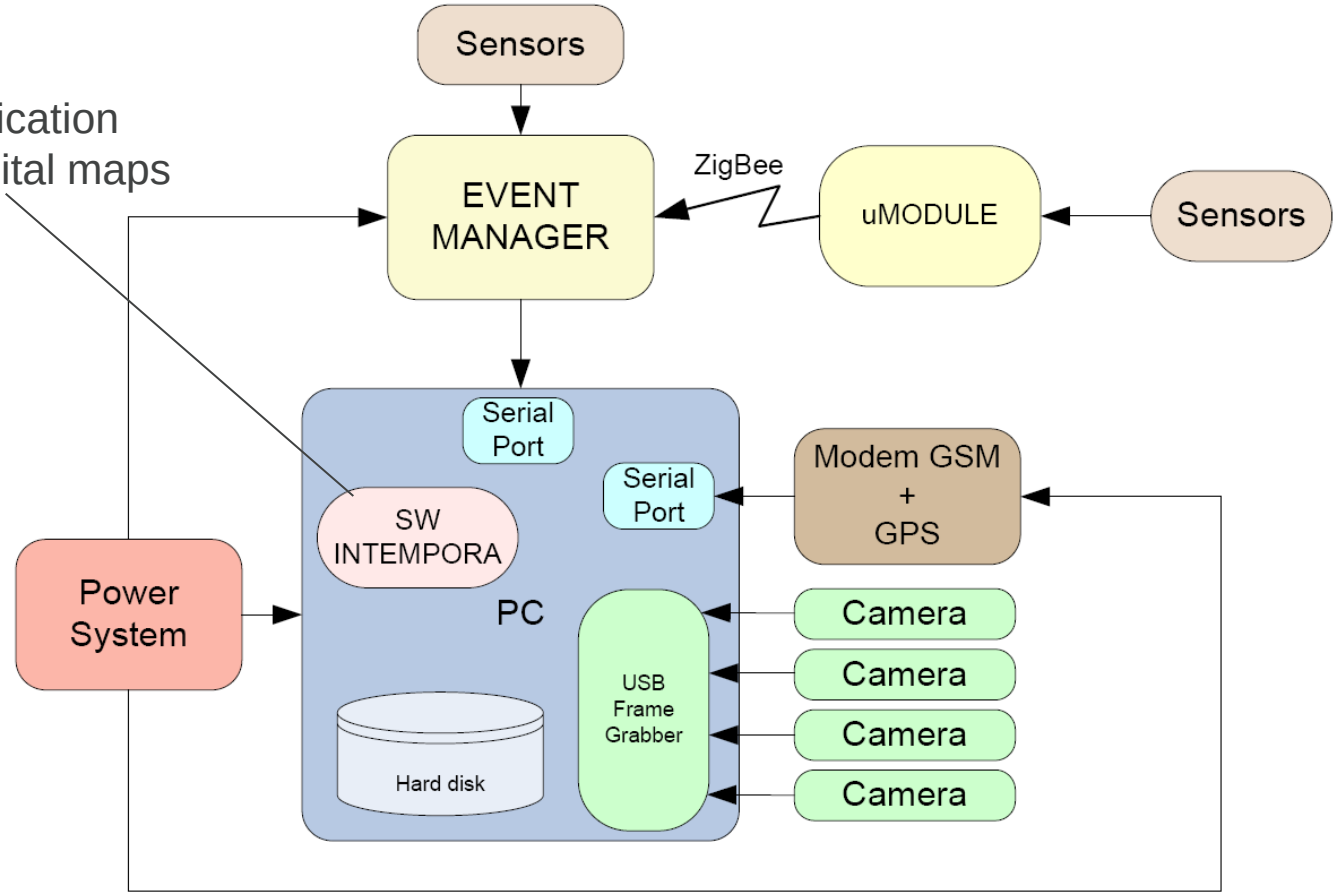
- Research hypothesis
  - When the complexity of driving situations increases, the mean duration of the cell phone calls decreases, whatever CC engagement status.
- Analysis principles
  - Analysis of the distribution of the mean duration of CP calls according to the different driving situation complexity.
- Required aggregated data
  - For each participant and for each call of the driver: call duration.
- Performance indicator
  - For each participant: mean call duration.
- ➔ Validation of the research hypothesis
  - If the mean call duration is significantly lower when the driving situation complexity increases.

Development of a Data Acquisition System (1/2)

- Pluggable in the participant vehicle
  - No link to specific car model / specific system implementation
  - Independent from vehicle CAN Bus
  - Information that cannot be measured are coded from video
  - Use triggers from sensors to ease coding job
- Dedicated to IVT use observation, through monitoring of
  - System functioning status
  - Drivers interaction with systems controls
  - Systems display monitoring
- Aware of driving context
  - Road characteristics
  - Traffic and weather conditions
  - Trips characteristic
- Developed by CTAG / INTEMPORA

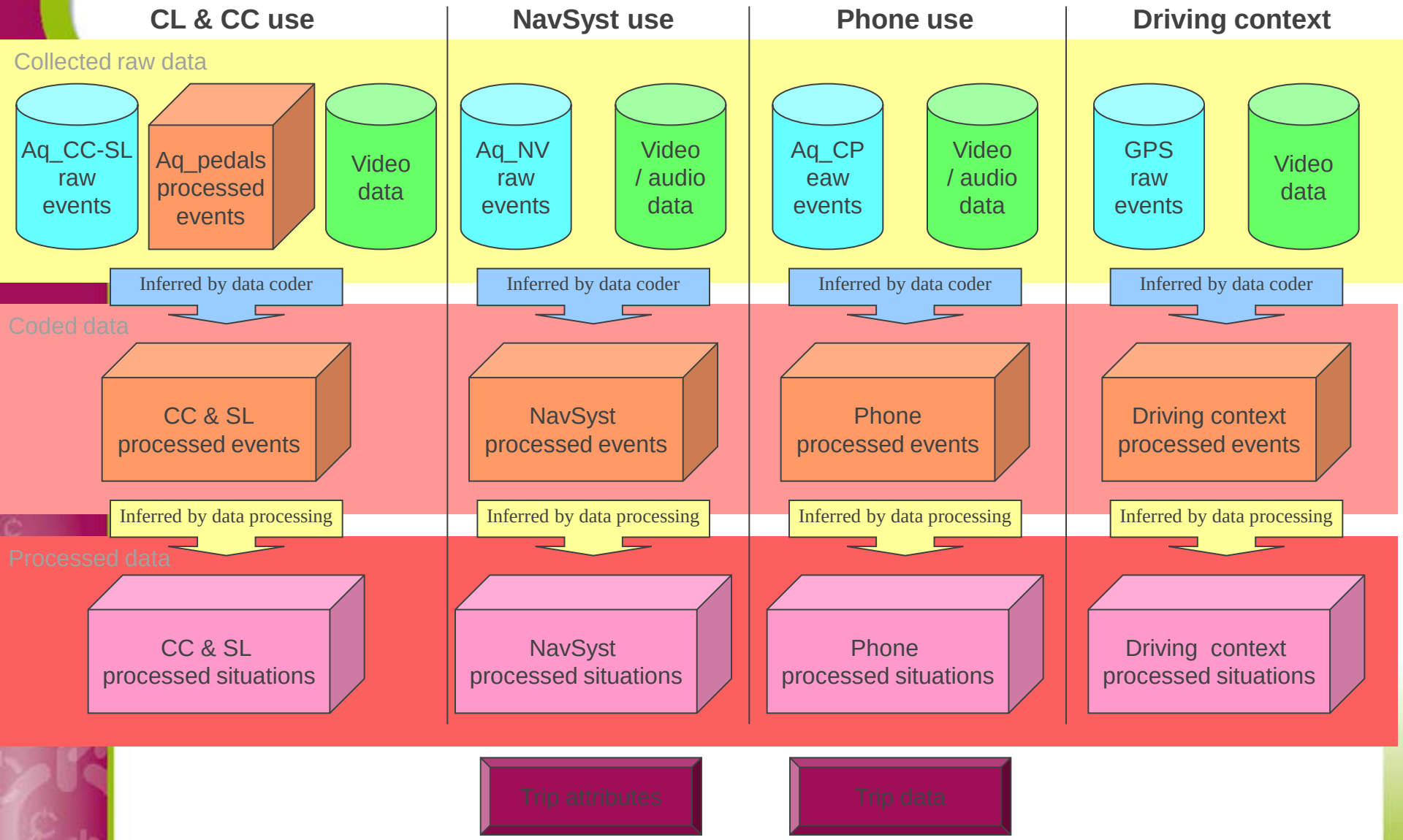
Development of a Data Acquisition System (2/2)

RTMaps software
- Acquisition
- Recording
- SMS Communication
- Interface to digital maps



Development of a Data Coding Software

- Objectives of data coding
  - Enrich the collected data with information on IVT status
  - Enrich data with driving context information
- Prerequisite of data coding
  - Perfect understanding of system functioning and system implementation to be able to determine IVT status through observation
- Functionalities of the software
  - Connection to the trip databases
  - Coding interface specific for each IVT
    - Adequate camera view / event annotation buttons / trigger list
  - Coding interface specific for the context
    - Adequate camera view / event annotation buttons
  - General visualization of DAS data
    - View of all camera view / sensors (vehicle dynamics) / current value (legal speed limit)
  - Preparation of output files for data aggregation and analysis
- Developed by IFSTTAR


CL & CC use
NavSyst use
Phone use
Driving context
Collected raw data
Aq_CC-SL raw events
Aq_pedals processed events
Video data
Aq_NV raw events
Video / audio data
Aq_CP eaw events
Video / audio data
GPS raw events
Video data
Inferred by data coder
Inferred by data coder
Inferred by data coder
Inferred by data coder
Coded data
CC & SL processed events
NavSyst processed events
Phone processed events
Driving context processed events
Inferred by data processing
Inferred by data processing
Inferred by data processing
Inferred by data processing
Processed data
CC & SL processed situations
NavSyst processed situations
Phone processed situations
Driving context processed situations
Trip attributes
Trip data

Experimental design (1/2)

- Participants characteristics
  - IVT use
    - Intensive users of CC/SL
    - > 50% of driving time
  - Travel patterns
    - Experienced drivers
    - 2000 km per month
    - Driving on different kinds of roads
  - Sex and age
    - Balanced between male/female
    - 25-50 years old
- Sample size
  - 20 drivers per country
  - In 7 countries

Experimental design (2/2)

- Timeframe and organisation
  - Participant briefing
  - DAS Installation
  - First in-depth observation ride
  - 4 weeks of naturalistic observation
  - Second in-depth observation ride
  - Participant interview
  - Data retrieval
  - DAS removal

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Conclusions

- Originalities of INTERACTION naturalistic observation
  - To be part of a comprehensive research approach of drivers' IVT use
  - To focus on a specific population of drivers

    Intensive IVT users
  - To perform a comparison between 8 European countries by applying the same methodology and analysis
  - To develop an open solution of data acquisition system that can be easily adapted to other drivers naturalistic observations

Thank you for your attention