



SAFER LEVEL CROSSING BY INTEGRATING AND  
OPTIMIZING ROAD-RAIL INFRASTRUCTURE  
MANAGEMENT AND DESIGN

# SAFER-LC Project Pilot Testing

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This project has received funding from the European Union's  
Horizon 2020 research and innovation programme under  
grant agreement No 723205



# Presentation agenda

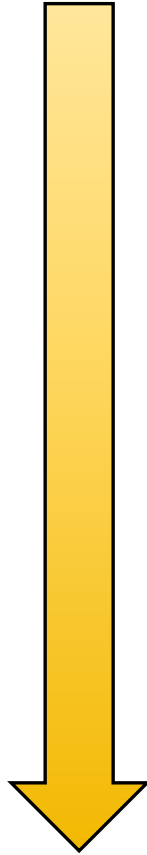
- ▲ Piloted safety measures
- ▲ Test sites
- ▲ Safety effects – Estimations assumptions
- ▲ Safety effects – Results
- ▲ Conclusions and recommendations

# Piloted safety measures

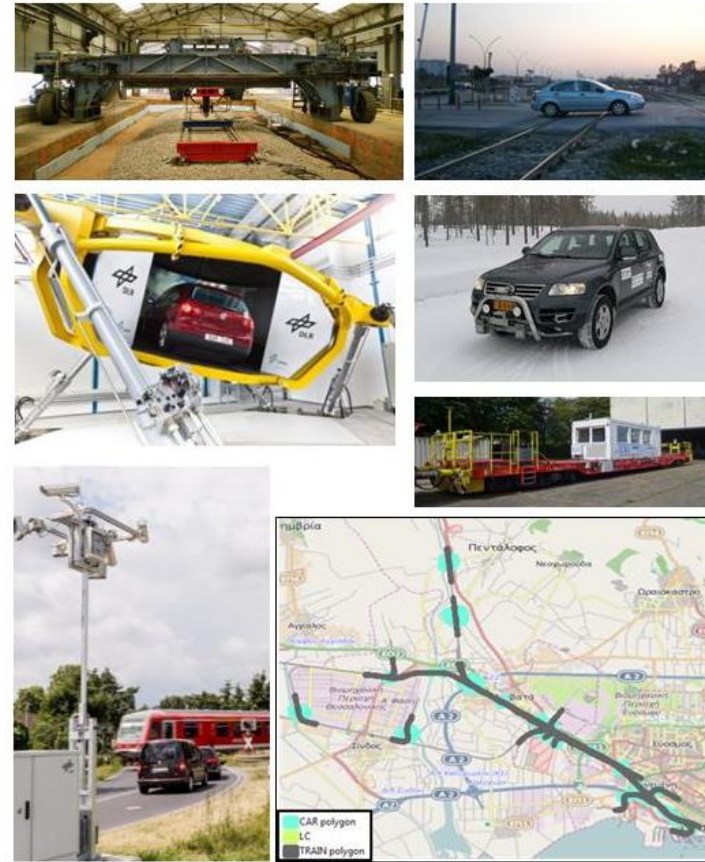
- ▲ 17 measures were piloted
- ▲ Targetted effect mechanisms:
  - ▲ Indirect safety effects (e.g. LC monitoring for detection of obstacles or maintenance-related issues)
  - ▲ Correct behaviour and LC existence awareness (e.g. passive LC signs)
  - ▲ Measures improving detectability of LC and train
  - ▲ Speed reduction
  - ▲ Active warnings, associated either with LC proximity, approaching trains or both

# SAFER-LC test sites

## Simulation



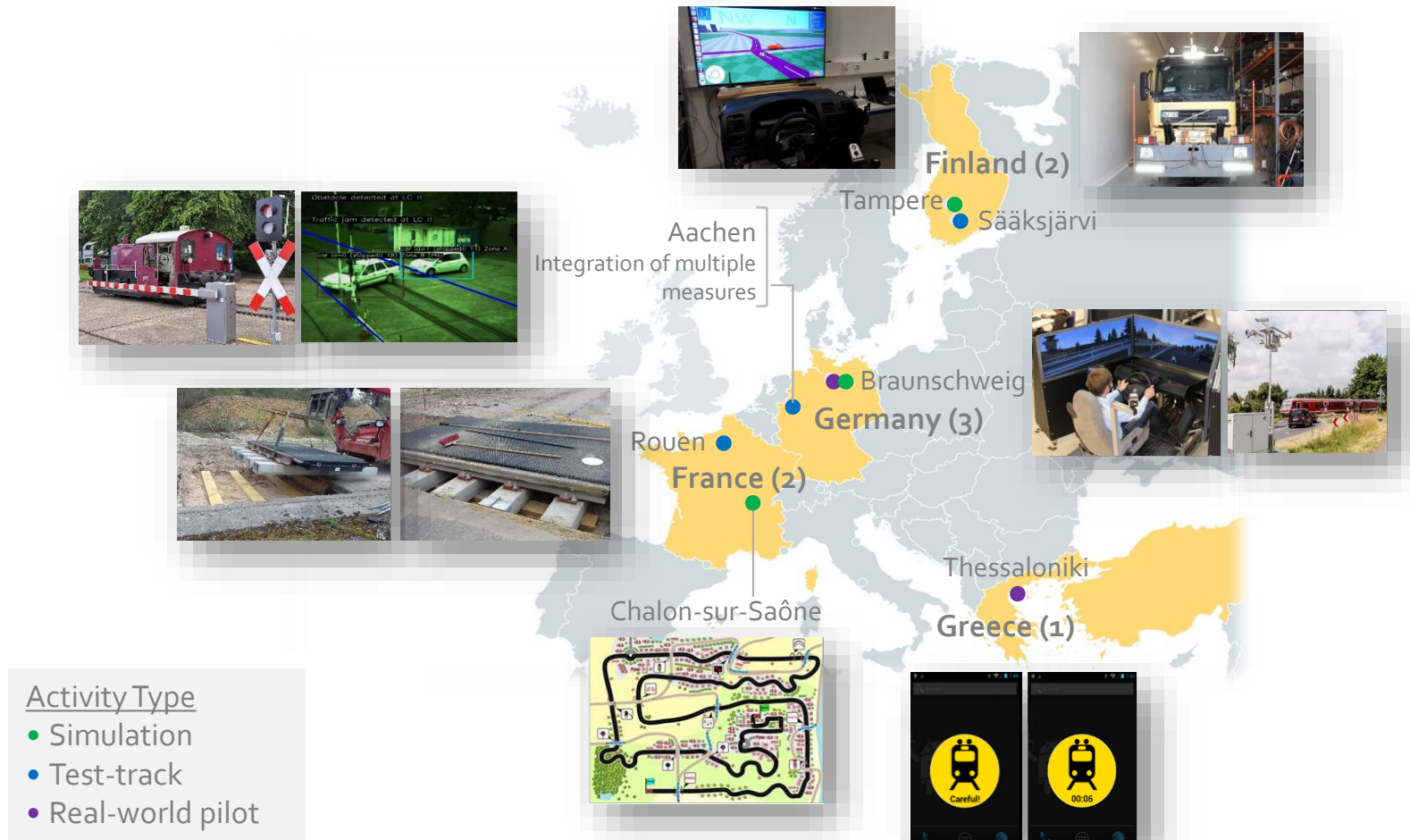
- Driving simulators (DLR, SNCF)
- Two simulation environments (VTT)
- Test-track pilot activities (RWTH, CEREMA)
- Self-driving vehicles (VTT)
- Test track under real rail environment (VTT)
- Real-world pilot activities (DLR, TRAINOSE, CERTH)



## Field tests



# SAFER-LC test sites



# Germany

## Aachen test site – Integration of multiple measures



### Tested measures (test-track)

- Smart Detection System
- Smart Communication System
- Alert to equipped vehicles
- Early train detection and hazard information

## Braunschweig test site



### Tested measures (real-world)

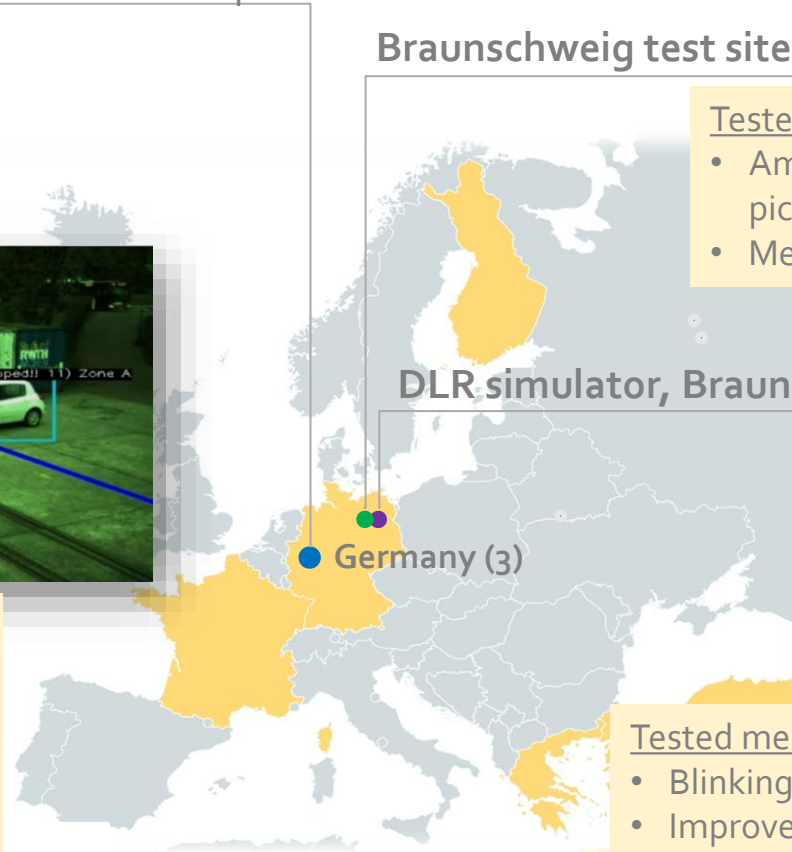
- Amber blinking light with train pictogram (electronic sign)
- Message written on the road

## DLR simulator, Braunschweig



### Tested measures (simulation)

- Blinking lights drawing driver attention
- Improve train visibility using lights
- Noise-producing pavement
- Sign look for train



### Activity Type

- Simulation
- Test-track
- Real-world pilot



# France

## SNCF simulator, Chalon-sur-Saône

### Rouen test site



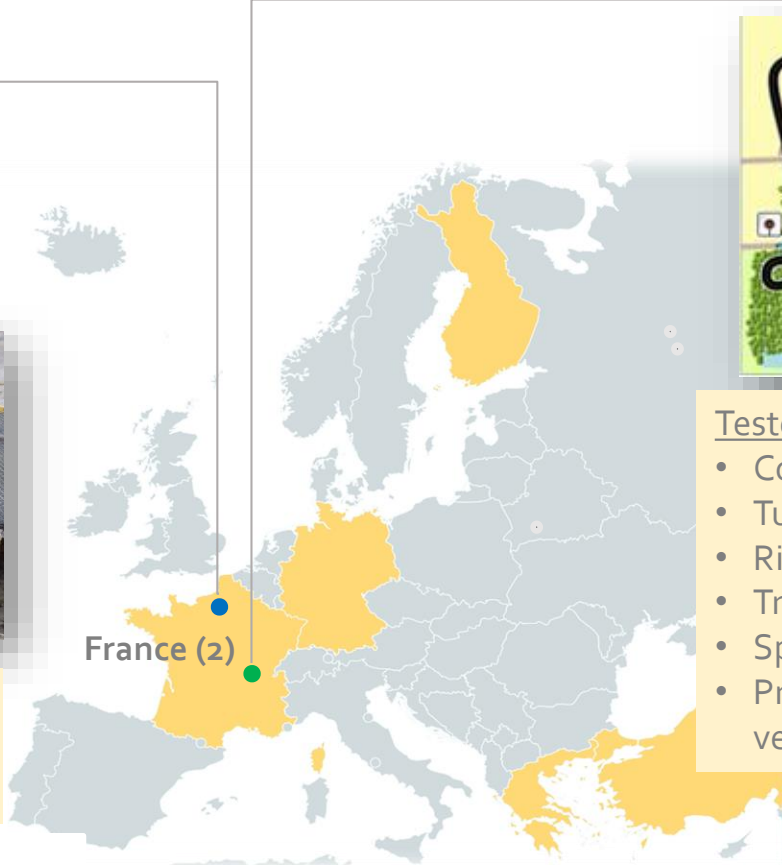
#### Tested measure (test-track)

- Monitoring and remote maintenance



#### Tested measures (simulator)

- Colored road markings
- Tunnel effect stick
- Rings
- Traffic lights
- Speed bump and flashing sticks
- Proximity message via in-vehicle device



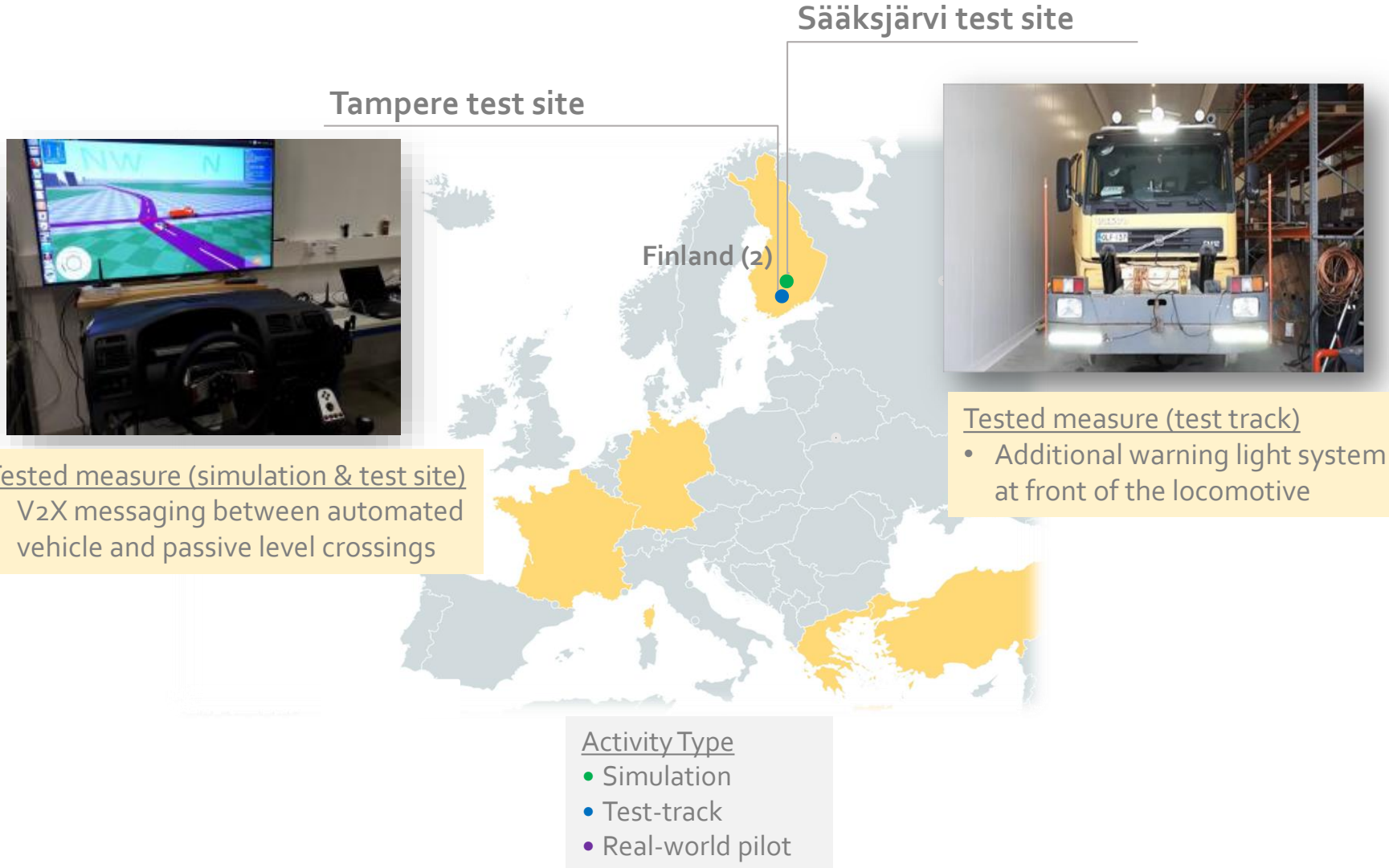
France (2)

#### Activity Type

- Simulation
- Test-track
- Real-world pilot



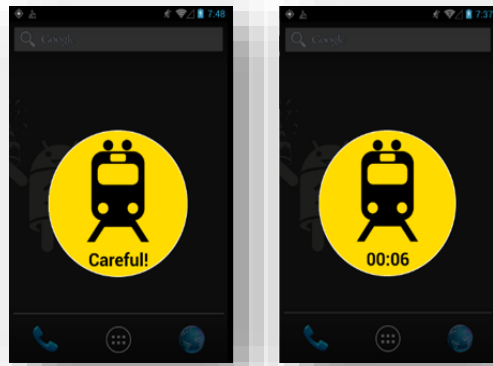
# Finland





# Greece

## Thessaloniki test site



### Tested measure (real-world)

- In- vehicle train and LC proximity alert



# Safety effects – Estimations assumptions

- ▲ An attempt was made to draw **numerical estimates of safety effects** (some uncertainties exist).
- ▲ The safety effects estimates include **assumptions**:
  - **100% implementation coverage**, meaning that all relevant LCs, trains and/or road users are equipped with the system.
  - The functionality and reliability of the system is **100% fail safe** and all the **road users receive and/or notice** the provided information and/or warnings.
- ▲ The assumptions used in the calculations are **clearly documented**.
  - Therefore, the safety estimates can be easily updated if new information become available.
- ▲ Detailed methodology in the project's **Deliverable D4.4** (available online).

# Safety effects - Estimations

Safety measure	Share of relevant LCs (%) A		Effectiveness estimate (%) B		Safety effects (%) AxB	
	Low	High	Low	High	Low	High
	Sign 'Look for train'	39.8	39.8	0.0	5.0	0.0
Road marking	39.8	39.8	0.0	5.0	0.0	2.0
Coloured road markings	100.0	100.0	0.0	5.0	0.0	5.0
Speed bumps and flashing posts	39.8	39.8	5.0	20.0	2.0	8.0
Funnel effect pylons	39.8	39.8	0.5	2.0	0.2	0.8
Noise-producing pavement	39.8	39.8	2.5	10.0	1.0	4.0
Proximity message via in-car device	25.5	25.5	0.0	5.0	0.0	1.3
Blinking amber light with train symbol	39.8	39.8	5.0	10.0	2.0	4.0
Blinking lights drawing driver attention (Perilight)	39.8	39.8	5.0	20.0	2.0	8.0
Traffic lights	25.5	25.5	0.0	5.0	0.0	1.3
In-vehicle train and LC proximity warning	39.8	100	10.0	15.0	4.0	15.0
Rings	39.8	39.8	2.5	10.0	1.0	4.0
Additional lights at the train front	39.8	100.0	15.0	30.0	6.0	30.0

\* only the measures with direct safety effects are included in this table.

# Conclusions and recommendations

- ▲ The safety effects of piloted measures are **promising**
- ▲ Measures with **highest estimated safety benefits** are:
  - ▲ **Additional lights at the train front.** Prevention of 6% to 30% of relevant LC accidents. Targets a rather large share of LC, 40–100% depending on the approach.
  - ▲ **Blinking lights drawing driver attention (Perilight).** Prevention of 2% to 20% of relevant LC accidents and targets 40% of LC.
  - ▲ **In-vehicle train and LC proximity warning.** Prevention of 4% to 15% of relevant LC accidents. Targets 40–100% of LC depending on the approach.
  - ▲ **Speed bumps and flashing posts.** Prevention of 2–8% of relevant LC accidents and targets 40% of LC.
- ▲ Some of the most promising measures should be further tested in **real-world** experiments of **larger scale** with well-planned research design
  - ▲ To obtain more information on their effects on road user behavior and thus on road safety, also on long term
  - ▲ To validate the numerical estimation of safety effects of the piloted measures

# Main reports

- ▲ Reports are online at <https://safer-lc.eu/>
- ▲ D4.1: Implementation guidelines
- ▲ D4.2: Evaluation framework
- ▲ D4.3: Pilot operation report
- ▲ D4.4: Results of the evaluation of the pilot tests



# Main contacts

- ▲ Jan Grippenkoven, DLR: [jan.grippenkoven@dlr.de](mailto:jan.grippenkoven@dlr.de) for “Implementation guidelines” and “Evaluation framework”
- ▲ Marco Petrelli, UNIROMA3: [marco.petrelli@uniroma3.it](mailto:marco.petrelli@uniroma3.it) for “Pilot operation report”
- ▲ Anne Silla, VTT: [anne.silla@vtt.fi](mailto:anne.silla@vtt.fi) for “Results of the evaluation of the pilot tests”

# Thank you for your attention!

