



Webinar on the revised FESTA handbook

Cooperative Systems Perspective

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FOT-Net is a support action co-funded by the European Commission to network FOT activities at European, national and international level.

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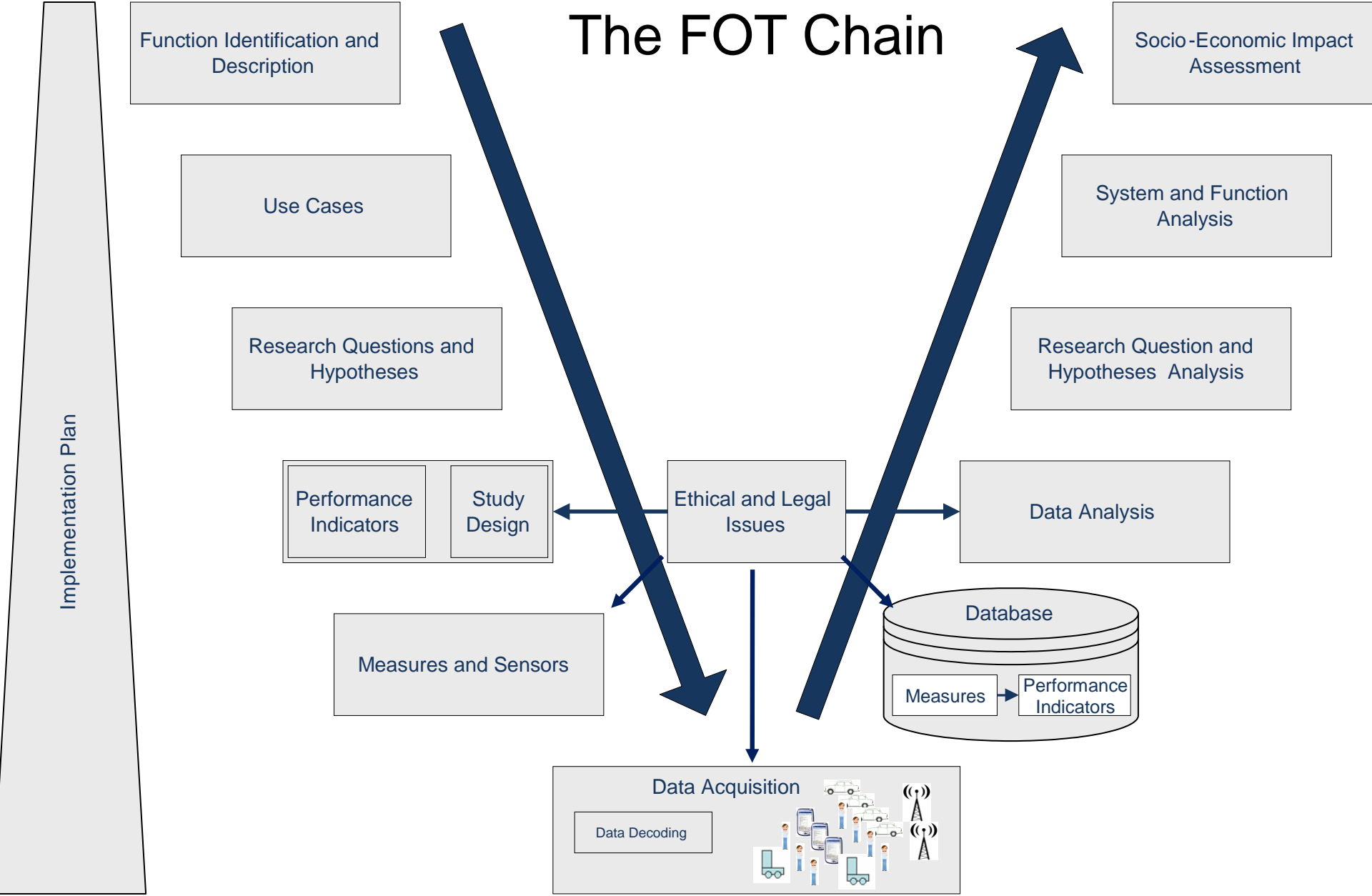
- FESTA Introduction
- Cooperative Systems
- Going down the V
- Going up the V
- Conclusions

FESTA

- European project developed methodology for conducting FOTs:
 - Systematic research-oriented approach to define tests: research questions, hypotheses and performance indicators
 - Data acquisition
 - Analysis, evaluation of outcomes and impact assessment
- Handbook



The FOT Chain



Function Identification and Description

Use Cases

Research Questions and Hypotheses

Performance Indicators Study Design

Measures and Sensors

Ethical and Legal Issues

Database
Measures → Performance Indicators

Data Analysis

Socio-Economic Impact Assessment

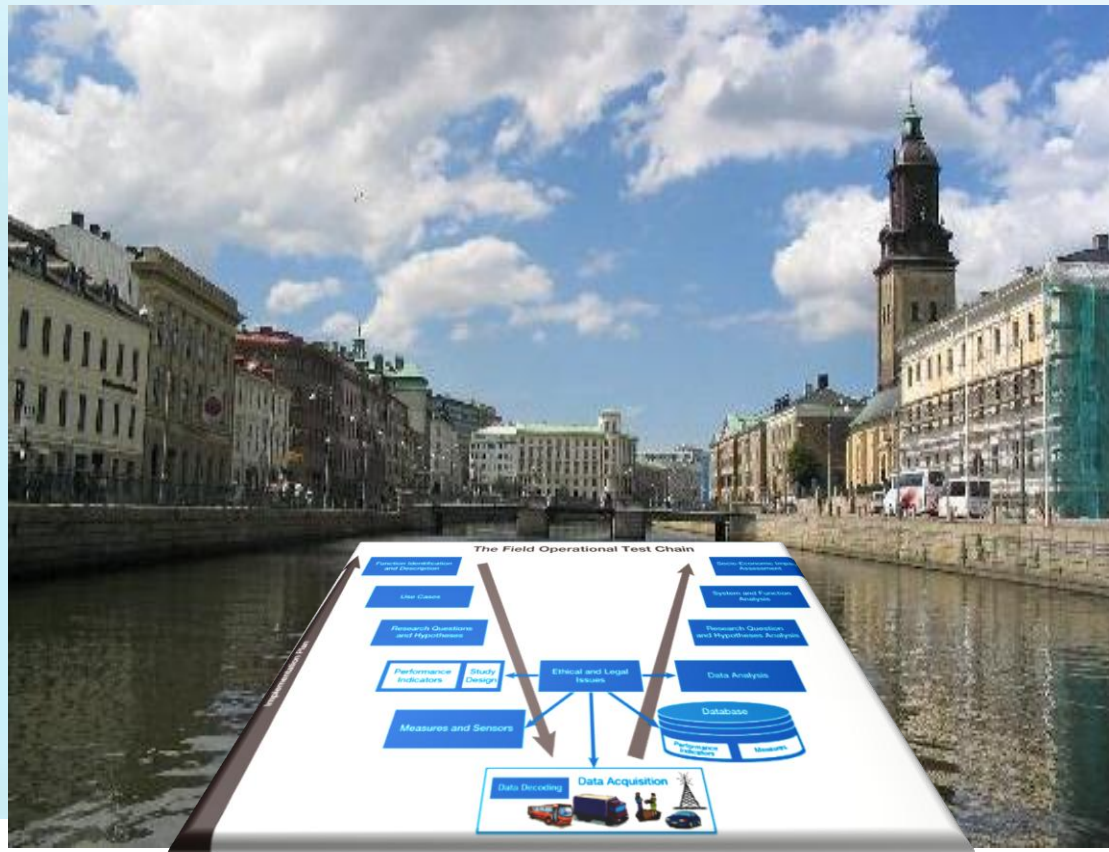
System and Function Analysis

Research Question and Hypotheses Analysis

Data Acquisition
Data Decoding

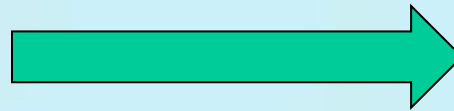
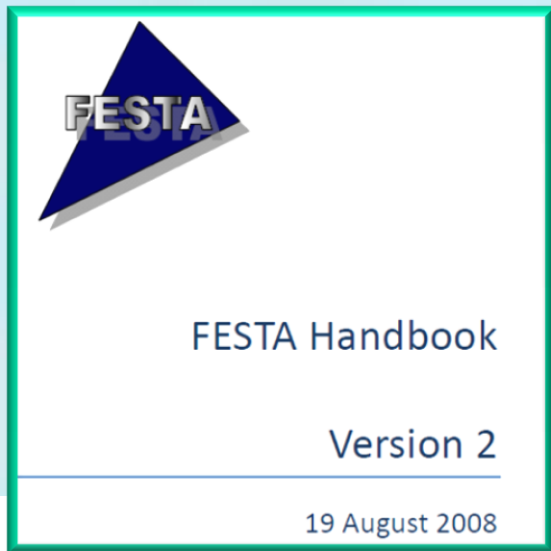
Implementation Plan

Proudly presenting: The revised FESTA Handbook



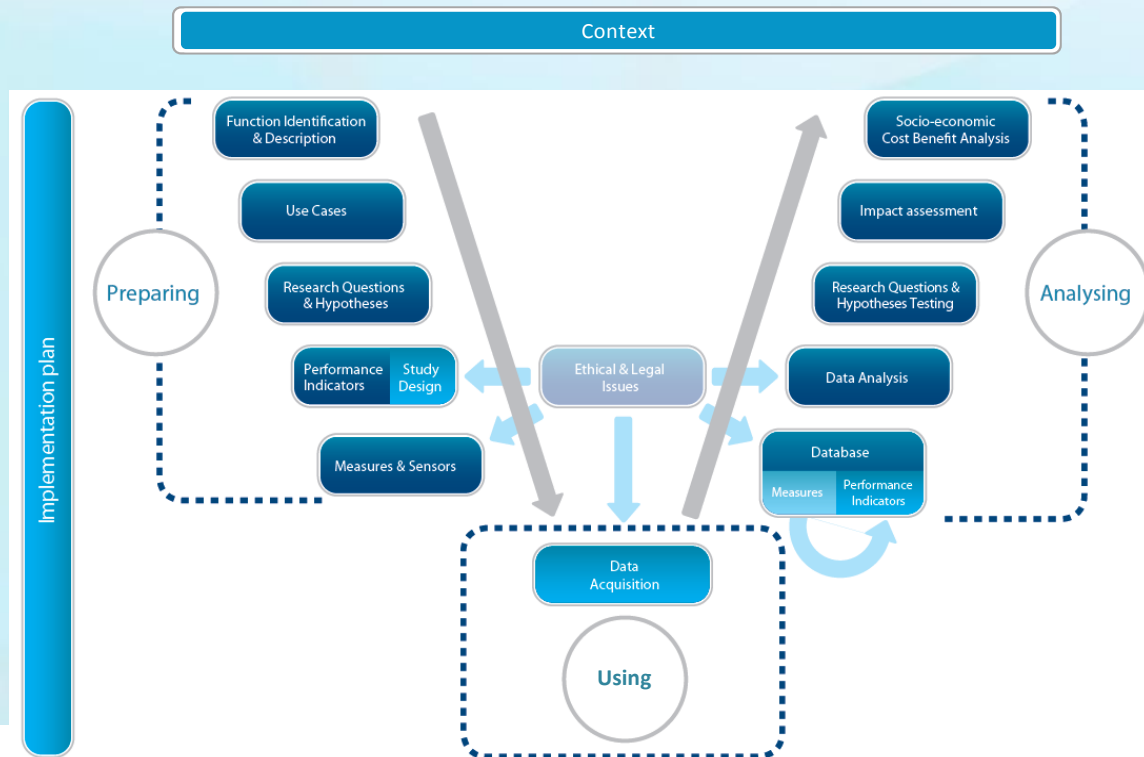
What was wrong with the old version?

- Not much
- It has been used extensively in FOTs
- And lessons were learnt from those experiences
- So we could make the handbook even better



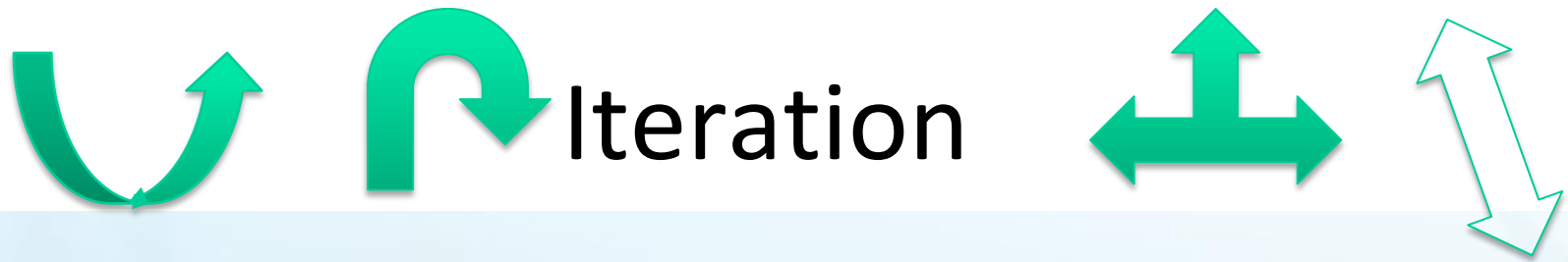
FESTA

- It's the old FESTA V
- but it's also new!

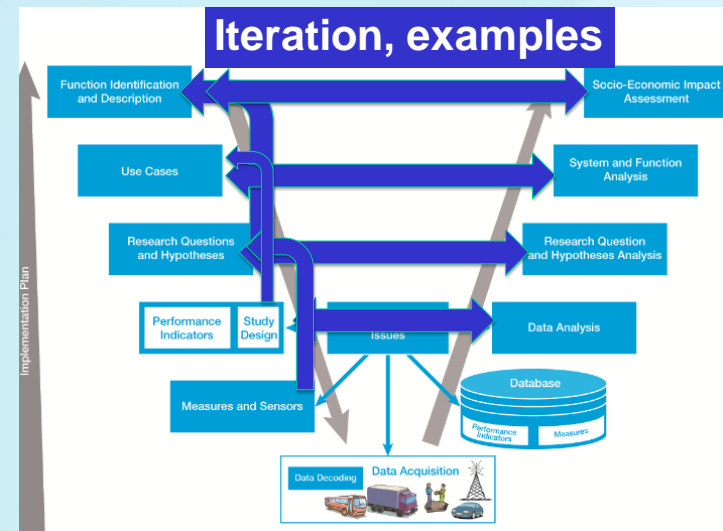


Spot the difference

- A study undertaken to evaluate a function, or functions, under normal operating conditions in environments typically encountered by the **host vehicle(s)** using quasi-experimental methods.
- A study undertaken to evaluate a function, or functions, under normal operating conditions in environments typically encountered by the **participants** using quasi-experimental methods.



- The FESTA methodology is not a linear process
- Iteration is needed, between left and right hand side of the V
- Between steps



Other perspectives

Different focus in FOTs

Not only ADAS

The FESTA handbook can be used from the perspective of:

- **Cooperative systems**
- **Nomadic Devices**
- **Naturalistic Driving Studies**

The process continues....

- Experiences from projects
- Seminars and stakeholders meetings
- Working groups
- FESTA is a living methodology



Cooperative Systems

- Vehicles communicating with
 - other vehicles,
 - roadside infrastructure or
 - central stations
- to cooperate (exchange information, inferred knowledge, intentions ...) for
 - Safety,
 - Traffic-efficiency,
 - Economical driving,
 - Business ...



CS: Technologies and Projects

- Using
 - WAVE, 802.11p, DSRC, 3G
- Are close to the market and therefore a hot topic for FOTs:
 - DRIVE C2X, simTD, SISCOGA, ScoreF, FOTsis, ...
- FOT process will be explained with practical examples for this webinar!

Example 1: GLOSA

- C2I: Greenlight-Optimal Speed Advisory
 - Connect to equipped traffic lights
 - Calculate “best” approaching speed
 - Inform driver



Source: <http://www.drive-c2x.eu/use-cases>

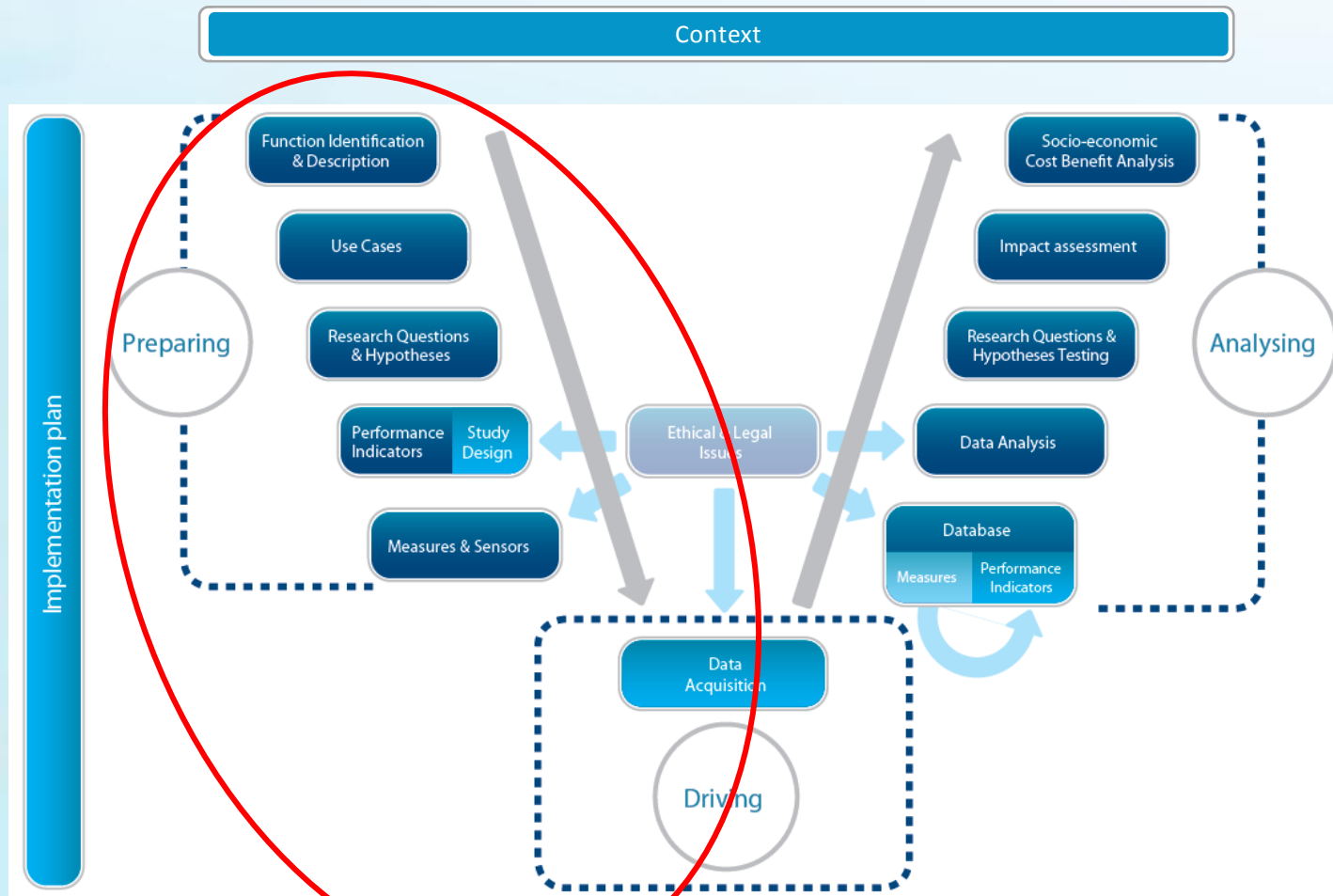
Example 2: CBW

- Car Breakdown Warning
 - Register broken down ego-vehicle
 - Send CBW message
 - Inform driver



Source: <http://www.drive-c2x.eu/use-cases>

Going down the V



RQs

- RQs formulation do not differ too much from the classical approach
- Top down or bottom up approach
- e.g.
 - GLOSA: “Will GLOSA improve overall efficiency?”
→ Top Down approach
 - CBW: “Will drivers reduce speed when approaching an accident?” → Bottom up approach

Hypothesis

- Hypothesis are formulated from RQs, as in the classical approach
- e.g.
 - GLOSA: “GLOSA will reduce fuel consumption in city scenario by 15%”
 - CBW: “Sudden decelerations will be reduced thanks to CBW in 30%”
- Possible feedback to traffic management centers is to be considered! (e.g., FCD)

PIs

- Performance Indicators will have into account the existence of other sources of information
 - Traffic Status
 - Traffic events
- This can make life easier (more information) or more complicated (more events / information to synchronize)
- e.g.
 - GLOSA: Vehicle speed / idle timing / traffic light status
 - CBW: average approach speed to event / traffic density

Experimental Design

- Experimental design in CS is different, because the **frequency of events** varies extremely over different functions
 - Even worse: for most C2C functions you need two vehicles within communication range, for some even more.
 - In C2I you need special infrastructure – and your functions will only work if subjects actually pass them (in the right moment).
- This *extremely* lowers your FoE!

Testing GLOSA

- The function will only work for equipped intersections
- Therefore the necessary sample size can be reached by:
 - Equipping a large number of vehicles
 - Equipping a large number of intersections
 - Picking test subjects, which mostly stay in a confined area (which you will equip)



Testing CBW

- In your daily drive, how often do you see a broken down vehicle?
- How often do equipped cars break down during an FOT?
- How likely is it, that another equipped vehicle passes the first one in the right moment?
 - Not very likely!
- How can we collect enough samples anyway?



Controlled testing

- With “normal” funding we need to introduce controlled elements into the test procedures to collect enough samples.
- We can either run a completely scripted test (scenario-based testing) or control elements of a naturalistic test
- For CBW we can send professional drivers to simulate break-downs

Measurements in CS

- Measurements in CS are different from ADAS or NDS in two ways:
 - On a *microscopic* level each vehicle has more sources: CAN-BUS, Positioning, Networking, Functions, ..
 - On a *macroscopic* level we need to look at the **summary** of stations to understand the functions' impact
 - Vehicles
 - Roadside Units
 - Central Stations
 - A logging, monitoring and evaluation system has to take this into account to allow the successful evaluation of CS

Example: GLOSA Measurements

- Vehicle Speed & Position
- Acceleration and Braking
- Function status
- Messages
- Traffic light status
- Traffic light position
- Traffic Flow information

Example: CBW Measurements

- Vehicle Speed & Position
- Vehicle Status (e.g. Engine failure, tire pressure, fuel level)
- Function status
- Messages
- Brake actuation

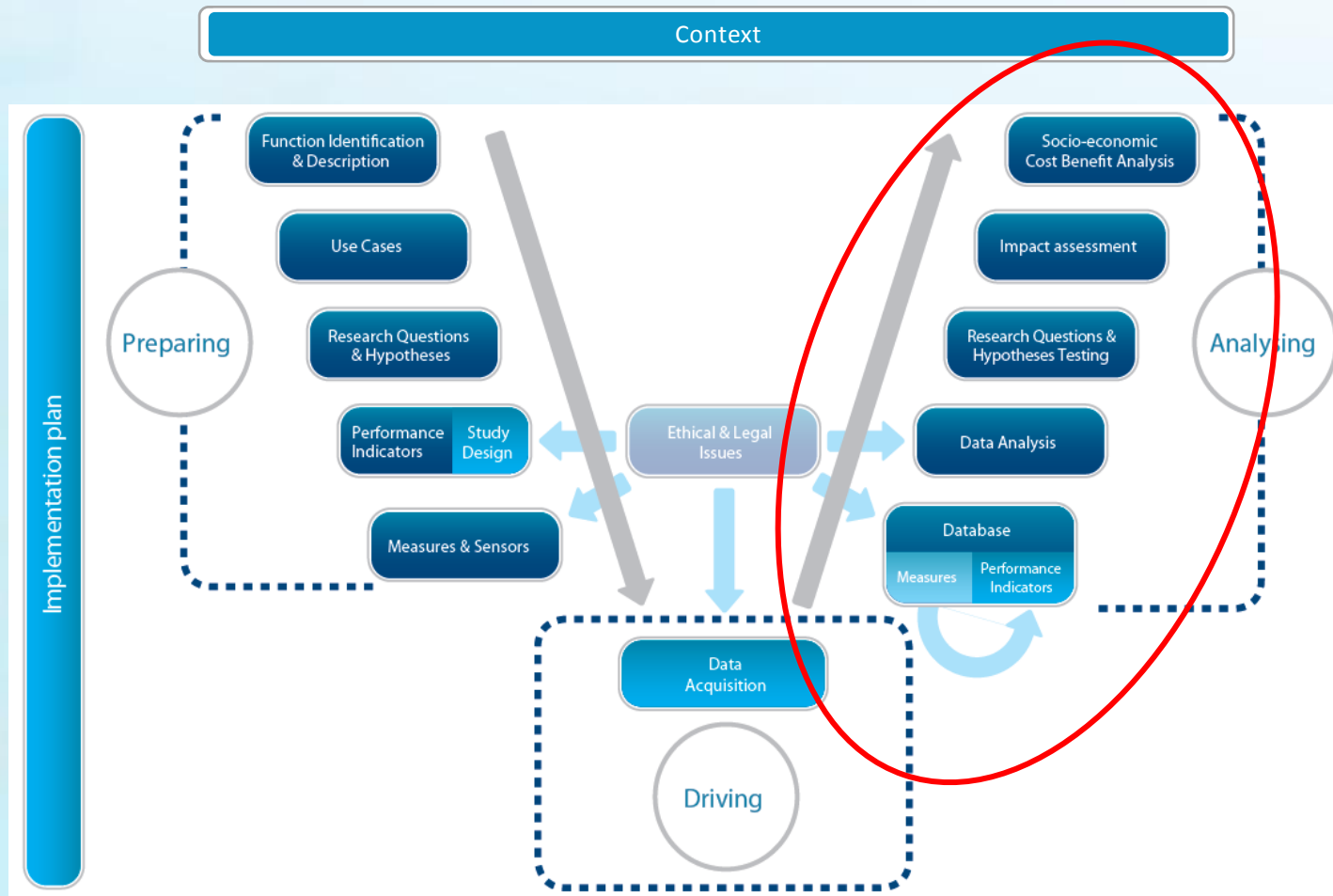
Logging & Monitoring

- Logging needs to be able to gather all needed measurements from their respective sources
- These are distributed within vehicles themselves, but also among the infrastructure and central stations
- It is necessary to observe log data collection carefully to ensure a complete view on the system (even more so, then in ADAS or NDS FOTs)

Data Handling, Sync, Enrichment

- Data is coming from different sources
 - Vehicle (built-in system and / or additional equipment)
 - Infrastructure
- Need for precise synchronization!
 - How to log data from vehicles and infrastructure and being able to synchronize
- Data retrieval
 - Remote (preferred for full naturalistic driving)
 - Manual pick-up
- Data enrichment
 - Map data
 - Situational variables (Traffic management center)

Going up the V



Evaluation

- This does not differ to much from other FOTs, but...
 - ...due to the limited amount of FoE, simulation might be necessary for upscaling results
 - ...specific analysis on penetration rate should be addressed
 - ...CBA model is a key element: who's paying and how much?
 - ...interoperability among systems and functions (technical evaluation) is to be considered

Conclusions

- Cooperative systems bring another element into FOT chain: infrastructure
- Not a mature on-the-market system!
- Data synchronization is of high importance
- Limiting element: number of vehicles to test, limited FoE
 - Simulation might be necessary to upscale results!
- No specific differences in the RQ – Hypothesis preparation
- CBA becomes necessary