SAFER-LC

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

SAFER-LC WP1

Task 1.2 Identification of typical factors behind LC accidents

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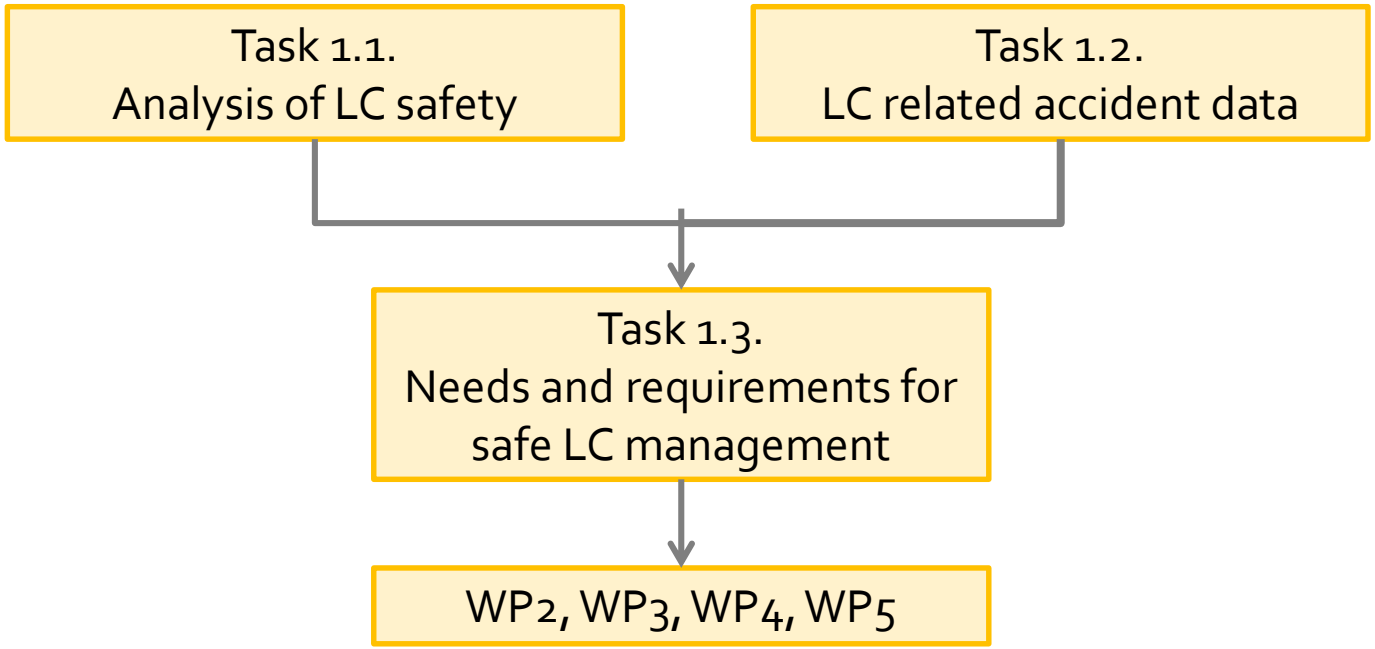
Objective of Task 1.2

- To produce an in-depth review of level crossing (LC) accident data collected in seven countries, namely Greece, Finland, France, Italy, Norway, Spain and Turkey



Data collection

- The involved partners were responsible for collecting the data from relevant sources in their country
- Aim was to collect accident data covering the past 5-year period
  - In practice, the extent of data period varied between 4–10 years
- The coverage of the in-depth LC accident data varied among countries
  - In most cases the number of cases included in the in-depth LC accident analysis was smaller than the one reported to ERA.
- The reasons for these differences varied between countries

Summary of received LC accident data

Country		Years	Total number of						
			Fatal accidents (fatalities)	Accidents with serious injuries (serious injuries)	Accidents with light injuries (light injuries)	Accidents with property damage	Unknown	Accidents	Involved persons[1]
Greece	EL	2012–2017	16	6	11	55	3	91	33
Finland	FI	2006–2015	56 (65)	0 (6)	2 (6)	3	0	61	77
France	FR	2012–2016	134 (146)	147 (307)[2]		297	0	578	453
Italy	IT	2011–2015	8 (15)	2 (5)	1 (57)	0	1	12	77
Norway	NO	2012–2016	9 (10)	4 (5)	6	20	1	40	21
Spain	ES	2013–2016	26	12	25	40	0	103	63
Turkey	TR	2012–2016	15 (34)	8 (23)	5 (25)	4	0	32	82

[1] Total number of involved persons refers to total number of victims. Therefore, this number might be higher than the total number of accidents with personal injuries.

[2] SNCF database do not distinguish the injuries

Collected data

- The collected data was investigated and reported both by organisations independent from railways and by railway stakeholders
- Independent from railways:
  - **Greece**: The Local Authority for Railway Accidents and Incidents
  - **Finland**: The Road Accident Investigation Teams
  - **Italy**: DiGIFEMA (Direzione Generale per le Investigazioni Ferroviarie e Marittime)
- Railway stakeholders:
  - **France**: Safety department of SNCF Réseau (French railway operator). In case of dramatic or serious accident, the investigation is conducted and reported by BEATT who is an independent structure of Ministry
  - **Norway**: Investigation and Analysis Unit of Bane NOR (the Norwegian infrastructure manager)
  - **Spain**: The main sources were the Administrator of Railway Infrastructure's safety database and Level Crossing Inventory database (the Spanish infrastructure manager). The National Accident Investigation Commission (CIAF) is an independent body in charge of the technical coordination of accident investigation.
  - **Turkey**: Accident investigations conducted by TCDD personnel (Turkish State Railways). In case of the higher victim number, the investigation is conducted by the accident research and investigation board of Ministry

Country	ERA statistics 2011–2015	Data period	Delivered in-depth data	Reasons for differences
Greece	30 fatalities 23 serious injuries	2012–2017	16 fatalities 6 serious injuries 11 light injuries 55 property damage	• Different time periods • Focus on car drivers and not on how many persons were in the car
Finland	18 fatalities 18 serious injuries	2006–2015	65 fatalities 6 light injuries 3 property damage	• Some non motor vehicle accidents can be missing • Victim died at the hospital • In-depth data includes suicides
France	147 fatalities 86 serious injuries	2011–2015	171 fatalities 75 serious injuries	• Reasons for the differences are not known • Lower number of serious injuries might be due to the existence of several infrastructure managers
Italy	53 fatalities 36 serious injuries	2011–2015	15 fatalities 7 serious injuries 56 light injuries	• DiGIFEMA investigates only a subset of railway accidents. The selection of cases is not always done based on the seriousness of the accident
Norway	6 fatalities 4 serious injuries	2012–2016	10 fatalities 4 serious injuries 7 light injuries 20 property damage	• Different time period • In-depth data includes suicides
Spain	34 fatalities 14 serious injuries	2013–2016	26 fatalities 12 serious injuries 25 light injuries 40 property damage	• Different time period
Turkey	170 fatalities 208 serious injuries	2012–2016	34 fatalities 23 serious injuries 25 light injuries 4 property damage	• No template for accident reports • No digital records of accident reports (some old ones difficult to read) → focus on reports with good coverage of information

Available variables by country

Title	Variable	Country						
		Greece	Finland	France	Italy	Norway	Spain	Turkey
Collision	Outcome (choose the most severe consequence)	X	X	X	X	X	X	X
	Type of road vehicle	X	X	X	X	X	X	X
	Month	X	X	X	X	X	X	X
	Day of the week	X	X	X	X	X	X	X
	Hour	X	X	X	X	X	X	X
	Year	X	X	X	X	X	X	X
Victim	Type of victim	X	X	X	X	X	X	X
	Type of road user	X	X	X	X	NA	NA	X
	Outcome	X	X	X	X	X	NA	X
	Gender	(X)	X	X	(X)	NA	NA	X
	Age	NA	X	X	X	NA	NA	X
	Intentionality	(X)	X	NA	X	X	NA	X
	Involvement in secondary tasks	NA	X	NA	X	NA	NA	X
	Intoxication	(X)	X	(X)	(X)	NA	NA	(X)
Road environment	Road traffic volume (AADT)	X	X	X	X	X	NA	X
	Type of road	X	X	X	X	X	X	X
	Road speed limit	X	X	X	X	X	NA	X
	Number of lanes per direction	X	X	NA	X	X	NA	X
	Type or road surface	X	X	NA	X	X	X	X
	Existence of level crossing sign before LC	X	X	NA	X	X	(X)	X
	Inclination	X	X	NA	X	X	NA	X
	Crossing angle (between road and track)	X	X	X	X	X	NA	X
Railway environment	Daily train volume (passenger + freight)	X	X	X	X	X	X	X
	Speed limit for person trains (km/h)	X	X	X	X	X	NA	X
	Speed limit for freight trains (km/h)	X	X	X	X	X	NA	X
	Condition of wait platform	X	X	NA	X	NA	X	X
	Number of tracks	X	X	X	X	X	X	X
LC characteristics	Type of LC	X	X	X	X	X	X	X
	Location of LC	X	NA	X	X	X	X	X
	Sight distances (from the road)	NA	X	NA	X	X	NA	X
Circumstances	Weather	(X)	X	(X)	X	NA	NA	X
	Lighting conditions	(X)	X	NA	X	NA	NA	X
Train	Train	X	NA	NA	X	X	(X)	X
Effect	Delay (number of minutes)	(X)	NA	NA	X	NA	NA	X
	Delay (number of trains cancelled)	NA	NA	NA	NA	NA	NA	X
	Costs (euros)	NA	NA	NA	X	NA	NA	X
Main factors affecting the accident		X	NA	X	X	X	NA	X

Collision

Variable	
Type of road vehicle	• Most often passenger car • The share of LC accidents in which no road vehicle was involved varied between 3% (in Greece) and 67% (in Norway) • The victims in more than half of LC accidents resulting in fatalities were pedestrians, cyclists, mopedists or motorcyclists in France, Spain and Norway
Month	• LC accidents are fairly evenly distributed throughout the year
Day of the week	• All days of the week are rather equally represented • A slightly higher share of LC accidents occurred during weekdays compared to weekends in Spain and in Turkey
Hour	• Most LC accidents occur during daytime, especially between 9 am and 6 pm • The share of LC accidents occurring in the evening or night time varied between 3% (in Spain) and 23% (in Greece and in Norway)

Victim

Variable	
Type of victim	• The victims are most often car drivers or pedestrians
Type of road user	• For those countries that collect this type of data the involved road users were typically local inhabitants; the share varied between 84% and 100%
Gender	• The victims were typically men, the share varied between 66% and 100%
Age	• In France 46% of fatal victims were 60 years or older • In Finland the corresponding share was 33%
Intentionality	• Most investigated databases include accidents only
Secondary tasks	• Only few databases included information • Based on the Finnish data the identified secondary tasks were: use of mobile phone, having conversation or listening to radio, attention focused on other paasengers, concentrated on thoughts or unidentified distraction
Intoxication	• Ony few databases included information • In Finland 22% of fatal victims were intoxicated

Road environment

Variable	
Road traffic volume	• In France 24% of LC accidents occur at LCs where road traffic volume is higher than 5 000 road vehicles per day • In Greece, in Finland and in Norway the road traffic volumes are typically smaller
Type of road	• All LC accidents in Turkey and in France analysed in this task occurred on streets
Road speed limit	• A high share of level crossing accidents occurred in areas where the road speed limit is rather low • The share of level crossing accidents which occurred in locations where road speed limit is 50 km/h or less was 100% in Turkey, 95 % in Norway, 87% in Greece, 83% in Norway and 78% in France.
Number of lanes	• The road passing the level crossing had typically one lane per direction
Type of road surface	• Asphalt pavement in most LC accidents in Greece (98%) and in Italy (92%) • Road was typically unpaved in LC accidents in Finland (54%) and in Norway (60%)

Road environment

Variable	
Existence of LC sign	• The coverage was 100% in France, 98% in Finland, 81% in Greece, 78% in Turkey and 75% in Italy.
Inclination	• The inclination of the road was typically less than 1.5% (flat) • In Finland there was a relatively high share of level crossing accidents (46%) where the inclination was at least 1.5% (hill).
Crossing angle	• The crossing angle between the road and the track was typically 70–110 degrees in most countries • France was the only country where the crossing angle was most often (80% of accidents) less than 70 degrees.

Railway environment

Variable	
Train traffic volume	• Rather low at accident LCs in Greece, in Norway, in Finland and in Turkey • Higher train traffic volumes could be found at LCs in France, Italy and Spain
Speed limit of passenger trains (km/h)	• Vary somewhat between countries • In some countries the passenger train speeds were rather high. For example, the passenger trains had a speed limit higher than 90 km/h in 63% of LC accidents in France. The corresponding share was 77% in Italy and 58% in Finland.
Spped limit of feight trains (km/h)	• The speed limits are somewhat lower for freight trains than for passenger train
Condition of wait platforms	• The condition of wait platform was estimated as good in most LC accident locations in Spain (46%) and in Turkey (75%). The estimation was most often average in Italy (67%) and poor in Greece (41 %) and in Finland (43 %).
Number of tracks	• LC accidents occurred typically at single-track railway sections in Finland (98%), in Norway (97%), in Spain (82%), in Turkey (74%) and in Greece (60%) • LC accidents occurring at double-track railway sections were more common in France (61%) and in Italy (58%)

LC characteristics

Variable	
Type of level crossing	• LC accidents occurred typically at passive level crossings in Finland (68%), in Turkey (47%) and in Spain (40%) • Most accidents occurred at LCs equipped with automatic user side protection and warning in France (72%) and in Norway (45%) • Most LC accidents occurred in LCs equipped with automatic user side protection and warning combined with rail side protection in Greece (57%) and in Italy (67%)
Location of level crossing	• Most LC accidents occurred in urban environments in Greece (63%), In France (56%), in Italy (58%) and in Turkey (63%) • In Norway 95% of LC accidents occurred in rural environment
Sight distances	• The sight distances were in most cases according to instructions in Finland (82%) and in Norway (91%) • According to the received accident data there were rather high share of accident LC s with poor visibility in Italy (75%) and in Turkey (69%)

Circumstances

Variable	
Weather	• Little information was available • In Finland the weather was typically sunny (48%) or cloudy (43%) • In Italy and in Turkey most of the accident occurred for which the weather information was available occurred during sunny weather • In France the most reported weather condition during LC accidents was snowy weather
Lighting conditions	• Little information available • Out of those accidents for which the information was available most occurred during day light in each country

Train

Variable	
Type of involved train	• The train involved in LC accidents was typically a passenger train

Effect

Variable	
Delays (in minutes)	No clear conclusion can be drawn based on the limited data
Delays (number of trains)	
Delays (in euros)	

Main factors affecting the realisation of the accident

- Breakdown of the car at the LC
- Non-observation of road signage
- Overtaking the queueing traffic
- Visibility: glare from the sun
- Car violating the barriers
- Car abandoned in LC
- Excessive speed
- Distraction
- Loss of control (vehicles or bicycles)

Distribution of the share of different types LCs in LC accidents vs. the share of different types of LCs

	Country	TYPE OF LEVEL CROSSING								TOTAL
		Automatic user side warning	Automatic user side protection	Automatic user side protection and warning	Automatic user side protection and warning and rail side protection	Manual user side warning	Manual user side protection	Manual user side protection and warning	Passive level crossing	
Share of LC accidents (%)	EL	0	0	0	58	0	0	14	27	100
	FI	2	0	30	0	0	0	0	68	100
	FR	13	0	72	0	0	1[1]	0	14	100
	IT	0	25	0	67	0	0	0	8	100
	NO	11	3	45	3	0	0	5	34	100
	ES	0	0	30	29	0	0	0	40	100
	TR	0	0	33	0	0	19	0	47	100
Share of LCs (%)	EL	0	0	0	49	0	3	0	48	100
	FI	3	0	20	0	0	0	0	77	100
	FR	0	0	68	0	0	0	10	22	100
	IT	0	0	71	5	0	0	0	23	100
	NO	3	1	10	0	0	0	0	86	100
	ES	16	0	0	19	0	0	1	64	100
	TR	0	0	27	0	0	8	0	66	100

[1] Due to unknown reasons these LCs are not included in the ERA database.

Recommendations on accident database which will be used in later stages of SAFER-LC

- Interest of WP2: victim details, road and railway environment, LC characteristics, circumstances
- The coverage of victim details varied between countries and in several cases they are lacking. Proposal to have a close cooperation of
  - Different parties involved in accident investigation
  - At international level
  - With road infrastructure managers
- The information on the type of victim is important from the traffic safety point of view
  - Allocation of resources and identification of target groups
  - Increase of awareness and concerns about LC accident prevention

Recommendations regarding in-depth LC accident database contents in general

- The exploitation of the in-depth LC accident data is not possible if the data is not available to the interested organisations
  - The access rights to the data should ideally be given to railway stakeholders and organisations involved in traffic safety work
  - The victim information could ideally also be available to research purposes
- The yearly number of fatalities and serious injuries did not perfectly match with the number of cases reported to the ERA database
  - Increase of cooperation
- A European wide recommendation on LC accident data collection including proposal on most useful variables to be collected

Conclusions

- The added value of our analysis compared to the data available in the ERA database is
  - From some countries we have also information on accidents causing light injuries and accidents causing property damage only
  - We have information on wide variety of variables related to the LC accidents