EVERSAFE

Everyday Safety for Electric Vehicles

ERA-NET Electromobility +
Mid-Term Event

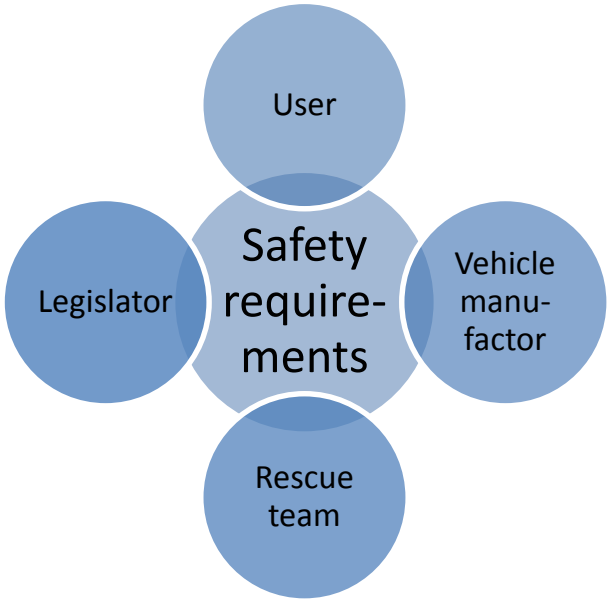
Bruno Augusto
Copenhagen, 8th February, 2014

SEVENTH FRAMEWORK PROGRAMME

EVERSAFE - Overview

- Scope: Safety of electric vehicles
- Aim: Recommendations for new safety requirements

- Timing: 2012/05 – 2014/09
- Budget: 1.6 M€
- Nr. Person Months: 153



Partners:

Sweden

vti

VOLVO

KTH VETENSKAP OCH KONST

bast

TECHNISCHE UNIVERSITÄT CHEMNITZ

Fraunhofer

Germany

EVERSAFE – Contributions to Key Dimensions

a) **Technological Strategies**
- Development of safety requirements
- Active Safety:
  - Powertrain failures and driver reaction
- Passive Safety:
  - Behavior of ESS under crash
  - Handling of ESS after crash

b) **Socio Economic Issues**
- Investigation of EV acceptance among users
- Assessment of safety concerns

EVERSAFE - Structure

WP1: Project management and dissemination

WP2: Vehicle stability and driver response

Technical WP

ACTIVE SAFETY

WP3: Crash compatibility and battery safety

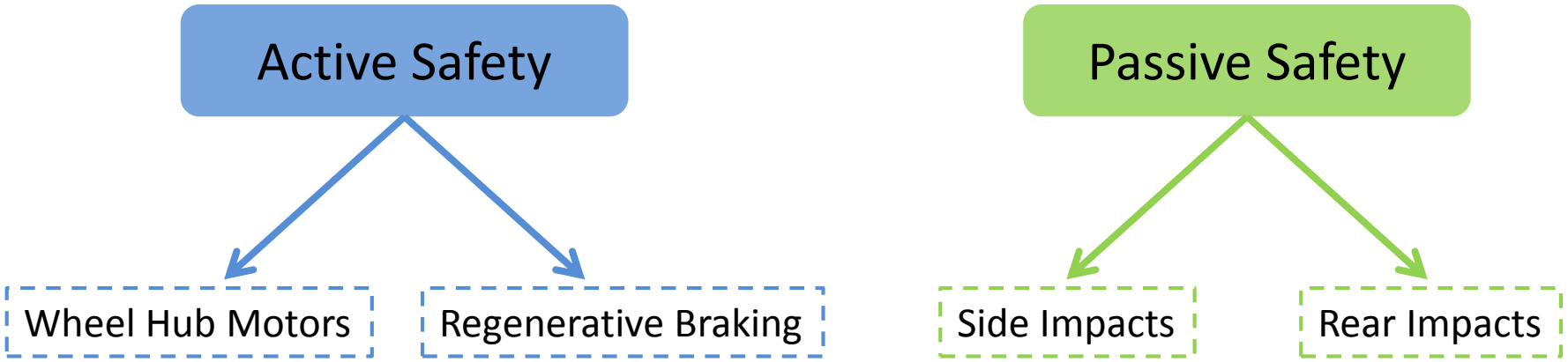
Technical WP

PASSIVE SAFETY

WP4: Problem identification and safety considerations

Problem Identification and Safety Considerations

- User Expectations
  - 23 distinct safety concerns identified
  - Concerns not only dedicated to system failures
- Test Scenario Definition



Vehicle Stability and Driver Response : Field Experiments

- Real car feedback
- Failures simulated with actuators
- Low speed tests

So Far:

- Two studies conducted on test track:
  - Reaction to wheel hub motor fault
  - Reaction to fault in regenerative braking
- Experiments complete and analysis is underway

Vehicle Stability and Driver Response : Simulator Experiments

- Simulated car feedback
- Repeatability
- High speed tests

So Far:

- One failure type was tested in the simulator.
  - Represented by braking torque on one of the rear wheels
- Different perception of failure between subjects

Crash Compatibility and Battery Safety : Crash Simulation

- Full scale car crash compatibility simulations
- Crash analyses of REESS and protective structure

So Far:

- Finite element first generation electric vehicle built
  - Modelling of batteries and protective structures
- Simulated 12 accident scenarios
  - No significant damage or intrusion in battery pack

Crash Compatibility and Battery Safety : Crash Tests

- Component tests
- Full scale car-to-car crash
- Mechanical, dynamic, chemical and electro-chemical issues

So Far:

- Shear, nail penetration, external shortcut and overcharge tests performed
  - No catastrophic results from this particular type of cell abuse
  - Overcharge led to thermal runway
- Release of toxic substances in all cases except external shortcut

EVERSAFE - Contributions

- Recommendations for new safety actions will be developed
  - Research
    - Better understanding of chemical hazards after crash, portable detection equipment for rescue crews
  - Standardization
    - Better definitions of hazard levels in ISO 26252
  - Legislation
    - Refinement of braking requirements to address regenerative braking (R 13)
    - Updating crash safety requirements for battery systems
- Guidelines and support for safety standards for electric vehicles -> Active Safety
- Concepts for safety requirements -> Passive Safety
  - Safe handling of REESS -> post-crash
  - Compatibility criteria

EVERSAFE

Thank you for your attention

Contact:

Bruno Augusto
Swedish National Road and Transport Research Institute (VTI)

Mail address: bruno.augusto@vti.se