SAFER-LC

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

Safer Level Crossings by improved Road-Rail Infrastructure Design

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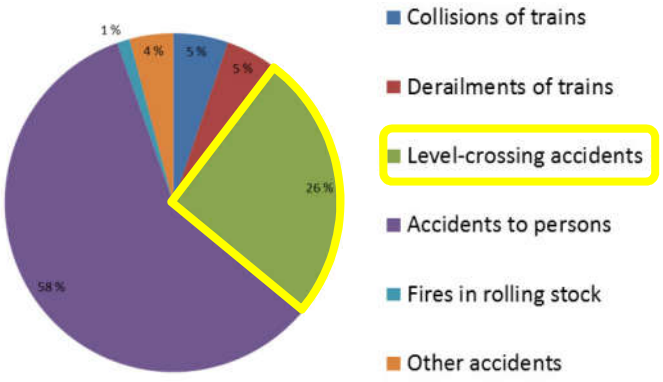
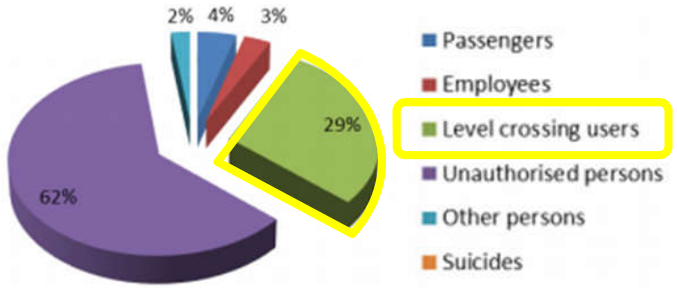
Background and Objectives



Circumstances of significant accidents in the European railway system



Victims in significant accidents in the European railway system

- **Improve safety and minimize risks at and around level crossings (LCs)**
  … by developing innovative solutions and tools to prevent incidents at level crossings
- **Focus both on technical solutions and on human processes**
  … to adapt infrastructure design to end-users
  … to enhance coordination and cooperation between stakeholders from different transportation modes.
- **Develop a toolbox integrating the project results and solutions**
  … to help rail and road managers to improve safety at level crossings.

Approach

- **Analyze LC safety systems**
- **Define needs and requirements of rail and road users for safer level crossings**
- **Develop innovative measures**
  - Human-centered low-cost measures
  - Technical solutions
- **Test and evaluate the measures**
- **Compile recommendations and guidelines**
- **Collect all results in a toolbox**

Time: May 2017 – April 2020

CONSORTIUM

COORDINATOR: 1-UIC - International Union of Railways

2-VTT - Technical Research Centre of Finland Ltd

3-NTNU - Norwegian University of Science and Technology

4-IFSTTAR - French institute of science and technology for transport, development and networks

5-FFE - Spanish Railways Foundation

6-CERTH-HIT - Centre for Research and Technology Hellas - Hellenic Institute of Transport

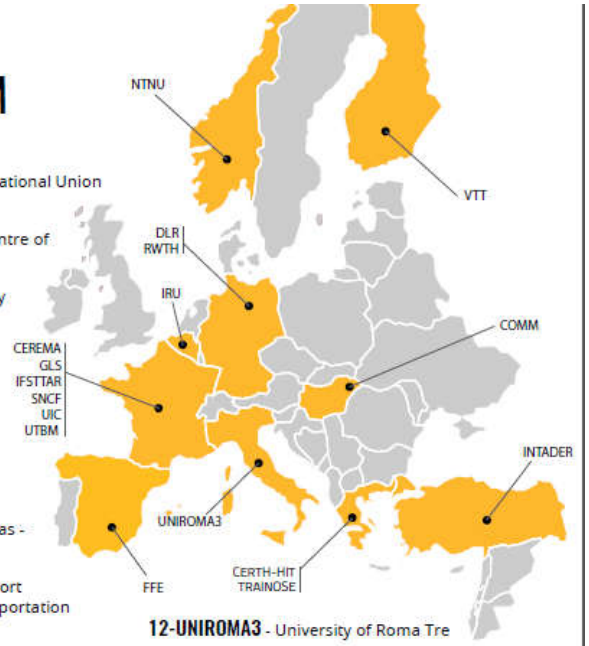
7-TRAINOSE - Trainose Transport – Passenger and Freight Transportation Services SA

8-INTADER - Intermodal Transportation and Logistics Research Association

9-CEREMA - Centre for Studies and Expertise on Risks, Environment, Mobility, and Urban and Country planning

10-GLS - Geoloc Systems

11-RWTH - Rheinisch-Westfaelische Technische Hochschule Aachen University



12-UNIROMA3 - University of Roma Tre

13-COMM - Commsignia Ltd

14-IRU - International Road Transport Union - Projects ASBL

15-SNCF - French Railways

16-DLR - German Aerospace Center - Institute of transportation Systems

17-UTBM - University of Technology of Belfort-Montbéliard

Challenges in road-user behavior

Active LCs with full barriers

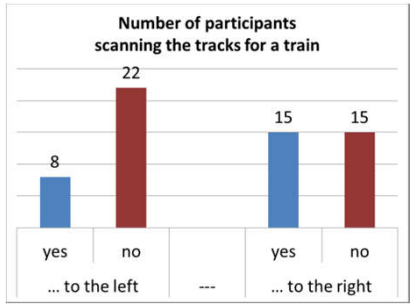
- Circumventing closed barriers (climbing over / below)
- Passing LC after pre-signaling has begun / while barriers are closing
- Getting caught between the barriers
- Getting stuck on the rails

Active LCs with half-barriers / light protection

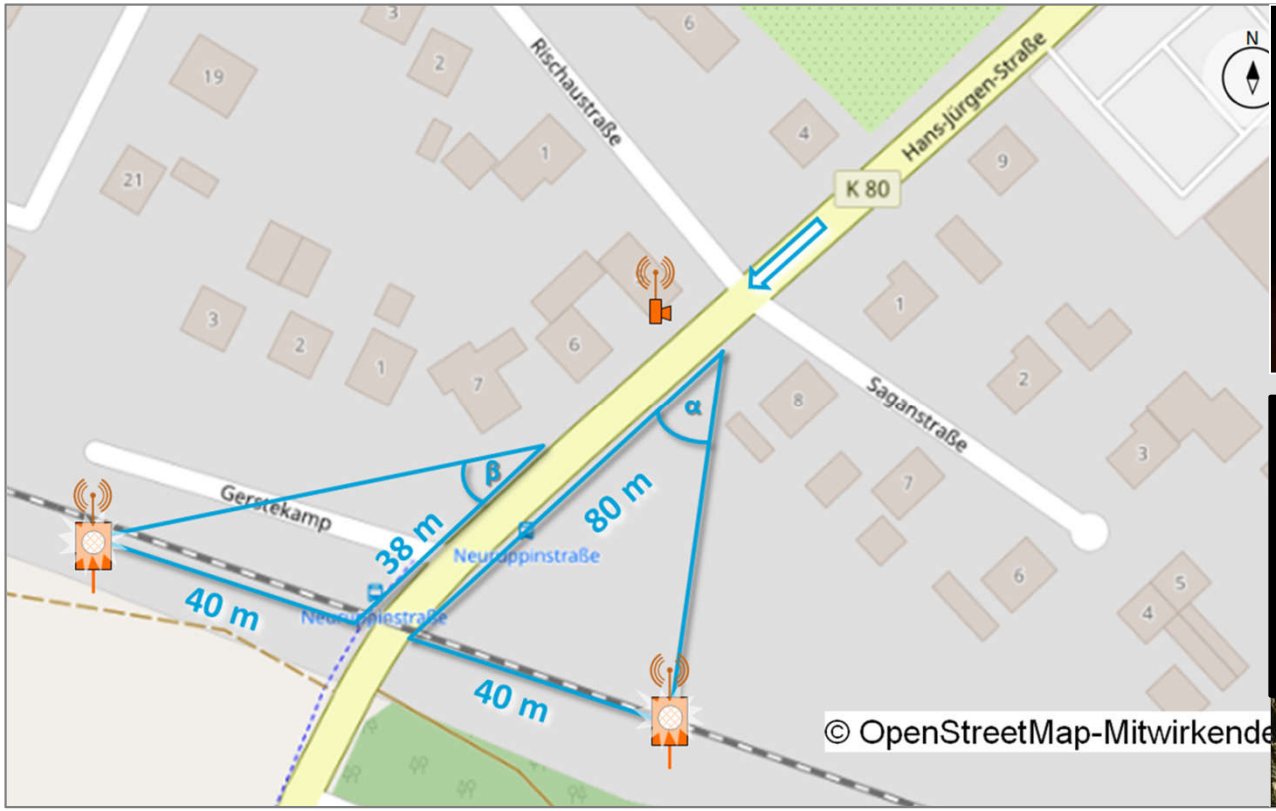
- Circumventing closed half-barriers (swerving around, climbing over / below)
- Passing in spite of active light signals (e.g. flashing red light)
- Passing after pre-signaling has begun / while barriers are closing
- Getting stuck on the rails

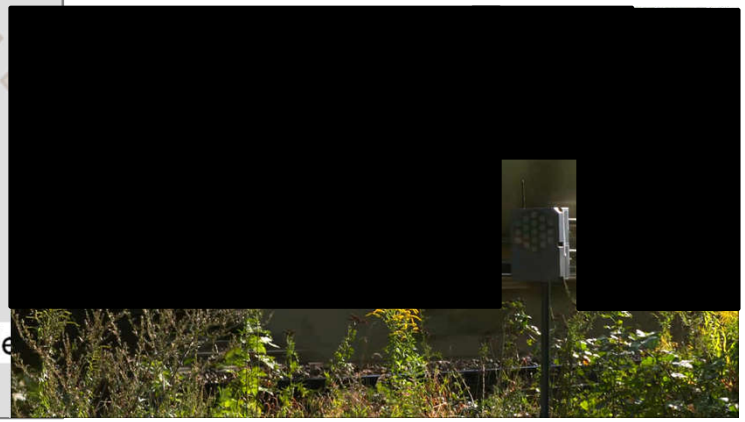
Passive LCs

- Insufficient visual scanning of tracks for train
- Insufficient adaption of approach speed to scanning needs



Peripheral blinking lights near the tracks



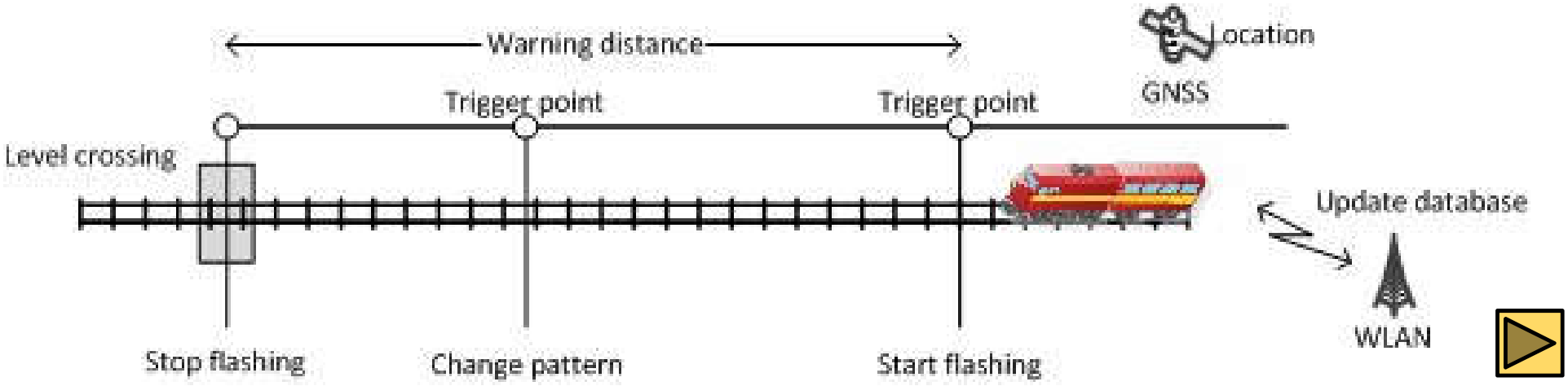


Safety effects on driver behavior

LC safety layout	% participants fixating visual ROI	
	Left Periphery	**Right Periphery**
Standard passive LC	**64,6**	**45,8**
Peripheral blinking lights	**83,7**	**65,1**
Rumble Strips	**66,7**	**40,0**
Sign ← Is a train coming? →	**80,0**	**46,7**

- peripheral blinking lights near the tracks
  - …induced **large increases in visual search for a train** both **to the left** and the **right side** of the tracks
  - .. induced significant **speed reduction** on approach to the LC
  - … gained **high participant ratings** on **usefulness** and **moderate to high ratings** on **ease-of-use** dimensions
- Test: driving simulator study (Silla et al., in prep.)

Auxiliary strobe light system for trains



Safety effects on driver behavior

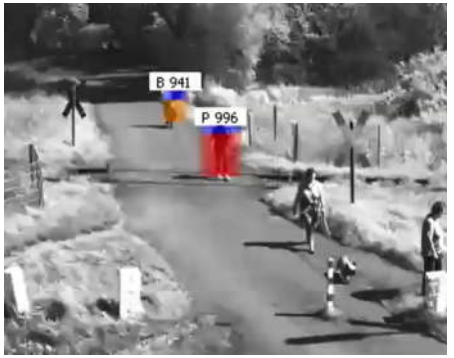
- Trains equipped with auxiliary strobe lights
  - … were **detected earlier** and **more reliably** than standard trains
  - …were associated with **earlier** and **stronger speed reduction** on approach
  - … gained **high participant ratings** on **usefulness** and **ease-of-use** dimensions
- Test: driving simulator study (Silla et al. 2019)

All pilot tests - overview

Simu-lation

Field

Testsites	Measures tested
Traffic data simulation (VTT)	V2X messaging system between automated vehicles and passive level crossings
Road Driving Simulators (DLR, SNCF)	Rumble strips, RU-activated peripheral blinking lights, Sign ← Is a train coming? →, Blinking lights on train; Coloured road markings on LC approach, Funnel effect sticks, Rings upstream of LC, Traffic light, Speed bump and flashing sticks, Proximity message via in-car device
Test track with mock-up LC and rail vehicle (RWTH , CEREMA, UTBM, COMMSIGNIA, IFSTTAR, Geolog, neoGLS)	Smart Detection system, Smart Communication system, Early detection and hazard information by cooperative perception messaging and driver's warning
Test site for LC monitoring and remote maintenance (CEREMA)	Monitoring and remote maintenance
Real-world rail environment at Rukkamaki, Finland (VTT)	Additional warning light system at locomotive front
Real-world LC at Braunschweig, Germany (Traffic data acquisition, DLR)	VRU-activated blinking amber light with train symbol, warning message written on road
29 real-world LCs at Thessaloniki, Greece (CERTH , TRAINOSE, DLR)	In-vehicle train and LC proximity warning



Outlook

- Aggregation of all results in web-based **SAFER-LC toolbox,** to be used by road and rail infrastructure managers, train operators, engineers, designers, scientists, policy makers and standardization bodies

- Content:
  - All collected safety measures
  - Empirical findings on effectiveness
  - Consideration of potential negative effects and restrictions
  - Recommendations for application

- Browsable according to specific problems and application contexts

- **Consideration of the *human factors that lead to errors and violations* in road-user behavior is essential in finding solutions that are both effective and low-cost.**

Thank you for your attention!

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http://safer-lc.eu/

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References

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- Silla, A., Lehtonen, E., Virtanen, A., Boufidis, N.; Salanova Grau, J.M.; Dressler, A.; Grippenkoven, J.; Taillandier, V.; Khoudour, L.; Jacqueline, D.; Antoine, R.; Boukour, F.; Edelmayer, A.; Ruffin, C.; Kassa, E. & Korkmaz, C. (in prep.). Results of the evaluation of the pilot tests. *Deliverable D4.4 of the SAFER-LC project*