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Deliverable D1.2

Level crossing accidents and factors behind them

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Authors:
Anne Silla, Harri Peltola, Elina Aittoniemi & Henri Sintonen, VTT
Annie Kortsari, CERTH-HIT
Virginie Taillandier, SNCF
Louahdi Khoudour & Christian Françoise, CEREMA
Marco Petrelli & Alessandra Renna, UNIROMA3
Elias Kassa, NTNU
Sarah Whalley & Laura Lorenzo, FFE
Elif Hatice Öztürk & Gokhan Karahan, INTADER

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Consortium - List of partners

Partner No	Short name	Name	Country
1	UIC	International Union of Railways	France
2	VTT	Teknologian tutkimuskeskus VTT Oy	Finland
3	NTNU	Norwegian University of Science and Technology	Norway
4	IFSTTAR	French institute of science and technology for transport, development and networks	France
5	FFE	Fundación Ferrocarriles Españoles	Spain
6	CERTH-HIT	Centre for Research and Technology Hellas - Hellenic Institute of Transport	Greece
7	TRAINOSE	Trainose Transport – Passenger and Freight Transportation Services SA	Greece
8	INTADER	Intermodal Transportation and Logistics Research Association	Turkey
9	CEREMA	Centre for Studies and Expertise on Risks, Environment, Mobility, and Urban and Country planning	France
10	GLS	Geoloc Systems	France
11	RWTH	Rheinisch-Westfaelische Technische Hochschule Aachen University	Germany
12	UNIROMA3	University of Roma Tre	Italy
13	COMM	Commsignia Ltd	Hungary
14	IRU	International Road Transport Union - Projects ASBL	Belgium
15	SNCF	SNCF	France
16	DLR	German Aerospace Center	Germany
17	UTBM	University of Technology of Belfort-Montbéliard	France

Executive summary

The aim of this deliverable was to produce an in-depth review of level crossing (LC) accident data collected from seven countries, namely Greece, Finland, France, Italy, Norway, Spain and Turkey. The involved partners were responsible for collecting the data from relevant sources in their country. The proposed main data sources were accident investigation reports from railway operators and national accident investigation bodies.

Summary and description of the collected data

There was some variation in the data sources the involved partners used to collect the in-depth LC accident data. The collected data was investigated and reported both by organisations independent from railways (Greece, Finland and Italy) and by railway stakeholders (France, Norway, Spain and Turkey). The list of accident investigation bodies can be found below:

- Greece: The Local Authority for Railway Accidents and Incidents (independent from railways and supervised by the Minister of Infrastructure, Transportation and Networks)
- Finland: The Road Accident Investigation Teams (independent from railways)
- 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
- Italy: DiGIFEMA (Direzione Generale per le Investigazioni Ferroviarie e Marittime) (independent from railways)
- Norway: Investigation and Analysis Unit of Bane NOR (the Norwegian infrastructure manager)
- Spain: The main sources of accident data for Spain 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 which own and operate all public railways in Turkey). In case of the higher victim number, the investigation is conducted by the accident research and investigation board of Ministry since 2015.

The original aim of this work was to cover accident data from the past 5-year period. In practice, the extent of data period varied between 4–10 years. Most of the countries provided the requested five years of data (France, Italy, Norway and Turkey) whereas the Spanish data covered 4 years, the Greek data 6 years and the Finnish data 10 years. The total number of reported accidents by country varied between 12 and 578 and the number of involved persons varied between 21 and 453.

The coverage of the in-depth LC accident data varied among countries when comparing the number of cases reported to European Union of Railways (ERA) database and the number of cases included in the in-depth LC accident data. 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. When comparing the received in-depth accident data

to the number of cases reported to the ERA database, we can also see that our in-depth sample includes information on some light injuries and property damage accidents which are not reported to the ERA database.

The coverage of in-depth LC accident samples with regards to the different requested variables varied between variable categories. The summary of the categories and the coverage of each group of variables is provided in the following:

- Collision related information (time of accident, outcome, type of involved vehicle): All variables were covered by the accident data samples from all countries
- Victim related information (type of victim, gender, age etc.): Finnish, Italian and Turkish data samples covered all or almost all variables. French had more limited data and Greek, Norwegian and Turkish data samples included no (or little) information on victims.
- Road environment (road traffic volume, type of road etc.): Most data samples covered all variables. French and Spanish data samples included limited amount of information on road related variables.
- Railway environment (train volume, train speed limits etc.): These variables were covered rather well; Spanish data sample did not include information on train speeds and French and Norwegian data did not include information on wait platforms
- LC characteristics (type of LC, location of LC etc.): Type of LC covered by all countries; more limited information regarding location of LC and sight distances
- Circumstances (weather, lighting conditions): The information related to these variables were mostly missing
- Train: No information from Finland and France; other countries had a limited or full coverage
- Effect (delays, costs): Mostly missing. Some information was received from Turkey, Italy and Greece
- Main factors affecting the accident: Relatively well covered

Representativeness of collected data with regards to the LC safety situation

This chapter focuses on the representativeness of collected LC in-depth accident data with regard to the general LC safety situation in each country. This comparison was proposed to be done, for example, based on a longer period and/or larger sample of LC accident data than the collected data sample.

Greece

The comparison between the data collected by ERA and the data collected by the Greek Authorities for the two periods (2011–2015, 2012–2017) shows that there is a decrease in accidents taking place in LCs in Greece. The overlapping of three years (2012–2015) emphasizes this fact, as the difference is even larger. This is in agreement with the fact that safety is LCs in Greece has been slightly improved during the last years.

Finland

The representativeness of the Finnish in-depth LC accident data was analysed by comparing the results with the findings from Laapotti (2016) who investigated fatal motor vehicle accidents at level crossings in Finland from 1991–2011 (also investigated by Road Accident Investigation Teams).

She found out that most accidents took place at passive level crossings. Furthermore, Laapotti found out that almost all the immediate risk factors in the LC accidents were of the human error type. Observation errors on the part of the road user were typical at passive level crossings, and risk taking at active crossings. The environment did not support safe crossing in most of the accidents at passive level crossings. The speed limits of both the road and rail were high, visibility was insufficient, and the level crossing was often situated on a hill. Our in-depth data sample supports most of the findings of Laapotti. The slight difference concerns the visibility of the accident level crossings. According to our sample the visibility was good in 82% of LC accidents. Laapotti concluded that the visibility was sufficient on 63% of LC accidents at passive LCs and on 93% of LC accidents at active LCs.

France

In general, a reduction of LC accidents (collisions and fatalities) has been observed from 1990 to 2016. Compared with the accident numbers in 1990, there has been a decrease of 53% of collisions and 43% of fatalities. At the same time, the number of LCs in France has been reduced by 25%.

Italy

The investigated and collected data represent in a satisfactory way the LC safety situation in Italy.

Turkey

Because of missing accident reports, rubbed out reports and missing data, the in-depth accident data collection in Turkey focused on analysing specific accident reports which covered nearly all of the required variables and LC accidents occurring between the years 2012–2016 and also nearly all of the required data.

According to the database of Turkish Railways (TCDD) 116 of the 196 LC accidents occurred at passive LCs and 42 at LCs with automatic user side protection and warning. Regarding the distribution on the type of level crossings and severity of injury, the accident analysis showed that the accident numbers are highest for passive LCs followed by LCs equipped with automatic user side protection and followed by warning. The most serious problem related to the LC accidents occurring in Turkey is risk taking and violation.

As mentioned above, due to various reasons it was not possible to analyse all the LC accidents occurring between the years 2012–2016. However, it was realised that during 2012–2016, three separate LC accidents were reported in one specific LC in Turkey. It is the highest number of accidents occurring at the same LC. The first occurred in 2011 and the last in 2016, the second report is missing. In addition, there were also additional LCs in which two separate accidents have occurred.

Comparison of collected data with regards to the LC inventory

This text focuses on the comparison of LC in-depth accident data with regards to the LC inventory in each country.

Comparison of collected data with regards to the type of LCs
In order to simplify this analysis the level crossings were divided into two types: 'passive level crossing' and 'active level crossing' (EU DIRECTIVE 2016/798). A 'passive level crossing' is one without any form of warning system or the protection is activated when it is unsafe for the user to traverse the crossing. An 'active level crossing' is one where the crossing users are protected from or warned of the approaching train by devices which are activated when it is unsafe for the user to traverse the crossing. These active level crossings can be either manual or automatic.

As mentioned earlier, there are some variations by country on the type of level crossings the most LC accidents occur. If using the above-mentioned simplification to active and passive LCs, Finland is the only country where LC accidents are more common in passive than in active level crossings (68% vs. 32%). This is not surprising since 77% of level crossings are passive in Finland. The share of LC accidents occurring at active level crossings is the highest in Italy (92%), followed by France (86%) and Greece (73%). When looking at the share of LCs in each country we can see that in these countries the share of active LCs is also the highest: 78% in France, 77% in Italy and 52% in Greece.

In Norway 66% of LC accidents occur at active level crossings even though the share of active LCs in Norway is only 14%. The results of in-depth data analysis indicate that LC accidents at active level crossings are overrepresented in Norway. Both in Spain and in Turkey somewhat higher share of LC accidents occur at active LCs compared to the share of active LCs of all LCs in these countries.

Comparison of collected data with regards to other LC related variables

Finland
Most level crossing accidents (52%) occur at level crossings with road speed limit of 80 km/h. When looking at all LCs 76% of them have this road speed limit so the level crossings with road speed limit of 80 km/h are somewhat underrepresented in LC accidents. The high share of road speed limits of 80 km/h is due to the fact that it is a general speed limit in Finland (i.e. the valid speed limit if not stated otherwise).

Most level crossing accidents (63%) in Finland occur at LCs with low daily road traffic volumes (100 road vehicles per day or less). However, when looking at the distribution of LCs by road traffic volume we can see that in 79% of Finnish LCs the daily road traffic volume is 100 road vehicles per day or less. Based on this the LCs with low road traffic volume are underrepresented in LC accident statistics. This same applies to train traffic volume: most level crossing accidents (68%) in Finland occur at LCs with low train traffic volume (20 trains per day or less) whereas 85% of LCs have this low train traffic volume.

France
The comparison of accident data to LC inventory reveals, for example, that urban areas are overrepresented in LC accidents. In France 55% of LC accidents occur in urban areas while 31% of LCs are located in urban areas.

Italy
The investigated data used for the in-depth accident analysis are relevant also in comparison with the LC Italian inventory. The distribution of road traffic volume in LCs with accidents is similar to all LCs. The LCs in Italy are typically located on roads with low traffic volumes and the traffic level changes mainly according to the area (rural or urban). The distribution of train traffic volume in LCs with accidents is not similar to all LCs in Italy. The train traffic volume in Italy varies geographically: the train traffic in the North of Italy is different from the South of Italy where the level of traffic is smaller.

Turkey
As seen in the analysis, LC accidents happen in both the LCs which are equipped with automatic barriers, have very good sight distances and very good design and at passive LCs which are located in rural areas with very bad design criteria. A majority of LC accidents in Turkey occurred at passive LCs. Turkish Railways builds passive LCs to locations where the daily average number of trains in a year multiplied by the daily average number of road vehicles in a year is up to 3000 and the maximum speed limit is 120 km/h.

In general, there are several variables, which can be used as indication of the safety of LCs. According to the LC accident prediction models (see e.g. Peltola 2013) the main factor affecting the prediction of level crossing accidents is the exposure which refers to the number of road and rail vehicles using the level crossing. According to the accident prediction model of Peltola the other factors affecting the prediction are existence of warning devices, speed limit on the road and rail, sight distances and type of road surface.

When looking at the LC related variables from the safety improvement viewpoint the type of road surface could, for example, indicate something about the type of environment (rural or urban) where the LC is located. This could in turn indicate something about the ease of installation, operation and maintenance of protection devices especially with regards to LCs in isolated rural locations.

The analysis conducted in this deliverable focused mainly on information included in one data table at the time. Therefore no in-depth analysis of accidents in relation to other variables to understand the significance of such variables as risk factors was not conducted (e.g. different characteristics of the road environment in relation to the proportion of LCs that can be found in such circumstances). This would have been interesting but within the scope of this study such depth of analysis was not reasonable. We rather gathered data available for further analyses based on the needs in WP2.

Recommendations regarding in-depth LC accident databases

The main aim of this task was to produce recommendations of LC accident database contents in general and concerning the accident database which will be used in later stages of SAFER-LC project for the assessment of the innovative measures to improve the safety of level crossings. The variables which are especially interesting from human factors point of view are the victim details. The detailed information about the victim profile such as type of victim, his/her qualities, motives and/or behaviour provide valuable input data when assessing the possible effects of LC safety measures. The coverage of victim details varied between countries and in several cases they were lacking. The coverage of victims details could be improved e.g. by a close cooperation of different parties involved in accident investigation. In addition, the road infrastructure managers could be better involved in the LC accident investigation process to collect and share information regarding LC accidents with railway stakeholders and/or independent accident investigation bodies. If needed, the cooperation could also be done at international level e.g. to consult colleagues in other countries to share practices used in collecting data in their country related to some specific variables.

Moreover, the information on the type of victim is important from the traffic safety point of view. The more detailed information on victims of level crossing accidents supports the authorities and railway stakeholders in their decision making process when deciding on how to allocate the funds for the traffic safety work and to decide on which audiences to target. Here the traffic safety work refers to implementation of different LC safety measures including safety campaigns. The more detailed information on victims of level crossings accidents might also increase the awareness and concern about the level crossing accidents and the importance of their prevention in general.

Other interesting variables from WP2 point of view are related to road and railway environment, LC characteristics and circumstances. The detailed information of the surroundings of LCs and the types of LCs were the LC accidents occur, for example, allow the planning and identification of different safety measures to different types of level crossings.

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. In addition, the victim information could ideally also be available to research purposes. In this case of open data the anonymity of the data should be respected and taken care of with appropriate procedures.

One major challenge is that the data collection procedures and the amount and details of documented data vary between countries. It was clear that this is the current situation in Europe. However, it was surprising to note that the yearly number of fatalities and serious injuries did not perfectly match with the number of cases reported to the ERA database in each country. Therefore, the recommendation is to increase the cooperation between the organisations conducting the in-depth LC accident investigations and the organisations which report the yearly accident numbers to the ERA database. Furthermore, it would be useful to have a European wide recommendation on LC accident data collection including proposal on most useful variables to be collected. A more detailed European wide LC accident data would enable more detailed analysis of LC accidents and would lead to useful conclusions.

The in-depth LC accident data available in each country was not in most cases directly available in the format as requested in this task. This might be due to several different and often culturally related factors which affect the collection of accident data or the extent in which the accident data is made available. It must also be noted that since there was a need to structure the information requested in a comparable way according to the pre-defined template, some information collected and documented in the accident reports may have been missed.

Even though the collected in-depth LC accident data does not in most cases cover all the occurred LC fatalities and/or accidents in that specific country, the added value of our analysis compared to the data available in the ERA database is a) that from some countries we have also information on accidents causing light injuries and accidents causing property damage only, and b) we have information on wide variety of variables related to the LC accidents.

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1. INTRODUCTION

1.1. Objectives of SAFER-LC project

The main objective of the SAFER-LC project is to improve safety and minimise risks at and around level crossings (LCs) by developing a fully integrated cross-modal set of innovative solutions and tools for the proactive management and new design of level-crossing infrastructure. These tools will enable

i. Road and rail decision makers to achieve better coherence between both modes
ii. Effective ways to detect potentially dangerous situations leading to collisions at LCs as early as possible,
iii. Prevent incidents at level crossing through innovative design and predictive maintenance methods, and
iv. Mitigate the consequences of incidents/disruptions due to accidents or other critical events.

The main output of the SAFER-LC project is a toolbox which will be accessible through a user friendly interface which will integrate all the project results and solutions to help both rail and road stakeholders to improve safety at level crossings.

1.2. Purpose of this deliverable

This deliverable reports the work conducted in Task 1.2 of Work package 1. The aim of Task 1.2 was to produce an in-depth review of LC accident data in seven countries involved in this task, namely: Greece, Finland, France, Italy, Norway, Spain and Turkey. The involved partners were responsible for collecting the data from relevant sources in their country. Analysis concentrated on variables such as details on collision, victim, road and railway environment, level crossing characteristics and circumstances. At the end the accident data was compared to the inventory of the local LC conditions by country.

In addition to the in-depth LC accident data analysis the current situation of level crossing safety was analysed based on European and worldwide statistics.

The other tasks of Work package 1 focus on identifying the differences in level crossing environments between countries (Task 1.1) and combining the findings from Task 1.1 and Task 1.2 to produce a list of requirements and recommendations to be taken into account when developing and testing innovative LC safety solutions (WP2, WP3) and when developing and applying the evaluation method to estimate the feasibility of the tested innovative LC safety solutions (WP2 and WP4) (Task 1.3).

1.3. Definitions

The below definitions were described as in Commission Regulations No 1192/2003 (European Commission 2003) and as in railway safety statistics of Eurostat (Eurostat 2016).

Concept	**Definition**
Level crossing accident	Any accident at level crossings involving at least one railway vehicle and one or more road vehicles, other users of the road such as pedestrians or other objects temporarily present at or near the track.
Suicide (intentional harm)	An act to deliberately injure oneself resulting in death, as recorded and classified by the competent national authority.
Significant accident	Any accident involving at least one rail vehicle in motion, resulting in at least one killed or seriously injured person, or in significant damage to stock, track, other installations or environment, or extensive disruptions to traffic. Accidents in workshops, warehouses and depots are excluded.
Serious injury accident	Any accident involving at least one rail vehicle in motion, resulting in at least one killed or seriously injured person. Accidents in workshops, warehouses and depots are excluded.
Person killed (fatality)	Any person killed immediately or dying within 30 days as a result of an accident, excluding suicides.
Person seriously injured	Any person injured who was hospitalised for more than 24 hours as a result of an accident, excluding attempted suicides.

1.4. Country codes

Code	Country
AT	Austria
BE	Belgium
BG	Bulgaria
CH	Switzerland
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
EL	Greece
ES	Spain
FI	Finland
FR	France
HR	Croatia
HU	Hungary
IE	Ireland
IT	Italy
LT	Lithuania
LU	Luxembourg
LV	Latvia
NL	The Netherlands
NO	Norway
PL	Poland
PT	Portugal
RO	Romania
SE	Sweden
SI	Slovenia
SK	Slovakia
UK	United Kingdom
TR	Turkey

2. LEVEL CROSSING SAFETY IN EUROPE AND WORDWIDE

2.1. Level crossing safety in Europe

In 2014 there were 114,580 level crossings in the 28 EU Member States. On average, there are five level crossings per 10 line-km in the EU. The highest densities of level crossings per line-km can be found from Sweden, Austria and the Czech Republic where there are more than 75 level crossings per 100 kilometres of railway line. The lowest densities of level crossings can be found from Bulgaria and Spain where there are less than 25 level crossings per 100 line kilometres. The number of level crossings has decreased with a speed of about 4% per year over the past five years across Europe. (European Union Agency for Railways 2016).

In 2014, in total 2,076 significant railway accidents occurred in the EU Member States resulting in 1,054 fatalities and 819 seriously injured persons. Level crossing accidents represent 24% of all significant railway accidents when railway suicides are excluded. (European Union Agency for Railways 2016).

The risk at level crossings in the EU countries is presented in Table 1 and Table 2. Table 1 presents the level crossing fatalities per million train kilometres whereas Table 2 covers seriously injured persons per million train kilometres. In addition to the country level analysis, the risk at level crossings was also analysed at EU-28. Based on EU-28 numbers both the risk of fatalities and serious injuries has decreased over the years. The risk of fatality reduced from 0.105 (2006–2008) to 0.068 in 2015 whereas the risk of serious injury reduced from 0.112 (2006–2008) to 0.061 in 2015.

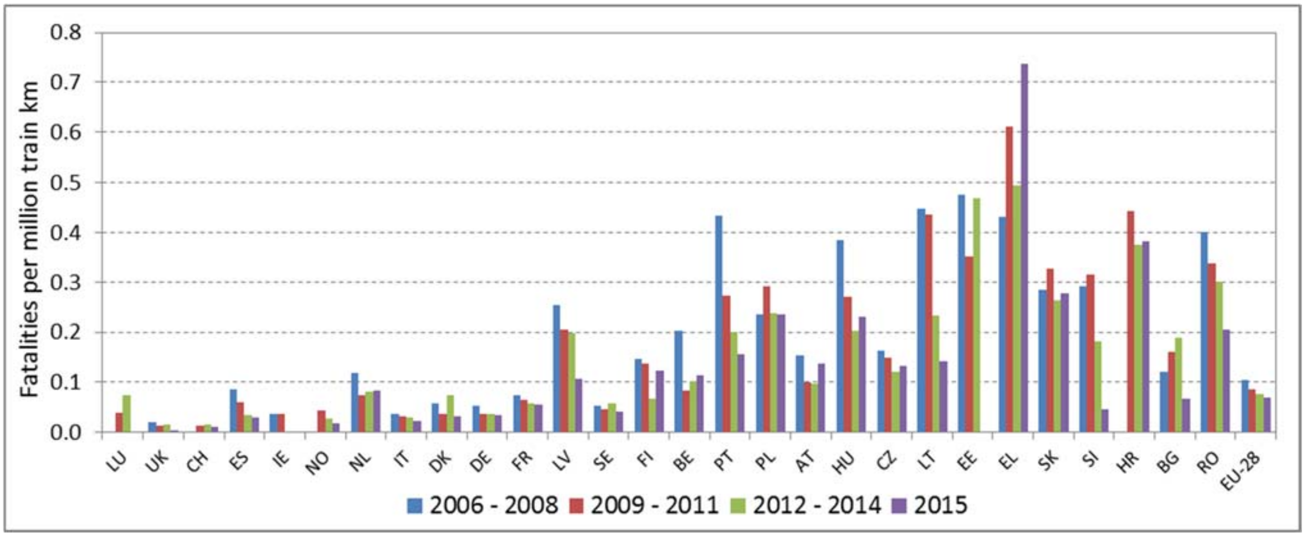

Table 1. Level crossing fatalities per million train kilometres in the EU by country and by EU-28 (European Union Agency for Railways 2016).

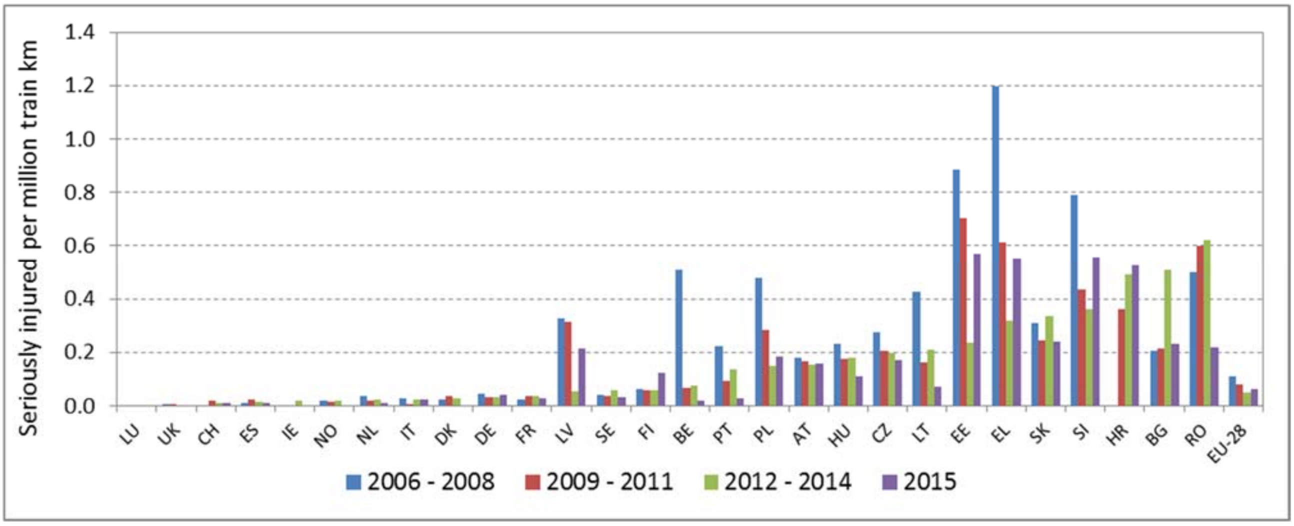

Table 2. Seriously injured persons per million train kilometres in the EU by country and by EU-28 (European Union Agency for Railways 2016).

2.2. Level crossing safety worldwide

The data sources for worldwide level crossings statistics are limited. An attempt to construct a comparable table indicating the risk at level crossings as with the European Union Agency for Railway (ERA) data was done for some selected non-European countries based on the statistics of the International Level Crossing Awareness Day (ILCAD) and International Union of Railways (UIC) (Table 3). The countries presented in Table 3 were selected based on the availability of the data. According to the information presented in Table 3 the risk of fatal collision at level crossing is clearly higher in Turkey and slightly higher in U.S. compared to EU-28.

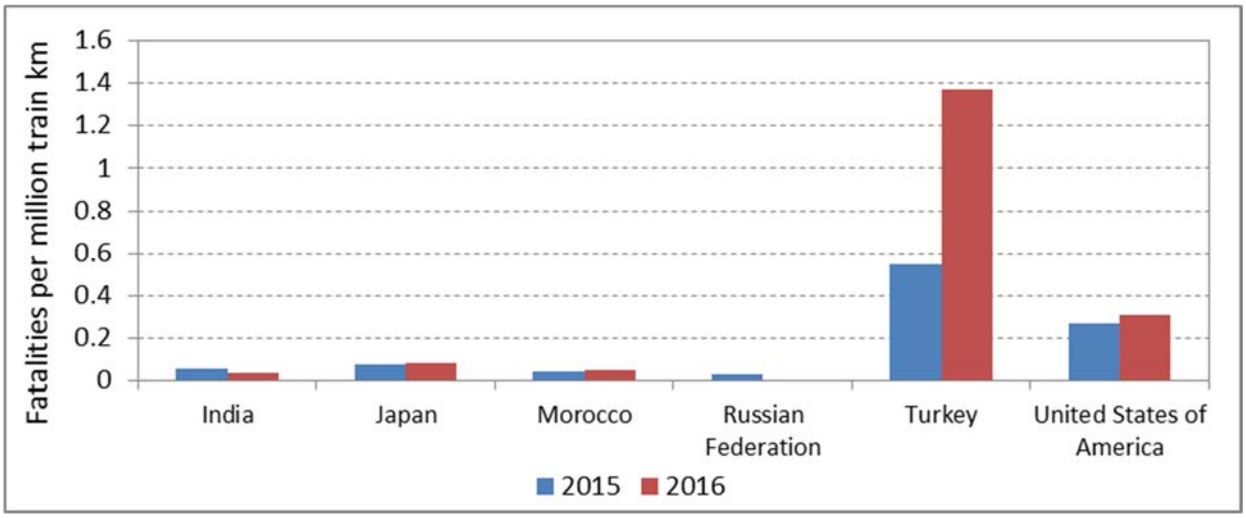

Table 3. Level crossing fatalities per million train kilometres in some selected non-European countries (ILCAD 2017, UIC 2017).

3. IN-DEPTH DATA COLLECTION AND ANALYSIS

In-depth LC accident data were collected by involved partners from their country. The aim was to collect in-depth accident data covering the period of the past 5 years. Analysis concentrated on variables such as details on collision, victim, road and railway environment, level crossing characteristics and circumstances. At the end, the accident data was compared to inventory of the local LC conditions by country.

3.1. Data collection

The list of variables requested from each country is described in Annex A (Variables and levels of information for in-depth accident data collection). This data collection form used as a basis a relevant form which was built in the framework in the RESTRAIL project to collect in-depth data on train-pedestrian collisions (Silla et al., 2012).

The requested data included variables related to i) collision, ii) victim, iii) road and railway environment, iv) LC characteristics, v) circumstances, vi) involved train, and vii) delays caused by the accidents. In addition, the main factors affecting the accidents according to the accident report were requested. At the end, there was also some space to add description of any other relevant detail or additional description related to fixed variables. These additional details should, for example, include the description of the secondary tasks the road user was involved in, clarification of the safety equipment in the LC or clarification related to chosen *Other* variables.

The in-depth LC accident data was collected from seven countries involved in this task (Greece, Finland, France, Italy, Norway, Spain and Turkey). The involved partners were responsible for collecting the data from relevant sources in their country. The proposed main data sources were accident investigation reports from railway operators and national accident investigation bodies. The data collection started at the beginning of June and continued for two months till the end of July.

The data collection sources and accident investigation procedures for each country are presented in the following chapters. In addition, the tables following the earlier mentioned descriptions include short discussion on i) the coverage of the collected in-depth accident data in relation to the ERA statistics and ii) the availability of requested variables.

3.1.1. Greece

The Authority responsible for the investigation and reporting of accidents taking place at level crossings in Greece is the Local Authority for Railway Accidents and Incidents. This Authority has been established within the framework of provisions made by article 21 of L. 3710/2008 (Government Gazette No 216A'/23.10.2008) and its task is to investigate all accidents and incidents that occur in the railway network. The authority is located in Athens, holds operational consistency and administrative independence and is supervised by the Minister of Infrastructure, Transportation and Networks. It is functionally independent from the Railway Safety Department and from any railways regulatory body including the Railway Authority of Greece.

Due to the fact that currently the Authority for Railway Accidents and Incidents is understaffed, accidents are often investigated by the Police and other stakeholders from the railway company (railway operator, railway infrastructure manager etc.).

In case of an accident or incident, the local police authorities request from the Railway Operator the following:

- Locomotive driver's report;
- Train personnel reports;
- Locomotive driver's license;
- Locomotive insurance and
- A copy of a speed graph in time of the accident.

Apart from the above, either the Authority or the police, requests from the Railway infrastructure manager to provide information regarding the railway line infrastructure, the systems that were in use in the exact LC at the time of the accident, etc.

Trained personnel exist in all depot sites around the Greek territory that are responsible for the investigation of the accidents and for the provision of the necessary data and reports to the authorities.

The categories for accidents occurring at level crossings, for which data is collected, include actually all accidents, from collision to fatalities. The accidents that are treated as serious are the ones who meet the respective criteria of EU law. In this respect, "serious accidents are considered the ones in which any train collision or derailment of trains takes place, resulting in the death of at least one person or serious injuries to five or more persons or extensive damage to rolling stock, the infrastructure or the environment, and any other similar accident with an obvious impact on railway safety regulation or the management of safety. As "extensive damage" is considered the damage that can immediately be assessed by the investigating body to cost at least EUR 2 million in total.

In the case of a "serious accident", an investigation team is immediately formed by the Railway Infrastructure Manager and is responsible for the investigation of the circumstances under which the accident occurred. The final investigation report includes the description, the documentation and the causes of the accident. Moreover, the report includes information in regards to potential fatalities, injuries and damages. Finally, the report concludes (if possible) on the causes of the accidents and potential responsible involved person(s).

	ERA statistics 2011–2015 (Greece)	Greek in-depth LC accident data 2012–2017
Number of persons killed in LC accidents	30	16
Number of persons	23	6

seriously injured in LC accidents		
Number of light injuries	-	11
Number of property damage accidents	-	55
Reasons for differences in number of investigated cases vs. ERA data	According to ERA, 30 people have been killed in Greece LCs from 2011 to 2015. According to the infrastructure manager and the railway operator's files, 16 people have been killed from 2012–2017. Unfortunately no data is available for the year 2011 so different periods cannot be compared to each other. It should also be noted that the data collected in Greece focus on the car driver and not on how many people there were inside the car. The fact that ERA statistics report zero events in case of light injuries probably means that ERA collects data only in case of serious injuries. According to the Greek infrastructure manager, 11 cases of light injury were reported.	
Reasons for missing information (list of variables for which no information was available; reasons for the missing data)	The type of data collected in Greece is different to the type of data proposed to be collected as part of Task 1.2. For example, the infrastructure manager and railway operator do not collect data regarding weather and lighting conditions at the time the accident occurred.	

3.1.2. Finland

The Road Accident Investigation Teams are in charge of the practical implementation of road and off-road traffic accident investigations. They investigate all fatal road and off-road traffic accidents (including level crossing accidents). Each investigation team have expert representation from the police, medicine, vehicle technology, road maintenance and behavioural sciences. If needed, other special branches can also be involved in the investigation.

There are 20 investigation teams operating in different parts of Finland. They have a total of approximately 300 members. The teams are mainly positioned according to the current regional borders. The investigation team members are subject to public liability and a non-disclosure obligation.

The Finnish Crash Data Institute (OTI) coordinates the work of road accident investigation teams but does not intervene in the independent working of the teams. OTI also takes care of the training of the teams, the use of investigation results, and information services.

The team members collect information about the vehicles involved in an accident, the drivers and passengers in these vehicles, the accident site, and the road and weather conditions. Accidents are investigated with regard to the

- chain of events
- risk factors
- consequences and

- circumstances

The investigation follows the specified investigation procedure to the letter, and standard forms are used for the investigation.

The investigation team prepares an investigation report that includes a description of how the accident happened, the factors leading up to it and its consequences, as well as the investigation team's proposed improvements to traffic safety. The teams do not investigate guilt or compensation issues related to accidents.

	ERA statistics 2011–2015 (Finland)	Finnish in-depth LC accident data 2006–2015
Number of persons killed in LC accidents	18	65
Number of persons seriously injured in LC accidents	18	0
Number of light injuries	-	6
Number of property damage accidents	-	3
Reasons for differences in number of investigated cases vs. ERA data	The Finnish in-depth LC accident data from 2011–2015 covers 16 fatalities. The Road Accident Investigation Teams should investigate all fatal motor vehicle level crossing accidents but in practice (when compared to ERA statistics) it can be seen that not all fatalities are covered. The missing cases can be e.g. pedestrian fatalities at LCs or information on fatal accident was received so late that investigation was not started (e.g. person died later at the hospital). Furthermore, the in-depth LC accident data from 2011–2015 included three cases which were classified as suicides by the Road Accident Investigation Team. According to definitions, these cases should not be included in the ERA statistics as LC accidents. In addition, in some cases the Road Accident Investigation Teams investigate LC accidents with no fatalities if they are, for some reason, found interesting.	
Reasons for missing information (list of variables for which no information was available; reasons for the missing data)	The Finnish in-depth LC accident data collected by the Road Accident Investigation Teams did not include any information on delays or the type of train which was involved in the collision. The information on delays is not included since it is not in their focus (not the focus of their investigation). Information on delays could be found from the documents of the Finnish Transport Agency. Information on the involved train can be found when reading the in-depth accident investigation folders. However, due to the limited resources the investigation conducted as part of this study focused only on the investigation results available in electronic accident information register (coded database). There was often either no information available on the specific level crossing where the collision occurred. The exact accident locations	

	(LCs) were identified based on other accident data sources of VTT, when possible, in order to include LC related information to our database (e.g. type of LC). This complementary data source did not include any information on the location of LC (whether LC is located in urban or rural environment). However, the road speed limit could provide an indication on the type of environment surrounding the LC.

3.1.3. France

An accident report is realized by a team in safety department of SNCF Réseau. It is carried out within the framework of Decree 2006–1279 of 19/10/2006 modified by Decree 2015-143 of 10/04/2015. It informs EPSF, BEATT and SNCF RESEAU about the circumstances, consequences and direct and indirect causes of a safety event.

The report consists of:

- Description of nature of event
- Description of infrastructure
- Context of circumstance
- The facts
- Consequences: human, material damages
- Measures taken by operator
- Causes
- Risk of the event
- Conclusion
- Photo, draw, plan, …

In case of dramatic or serious accident, there is BEATT who is an independent structure of ministry, they realize investigation and survey and give recommendations. They realize investigation on request of 1st Ministry, or on willing of director of BEATT.

	ERA statistics 2011–2015 (France)	SNCF in-depth LC accident data 2011–2015
Number of persons killed in LC accidents	147	171
Number of persons seriously injured in LC accidents	86	75
Number of light injuries	-	-
Number of property damage accidents	-	-
Reasons for differences in number of investigated cases vs. ERA data	The reasons for the differences in number of fatalities in SNCF and ERA database are not known. The differences in the number of persons seriously injured in LC accidents can probably be explained by the fact that there are several infrastructure managers in France.	

Reasons for missing information (list of variables for which no information was available; reasons for the missing data)	No information was available on the following variables: - Victim: Intoxication and involvement in secondary tasks; *SNCF do not have any contact with the victim and thus do not have this information* - Road environment: Number of lanes per direction, type of road surface, existence of LC sign and inclination; *This information could be added to database if SNCF would go to google maps to check this information for every collision* - Railway environment: Condition of wait platform - LC characteristics: Sight distances from the road; *French regulation require sight distances only for passive LCs.* - Circumstances: Lighting conditions; *Information on weather is available only in few cases* - Train: Involved train; *SNCF has the information if the train was freight or traveller (TGV, regional train) but due to limited resources this information was not collected from individual accident reports.* - Effect: All variables are missing

Information on LC accidents in France can also be found from the ONISR database which contains information on accidents with injured people occurring on public roads (including level crossings). It therefore represents an exhaustive source of these accidents. In this database all causes of bodily injury are taken into account when the accident has caused at least one victim. In 2015 58,654 road accidents with injuries were reported to ONISR database out of which 72 (0.12%) were LC accidents.

The ONISR database detailed information on general characteristics of the accident (date, time, location, accident situation, type of intersection, atmospheric conditions, type of collision, road category, number of traffic roads, road layout, road profile, road width, road surface condition, and number of vehicles and persons involved). In addition, it contains vehicle and person specific information. For each vehicle, its category (including train), the direction of traffic, the obstacle, the point of shock and the manoeuvre carried out during the accident are specified. For each person, it contains, for example, the user category, gravity, gender, year of birth, reason for travel, etc.

3.1.4. Italy

DiGIFEMA (Direzione Generale per le Investigazioni Ferroviarie e Marittime) coordinates the work of railway accident investigation teams to improve railway and maritime safety, using investigation activities to define the chain of events and provide recommendations.

The railway accident investigation teams investigate the railway accidents (including level crossing accidents) with regard to the seriousness of the events, the impacts on the railway safety and the different stakeholders involved. The teams are composed of internal experts of the Ministry of Infrastructure and Transport (MIT) and external experts in technical data and regulation of the railway sector. They are about 80 engineers, in detailed 28 internal experts and 53 external experts and they operate in different parts of Italy according to the current regional borders.

The data are collected by different figures such as police, infrastructure managers and competent authorities in the fields of railway and maritime safety. DiGIFEMA has the task of processing and analysing the data.

Accidents are investigated with regard to the

- chain of events
- risk factors
- consequences
- circumstances

The investigation team prepares an investigation report that includes a description of how the accident happened, the factors leading up to it and its consequences, as well as the investigation team's proposed improvements to traffic safety.

	ERA statistics 2011–2015 (Italy)	Italian in-depth LC accident data 2011–2015
Number of persons killed in LC accidents	53	15
Number of persons seriously injured in LC accidents	36	7
Number of light injuries	-	56
Number of property damage accidents	-	
Reasons for differences in number of investigated cases vs. ERA data	The number of persons involved in the investigated cases is different from ERA data because DiGIFEMA examines only a subset of the railway accidents (including LC accidents). The subset of accidents selected for investigation from DiGIFEMA is not always related to killed persons and, in some cases, could concern also accidents with only light injuries. Therefore the figures of investigated cases, even if in the same years, are lower than figures from ERA data.	
Reasons for missing information (list of variables for which no information was available; reasons for the missing data)	No information was available for the following variables: – Victim intoxication and involvement in secondary tasks. The lack of information about these aspects is generally due to the fact that it is considered of no relevance in respect to the accidents; – Number of trains cancelled after the accidents. However there is detailed information about the length of the rail traffic interruption; – Costs related to fatalities or injuries. The only information available on costs is evaluated and computed in relation to the infrastructure, rail rolling stocks and vehicles damages.	

3.1.5. Norway

Bane NOR has established an Investigation and Analysis Unit which, on behalf of the Group Management, examines the most serious events associated with the railway. The Investigation and Analysis Unit is located in Oslo and staffed with specialist who will be equipped to investigate the majority of types of incidents on the railway. If necessary, relevant professional expertise and local knowledge will be drawn into the review team. Local investigations are also conducted in serious events.

The investigation maps the course of events and causal relations for the purpose of finding learning points and measures in Bane NOR that will help prevent similar events from happening again. The purpose of the research and analysis work is to contribute to learning and improvement, and to an open and good security culture. The work and final report is not intended to distribute fault and responsibility.

All surveys prepared contain:

- Event history mapping
- Actual consequences and most likely potential consequences under some other circumstances
- Event Analysis
- Analysis of causes / barrier analysis
- Learning Points and Measures

For level crossing accidents, there is a special focus in the audit work to investigate whether there is a failure in systems or routines from Bane NOR's side (safety critical failure). Depending on the type of level crossing accident, either the Investigation and Analysis Unit, Local Audit Groups, or departments Groups will investigate the incident.

	ERA statistics 2011–2015 (Norway)	Norwegian in-depth LC accident data 2012–2016
Number of persons killed in LC accidents	6	9 (10)
Number of persons seriously injured in LC accidents	4	4
Number of light injuries	-	7
Number of property damage accidents	-	20
Reasons for differences in number of investigated cases vs. ERA data	– Take note that Bane NOR data was given for 2012–2016, whilst ERA statistics listed above is 2011-2015 – ERA statistics does not involve suicide. Data in Bane NORs Synergy-database (for answering the questionnaire) includes suicide. It is the Police who investigates and decides if the accident is a suicide or not. In some cases this takes a long time and data reported to ERA as an accident might later be changed	

	to suicide and give inconsequence in the data. - In Bane NORs Synergi-database all incidents are recorded, in order to get more data for learning purposes. However the formal definition and criteria for reporting of accidents to The Norwegian Railway Authority (Statens Jernbanetilsyn) is: ▪ Rail accident refers to an incident that causes death or serious personal injury or damage to material, track, other installations or external environment, or extensive traffic disturbances (consequences of the accident). Actual injury and damage potential is significant. ▪ "Death" means that somebody dies immediately or within 30 days as a result of the incident. ▪ "Seriously injured" means personal injury that leads to hospitalization for more than 24 hours. ▪ "Significant damage" means material damage or damage to the environment, etc. for more than 150,000 euros, about 1,300,000 Norwegian kroner. ▪ Events that cause traffic delay on a route for 6 hours or more shall be characterized as a railway accident. - This implies that Jernbaneverket/Bane NOR has more “accidents” in the database (minor ones) than what is reported. - Norway has the same definition as all EU / EEA countries to ensure equal reporting
Reasons for missing information (list of variables for which no information was available; reasons for the missing data)	- Information requested by the questionnaire are scattered in different Bane NOR databases or systems and is quite time consuming to find all the answers. Some data are not recorder (weather, personal information about victim etc.) - “Other” is used in the instances where it was not a freight train or a passenger train, but rather a service train or service machine. Other is also used in instances where the vehicle involved was not an option, for example some types of farming machines

3.1.6. Spain

Investigation of serious accidents in Spain

The information provided herein is based on the two laws that are in force to regulate the investigation of railway accidents/incidents: Ley 38/2015 (Railway Sector Law 38/2015); Real Decreto 623/2014 (Royal Decree 623/2014) and the latest Annual accident and incident investigation report (2015) produced by the National Investigation body (Comisión de Investigación de Accidentes Ferroviarios – CIAF)

All serious accidents[1] occurring on the National Rail Network of Common Interest are investigated, in addition to other accidents and incidents selected on the basis of their potential to provide lessons regarding future accident/incident prevention.

Investigation objectives

- To determine the cause of the accident without identifying blame or responsibility.
- To better understand the circumstances and events leading up to the accident/incident in order to improve safety and prevent their reoccurrence in the future.

The National Accident Investigation Commission (CIAF) is an independent body in charge of the technical coordination of accident investigation. It comprises a President, five committee members and a Secretary. Three of the board members are engineers in a related field with expertise in railway infrastructure, rolling stock, and signalling and railway communication. In addition one of the members is an expert in railway safety and rail operations.

There are two research technicians attached to the Commission who are responsible for conducting investigations and preparing reports, with the collaboration of experts and area technicians who are assigned on a geographic basis to provide support to the investigation, facilitated by Ineco, a transport engineering consultancy.

The investigation team attends the place of the accident/incident carrying out an immediate inventory of the evidence. They gain access to information contained in the black box and recording equipment on and off the board; victim forensic reports; and results of the medical examination of railway staff involved. They question railway staff and other witnesses involved; and obtain relevant information or documentation from the infrastructure manager, railway operator and State Railway Security Agency.

The lead investigator produces a technical report for each accident/incident containing appropriate safety recommendations. The information provided in the report adheres to the structure set out by law (Real Decreto 623/2014). This includes a description of the event, when and where it took place and its consequences. It indicates the direction, contributing and underlying causes identified by the investigation. It outlines recommendations and information regarding the end users of these recommendations.

Level crossing accident database from Spain

The main sources of accident data for Spain are the Administrator of Railway Infrastructure's safety database and Level Crossing Inventory database.

The Administrator of Railway Infrastructure's safety database collects information on all events occurring in level crossings on Spain between 2013 and 2016. Events encompass accidents or

[1] Definition of serious accident in line with European Railway Safety Directive (EU) 2016/798 [(…)the death of at least one person or serious injuries to five or more persons or extensive damage to rolling stock, the infrastructure or the environment…].

incidents at level crossings where people or vehicles have been involved. Information is collected about when (time, day, month and year) and where (train line, station and kilometre point) the accident or incident occurred; the severity of the victim: fatality, serious injury or light injury and its link with the railroad: employee, traveller or third parties.

The Level Crossing Inventory database collects information about level crossings location and characteristics in Spain. Information on location refers to the train line, station, kilometre point, municipality and geographical coordinates. Information on level crossing characteristics refers to the owner of level crossings (City Council, private…), type of level crossing (passive level crossing, automatic user side protection and warning and rail side protection, etc.), type of road surface (asphalt, gravel…) and type of level crossing surface (asphalt, strail…).

	ERA statistics 2011–2015 (Spain)	Spanish LC accident database 2013–2016
Number of persons killed in LC accidents	34	26
Number of persons seriously injured in LC accidents	14	12
Number of light injuries	-	25
Number of property damage accidents	-	40
Reasons for differences in number of investigated cases vs. ERA data	The data provided to the Task 1.2 are from 2013 to 2016, so they are not comparable with those of the ERA (2011–2015). If there is any difference in the statistics could be by the definitive state or not of the data.	
Reasons for missing information (list of variables for which no information was available; reasons for the missing data)	There is no European wide agreement on the type of information to be collected in accidents and/or incidents, so there are differences between countries. The Administrator of Railway Infrastructure collects the information that is useful for: – To determine the cause of the accident without identifying blame or responsibility. – To better understand the circumstances and events leading up to the accident/incident in order to improve safety and prevent their reoccurrence in the future.	

3.1.7. Turkey

The level crossing accident investigations in Turkey are conducted and reported by TCDD personnel including “regional director of planning and coordination department and director of road maintenance and repair/restoration”. Unfortunately, no template is available for LC accident investigation at TCDD. Therefore, many of the accident reports do not include the required data or they are not very detailed. In case of the higher victim number, the investigation is conducted by the accident research and investigation board of Ministry.

Some of the LC accident reports of TCDD that were generated by TCDD staff and were analysed within the task include the below data:

- Occurrence of the accident
- Type of victim (driver, motorist, pedestrian…etc.)
- Age and sex of victim
- Date (DD/MM/YYYY; time)
- Intoxication of machinist/ victim
- Speed of train
- Type of LC
- Existence of traffic signals
- Outcome (fatality, near miss… etc.)
- Delay (number of minutes)

LC accident reports of Ministry of Transport: These reports are very detailed and they are investigated by accident research and investigation board of Ministry of transport in case of higher victim rate. Unfortunately, the accident reports of the Ministry of transport exist only since 2015. Therefore, the number of these accident reports is rather low.

These records are very detailed excluding the age of victim and sex of victim.

- Occurrence of the accident
- Date (DD/MM/YYYY; time)
- Intoxication of machinist/ victim
- Speed of train
- Type of LC
- Existence of traffic signals
- Outcome (fatality, near miss… etc.)
- Delay (number of minutes)
- Recommendations
- Summary of the accident
- Data related to accident;
- Details of the accident
- Details regarding the location of the accident including LC and road environment
- Sight distances and weather condition
- Type of Train (passenger/ freight) & type of road vehicle
- The course of accident (Before accident and time of accident)
- Commissioning of the track
- Evaluation of the accident and LCs
- Measures to be taken for the LC
- Legislations
- Recommendations to TCDD, Ministry of Interior, municipality, Governorate etc.
- Photos

	TCDD statistics 2011–2015 (Turkey)	Turkish in-depth LC accident data 2012–2016
Number of persons killed in LC accidents	170	8

Number of persons seriously injured in LC accidents	208	8
Number of light injuries	-	25
Number of property damage accidents	-	4
Reasons for differences in number of investigated cases vs. ERA data	Turkish in-depth accident data collection covered several accident reports which did not include many of the variables (sex and age of the victim, type of the train, design criteria of the LCs etc.). It was quickly realised that there were many missing information in the reports. TCDD did not use to have a template for the accident reports and thus the coverage of the information varies between reports. Some of the reports include only the place, date, time of the accident and the result of the accident. Because of the problems with coverage of the accident reports it was decided to focus on the reports which really delivered the reasons behind the accidents, and present most of the variables that were requested in the in-depth analysis tool. Also, another challenge with the reports was that they were not saved digitally. Therefore, in some cases it was impossible to read the time-worn analysis reports because they were rubbed out.	
Reasons for missing information (list of variables for which no information was available; reasons for the missing data)	Due to TCDD does not have a template to investigate reports - rather than the ones that were investigated by INTADER – no information is not available on these variables: – Outcome of the collision (injury/ dead/ property damage) – Age and sex of victim – Intentionality – Involvement in secondary tasks – Intoxication – Type of road user in terms of “ local inhabitant/random user” – Road traffic volume (AADT) – Type of road – Road speed limit – Number of lanes per direction – Type of road surface – Existence of level crossing sign before LC – Inclination – Crossing angle (between road and track) – Daily train traffic volume (passenger + freight) – Speed limit for person and freight trains (km/h) – Condition of wait platforms – Number of tracks – Sight distances (from the road) – Weather – Lighting conditions – Costs (euros) – Main factors affecting the accident according to the accident	

report

Due to the above mentioned missing information of the reports, INTADER focused on the reports that provided most information. Also, information for some of the variables was investigated from TCDD database.

Also, for the reports of the ministry these items are missing:

- Age and sex of victim
- Type of road user in terms of “ local inhabitant/random user”
- Intentionality
- Involvement in secondary tasks
- Intoxication
- Road traffic volume (AADT)
- Number of lanes per direction
- Type of road surface
- Daily train traffic volume (passenger + freight)
- Speed limit for person and freight trains (km/h)

These data was investigated from the different sources by INTADER such as from TCDD, District Governorship for the analysis. Also, TCDD does not separate the injuries as light injury or serious injury. The numbers of the serious and light injuries are extracted from the accident reports for LC in-depth analysis.

3.2. Description of received data

In-depth LC accident data was received from 7 countries. Table 3 provides a summary of the received accident data by country. A more detailed description of the received data (by variable) can be found in Table 4.

Table 3. The received in-depth LC accident data by country.

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

Table 4. Available variables by country (X = available, (X) = available only in few cases, NA = Not available).

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 according to the accident report		X	NA	X	X	X	NA	X

3.3. Data analysis

The received data is presented in frequency tables. The information from different countries was included in one table per variable when possible. Regarding train traffic volume the reported categories were so different that two separate tables were needed to report the results. Some data tables were included as an annex to the deliverable. Specifically, this was done for data tables including variable for which not much information was available, the data included several unknown cases or the data did not allow us to make clear conclusions.

Key features of each summary table are presented before the tables in order to provide the reader a general insight into the content of the table. The main aim of this deliverable is not to make comparison between countries but to present and analyse the data in general.

Unknown variables were excluded from the analysis when percentage shares were calculated to summarise the results in the *Results* section. When interpreting the results it is also important to note that the data tables cover only the LC accidents included in the in-depth analysis. Therefore the data does not necessarily provide a complete picture of the LC safety situation (and division of different variables) in each country.

4. RESULTS

4.1. Background information

Out of the seven countries involved in the in-depth LC accident data collection, the one in which the highest number of train-kilometres was driven is France and the one with the lowest number is Greece (Table 3). The length of tracks in France was 18 times bigger than in Greece, while the annual number of train kilometres in France is 32 times greater than that in Greece. The train traffic was most dense (train-km / track-km) in Italy and least dense in Turkey.

Table 5. Background information by country.

Country		Population (million)[1]	Area (1 000 km^2)[1]	No of track-km in 2015[2]	No of train-km in 2015 (million)[2]
Greece	EL	10.812	132.0	2764	10.8
Finland	FI	5.472	338.4	6658	48.6
France	FR	66.352	633.1	49715	494
Italy	IT	60.796	301.3	23437	340.5
Norway	NO	5.166	323.8	4219	51.7
Spain	ES	46.440	506.0	21159.4	200.8
Turkey	TR	77.696	785.3	31585[3]	36.95[3]

1 EU Transport in figures, Statistical pocketbook 2016, European Union 2016.
2 ERAIL (European Railway Accident Information Links) database, European Union Agency for Railways 2017. https://erail.era.europa.eu/safety-indicators.aspx
3 Information provided by TCDD.

The number of level crossings per country varies from 1,453 in Greece to almost 16,000 in France (Table 6). The density of LCs is the highest in Norway (85 LCs per 100 track-km) and the lowest in Turkey (10 LCs per 100 track-km). The shares of active level crossing are the highest in France (78%) and in Italy (77%) whereas the shares of passive level crossing are the highest in Norway (86%) and in Finland (77%). These results are not surprising since according to the European Union Agency for Railways (2012) a low ratio of active level crossings compared to all level crossings is typical for the less densely populated countries.

Table 6. Type of LC by country in 2014 (European Union Agency for Railways 2017).

Level crossing types	EL	FI	FR	IT	NO	ES	TR[1]
Active LC with automatic user-side warning	3	97	46	21	98	539	0
Active LC with automatic user-side protection	0	0	0	2	25	0	0
Active LC with automatic user-side protection and warning	0	670	10,773	3,552	366	0	833
Active LC with automatic user-side protection and warning, and rail-side protection	708	0	0	272	0	621	0
Active LC with manual user-side warning	1	0	0	0	0	0	0
Active LC with manual user-side protection	47	0	0	1	2	4	235
Active LC with manual user-side protection and warning	1	0	1,656	1	14	17	0
Total number of active level crossings	760	767	12,475	3,849	505	1,181	1,068
Total number of passive level crossings	693	2,617	3,468	1,161	3,061	2,123	2,042
Total number of level crossings	1,453	3,384	15,943	5,010	3,566	3,304	3,110

1 Numbers for Turkey are from 2015. Source: UIC Level crossing database.

Table 6 shows that 86% of active level crossings are equipped with automatic user-side protection and warning (barriers and flashing lights). The share of these types of level crossings among all active level crossings is also high (66%) in 28 EU countries (European Union Agency for Railways 2017). The share of passive level crossing in the EU-28 is 47%.

4.2. Collision

4.2.1. Type of road vehicle

The type of road vehicle involved in level crossing accidents was most often passenger car (Table 7). 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 (52%), in Spain (54%) and in Norway (67%). The share of *Other* category is exceptionally high in Spain since the available database does not distinguish between the type of vehicle.

Table 7. Distribution of type of road vehicle by country and severity of injury.

Country		TYPE OF ROAD VEHICLE								Total
		Passenger car	Bus	Van	Truck	Tractor	Other	No vehicle involved	Unknown	
EL	Fatalities	10	1	2	2	1	0	0	0	16
	Serious injuries	4	0	0	1	0	0	1	0	6
	Light injuries	9	0	0	0	2	0	0	0	11
	Property	49	1	0	3	1	0	1	0	55
	Unknown	2	0	0	0	0	0	1	0	3
FI	Fatalities	30	0	4	2	1	6[1]	13	0	56
	Light injuries	0	0	0	2	0	0	0	0	2
	Property	1	0	1	1	0	0	0	0	3
FR	Fatalities	54	0	0	2	0	8	70	0	134
	Injuries	81	0	6	15	9	8	28	0	147
	Property	239	1	14	23	12	6	2	0	297
IT	Fatalities	2	0	0	1	0	2[2]	3	0	8
	Serious injuries	1	0	0	1	0	0	0	0	2
	Light injuries	0	1	0	0	0	0	0	0	1
	Unknown	0	1	0	0	0	0	0	0	1
NO	Fatalities	0	0	2	0	0	1	6	0	9
	Serious injuries	1	0	0	0	1	1	1	0	4
	Light injuries	4	0	0	1	0	0	1	0	6
	Property	13	0	0	2	2	3	0	0	20
	Unknown	0	0	0	1	0	0	0	0	1
ES	Fatalities	0	0	0	0	0	12	14	0	26
	Serious injuries	0	0	0	0	0	8	4	0	12
	Light injuries	0	0	0	0	0	20	5	0	25
	Property	0	0	0	0	0	40	0	0	40
TR	Fatalities	3	1	1	0	1	7	1	1	15
	Serious injuries	3	0	1	2	0	1	1	0	8
	Light injuries	3	0	0	1	0	1	0	0	5
	Property	3	0	0	0	0	1	0	0	4

1 *Other* was bicycle on 4 cases and moped in 2 cases.
2 *Other* for both cases was ambulance.

4.2.2. Month

Based on our in-depth data sample the level crossing accidents are fairly evenly distributed throughout the year (Table B1, included as part of Annex B).

4.2.3. Day of the week

All days of the week are rather equally represented when looking at the distribution of level crossing accidents by weekdays (Table B2, included as part of Annex B). In Spain and in Turkey a slightly higher share of LC accidents are occurring during weekdays compared to weekends.

4.2.4. Hour

Most level crossing accidents occurred during daytime, especially between 9 am and 6 pm (Table B3, included as part of Annex B). The share of accidents occurring in the evening or nigh time (between 9 pm and 6 am) varied between 3% (In Spain) and 23% (in Greece and in Norway).

4.3. Victim

The victim details were instructed to include for each victim separately if the collision involved more than one victim. However, this separation was done only in Finnish, Norwegian and Turkish datasets and thus in several cases the total number of victims is the same as the total number of accidents.

4.3.1. Type of victim

The victims in level crossing accidents are most often car drivers or pedestrians (Table 8). The high share of *Other* category in the Spanish data refers to the third person who is killed or injured in the accident, and the type of vehicle is unknown.

Table 8. Distribution of type of victim by country and severity of injury.

Country		TYPE OF VICTIM								Total
		Car driver	Car passenger	Pedestrian	Cyclist	Mopedist	Motorcyclist	Other	Unknown	
EL	Fatalities	14	0	1	0	0	0	0	1	16
	Serious injuries	2	0	2	2	0	0	0	0	6
	Light injuries	7	2	0	0	0	0	2	0	11
FI	Fatalities	30	14	14	3	2	0	2	0	65
	Serious injuries	4	2	0	0	0	0	0	0	6
	Light injuries	3	2	0	0	0	0	1	0	6
FR	Fatalities	56	0	59	11	0	8	0	0	134
	Injuries	111	0	17	11	0	8	0	0	147
IT	Fatalities	0	1	2	1	0	1	3	0	8
	Serious injuries	0	1	0	0	0	0	1	0	2
	Light injuries	0	0	0	0	0	0	1	0	1
	Unknown	0	0	0	0	0	0	0	1	1
NO	Fatalities	2	1	4	1	0	1	1	0	10
	Serious injuries	1	1	1	0	0	0	2	0	5
	Light injuries	5	0	1	0	0	0	0	0	6
	Unknown	1	0	0	0	0	0	0	0	1
ES	Fatalities	0	0	14	0	0	0	12	0	26
	Serious injuries	0	0	4	0	0	0	8	0	12
	Light injuries	0	0	5	0	0	0	20	0	25
TR	Fatalities	3	21	1	2	3	3	1	0	34
	Serious injuries	10	9	1	0	0	1	0	0	21
	Light injuries	3	1	0	0	1	0	0	0	5

4.3.2. Type of road user

Several countries had no information about the involved road users, i.e. whether the victim was a local inhabitant or random user of the level crossing (Table 9). For those countries that collect this type of data, the involved road users were typically local inhabitants. If looking at the fatalities only, the share of local inhabitants varied between 84% (in Finland) and 100% (in Italy and Turkey).

Table 8. Distribution of type of road user by country and severity of injury.

Country		TYPE OF ROAD USER			Total
		Local inhabitant	Random user	Unknown	
EL	Fatalities	9	1	6	16
	Serious injuries	2	1	3	6
	Light injuries	5	3	3	11
FI	Fatalities	37	7	21	65
	Serious injuries	4	0	2	6
	Light injuries	3	1	2	6
FR	Fatalities	56	4	74	134
	Injuries	38	3	106	147
IT	Fatalities	7	0	1	8
	Serious injuries	0	0	2	2
	Light injuries	1	0	0	1
	Unknown	1	0	0	1
NO	Fatalities	0	0	10	10
	Serious injuries	0	0	5	5
	Light injuries	0	0	6	6
	Unknown	0	0	1	1
ES	Fatalities	0	0	26	26
	Serious injuries	0	0	12	12
	Light injuries	0	0	25	25
TR	Fatalities	28	0	6	34
	Serious injuries	15	1	5	21
	Light injuries	5	0	0	5

4.3.3. Gender

The victims in level crossing accidents were typically men (Table B4, included as an Annex B). If excluding the unknown cases the share of men varied between 66% (In Finland) and 100% (in Italy).

4.3.4. Age

Information about the age of the victim could be found from the in-depth LC accident databases of Greece, Finland, France and Turkey (Table B5, included as an Annex B). The databases of Greece and Turkey included several unknown cases and thus no clear conclusions could be drawn based on them. In France 46% of fatal victims were 60 years or older. In Finland the corresponding share was 33%.

4.3.5. Intentionality

Most investigated databases include only accidents (Table 10). According to the data collection instructions the intentional collisions were instructed to be excluded from the accident category and reported separately as suicides. In Finland 9 out of 65 (14%) fatalities were documented as suicides (intentional collisions). More specifically, these cases were classified as suicides if the victim did nothing to prevent the accident and the victim drove or moved consciously into the situation.

Table 10. Distribution of intentionality of involved persons by country and severity of injury.

Country		INTENTIONALITY			Total
		Suicide	Accident	Unknown	
EL	Fatalities	1	6	9	16
	Serious injuries	0	4	2	6
	Light injuries	0	5	6	11
FI	Fatalities	9	42	14	65
	Serious injuries	0	5	1	6
	Light injuries	0	4	2	6
FR	Fatalities	0	0	134	134
	Injuries	0	0	147	147
IT	Fatalities	0	8	0	8
	Serious injuries	0	1	1	2
	Light injuries	0	1	0	1
	Unknown	0	1	0	1
NO	Fatalities	4	5	1	10
	Serious injuries	0	5	0	5
	Light injuries	0	6	0	6
	Unknown	0	1	0	1
ES	Fatalities	0	0	26	26
	Serious injuries	0	0	12	12
	Light injuries	0	0	25	25
TR	Fatalities	0	34	0	34
	Serious injuries	0	20	1	21
	Light injuries	0	5	0	5

4.3.6. Secondary tasks

Possible involvement in secondary tasks was reported only in the Finnish, Italian and Turkish databases (Table 11). The secondary tasks were defined here as tasks performed by the driver which are not directly related to manoeuvring the vehicle (i.e. the primary driving task) such as talking on the phone, using a mobile prone (texting etc.), handling or looking at the navigator, eating/drinking, smoking, looking at passengers etc. Based on the Finnish data the identified secondary tasks were: use of mobile phone, having conversation or listening to radio, attention focused on other passengers, concentrated on thoughts or unidentified distraction.

Table 11. Distribution of involvement in secondary tasks of involved persons by country and severity of injury.

Country		INVOLVEMENT IN SECONDARY TASKS			Total
		Yes	No	Unknown	
EL	Fatalities	0	0	16	16
	Serious injuries	0	0	6	6
	Light injuries	0	0	11	11
FI	Fatalities	8	29	28	65
	Serious injuries	0	3	3	6
	Light injuries	3	1	2	6
FR	Fatalities	0	0	134	134
	Injuries	0	0	147	147
IT	Fatalities	0	8	0	8
	Serious injuries	0	1	1	2
	Light injuries	0	1	0	1
	Unknown	0	1	0	1
NO	Fatalities	0	0	10	10
	Serious injuries	0	0	5	5
	Light injuries	0	0	6	6
	Unknown	0	0	1	1
ES	Fatalities	0	0	26	26
	Serious injuries	0	0	12	12
	Light injuries	0	0	25	25
TR	Fatalities	0	3	31	34
	Serious injuries	0	2	19	21
	Light injuries	0	0	5	5

4.3.7. Intoxication

Few countries collect information in regards to the victim's potential intoxication (Table 12). Most information was available from Finland where 22% of fatal victims were intoxicated by alcohol, medicines and/or drugs (unknown cases were excluded).

Table 12. Distribution of intoxication of involved persons by country and severity of injury.

Country		INTOXICATION			Total
		Alcohol, medicines and/or drugs	No intoxication	Unknown	
EL	Fatalities	0	1	15	16
	Serious injuries	0	0	6	6
	Light injuries	0	1	10	11
FI	Fatalities	10	36	19	65
	Serious injuries	0	3	3	6
	Light injuries	1	3	2	6
FR	Fatalities	1	0	133	134
	Injuries	1	0	146	147
IT	Fatalities	0	0	8	8
	Serious injuries	1	0	1	2
	Light injuries	0	0	1	1
	Unknown	0	0	1	1
NO	Fatalities	0	0	10	10
	Serious injuries	0	0	5	5
	Light injuries	0	0	6	6
	Unknown	0	0	1	1
ES	Fatalities	0	0	26	26
	Serious injuries	0	0	12	12
	Light injuries	0	0	25	25
TR	Fatalities	0	10	24	34
	Serious injuries	2	4	15	21
	Light injuries	0	0	5	5

4.4. Road environment

4.4.1. Road traffic volume

The road traffic volume refers to Annual Average Daily Traffic (AADT) which concerns the number of road vehicles passing the LC each day. The highest road traffic volumes in accident locations can be found in France where 24% of accidents occur at level crossings where road traffic volume is higher than 5 000 road vehicles per day (Table 13). In Greece, in Finland and in Norway the road traffic volumes are typically smaller. For example, in Greece 95% of level crossing accidents occurred in places where the road traffic volume at the highest 300 road vehicles per day. In Norway 72% of accidents occurred at level crossings where the road traffic volume is maximum 200 vehicles per day whereas in Finland 60% of accidents occurred at level crossings where the road traffic volume is maximum 100 vehicles per day.

Table 13. Distribution of road traffic volume in accident location by country and severity of injury.

Country		ROAD TRAFFIC VOLUME (AADT)														Total
		<10	10–100	101–200	201–300	301–400	401–500	501–1000	1001–2000	2001–3000	3001–4000	4001–5000	5001–10000	> 10000	Unknown	
EL	Fatalities	0	1	9	6	0	0	0	0	0	0	0	0	0	0	16
	Serious injuries	0	0	0	4	2	0	0	0	0	0	0	0	0	0	6
	Light injuries	0	2	6	1	2	0	0	0	0	0	0	0	0	0	11
	Property	0	10	14	29	1	0	0	0	0	0	0	0	0	1	55
	Unknown	1	1	0	1	0	0	0	0	0	0	0	0	0	0	3
FI	Fatalities	13	16	6	1	1	0	4	0	2	0	2	1	1	9	56
	Light injuries	0	0	0	0	0	1	0	0	0	0	1	0	0	0	2
	Property	0	1	0	0	0	0	0	0	0	0	0	0	0	2	3
FR	Fatalities	3	19	8	4	2	2	10	18	11	11	7	18	10	11	134
	Injuries	9	20	7	6	5	7	13	20	9	12	5	19	10	5	147
	Property	9	50	16	6	13	7	23	31	23	25	17	40	34	3	297
IT	Fatalities	0	1	0	0	0	0	0	1	3	0	0	2	1	0	8
	Serious injuries	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2
	Light injuries	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
	Unknown	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
NO	Fatalities	1	3	1	0	0	1	0	2	0	0	0	0	0	1	9
	Serious injuries	2	1	0	0	0	0	0	0	0	0	0	0	0	1	4
	Light injuries	1	0	2	0	0	0	0	1	0	0	0	0	0	2	6
	Property	3	4	3	0	0	1	0	2	0	0	1	0	0	6	20
	Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
ES	Fatalities	0	0	0	0	0	0	0	0	0	0	0	0	0	26	26
	Serious injuries	0	0	0	0	0	0	0	0	0	0	0	0	0	12	12
	Light injuries	0	0	0	0	0	0	0	0	0	0	0	0	0	25	25
	Property	0	0	0	0	0	0	0	0	0	0	0	0	0	40	40
TR	Fatalities	0	4	2	2	0	1	2	0	1	0	0	3	0	0	15
	Serious injuries	0	2	0	1	0	1	1	0	0	0	0	2	1	0	8
	Light injuries	0	1	0	0	0	0	0	0	0	0	1	2	1	0	5
	Property	0	2	0	0	0	0	0	1	0	0	0	0	1	0	4

4.4.2. Type of road

All level crossing accidents in Turkey and in France which were analysed in this task occurred on streets (Table B6, included as an Annex B).

4.4.3. Road speed limit

An interestingly high share of level crossing accidents occurred in areas where the road speed limit is rather low (Table 14). 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. In Finland the corresponding share was somewhat lower (48%). This might be due to the fact that if no speed limit is indicated the road speed limit is considered in Finland as 80 km/h.

Table 14. Distribution of road speed limits in accident location by country and severity on injury.

Country		ROAD SPEED LIMIT (km/h)										Total
		≤ 30	40	50	60	70	80	90	100	> 100	Unknown	
EL	Fatalities	0	9	6	0	0	1	0	0	0	0	16
	Serious injuries	0	1	4	1	0	0	0	0	0	0	6
	Light injuries	2	4	2	1	1	1	0	0	0	0	11
	Property	5	21	21	6	0	1	0	0	0	1	55
	Unknown	0	2	1	0	0	0	0	0	0	0	3
FI	Fatalities	1	13	8	0	0	25	0	0	0	9	56
	Light injuries	0	1	1	0	0	0	0	0	0	0	2
	Property	0	0	0	0	0	1	0	0	0	2	3
FR	Fatalities	11	3	49	0	1	0	14	0	0	56	134
	Injuries	16	5	61	0	2	0	16	0	0	47	147
	Property	19	6	124	2	3	0	43	0	0	100	297
IT	Fatalities	1	0	5	0	0	2	0	0	0	0	8
	Serious injuries	0	0	2	0	0	0	0	0	0	0	2
	Light injuries	0	0	1	0	0	0	0	0	0	0	1
	Unknown	0	0	1	0	0	0	0	0	0	0	1
NO	Fatalities	2	1	4	0	1	0	0	0	0	1	9
	Serious injuries	2	0	0	0	0	0	0	0	0	2	4
	Light injuries	1	1	2	0	0	0	0	0	0	2	6
	Property	4	1	2	0	0	0	0	0	0	13	20
	Unknown	0	0	0	0	0	0	0	0	0	1	1
ES	Fatalities	0	0	0	0	0	0	0	0	0	26	26
	Serious injuries	0	0	0	0	0	0	0	0	0	12	12
	Light injuries	0	0	0	0	0	0	0	0	0	25	25
	Property	0	0	0	0	0	0	0	0	0	40	40
TR	Fatalities	0	0	15	0	0	0	0	0	0	0	15
	Serious injuries	0	0	8	0	0	0	0	0	0	0	8
	Light injuries	0	0	5	0	0	0	0	0	0	0	5
	Property	0	0	4	0	0	0	0	0	0	0	4

4.4.4. Number of lanes

The road passing the level crossing had typically one lane per direction (Table B7, included as an Annex B).

4.4.5. Type of road surface

The road had asphalt pavement in most level crossing accidents in Greece (98%) and in Italy (92%) whereas the road passing the level crossing was typically unpaved in level crossings accidents in Finland (54%) and in Norway (60%) (Table B8, included as an Annex B). In Spain the type of road surface for most of the LC accidents was reported as “Camino”. In Spain “Camino” can be either gravel or asphalt.

4.4.6. Existence of LC sign

Level crossing signs typically existed before the level crossings (Table 15). The coverage was 100% in France, 98% in Finland, 81% in Greece, 78% in Turkey and 75% in Italy. In Norway the LC sign was typically missing and Spanish database did not include information on this variable.

Table 15. Distribution of existence of LC sign before level crossing in accident location by country and severity of injury.

Country		EXISTENCE OF LC SIGN BEFORE LC			Total
		Yes	No	Not known	
EL	Fatalities	10	1	5	16
	Serious injuries	4	0	2	6
	Light injuries	6	1	4	11
	Property	19	7	29	55
FI	Fatalities	46	1	9	56
	Light injuries	2	0	0	2
	Property	1	0	2	3
FR	Fatalities	134	0	0	134
	Injuries	147	0	0	147
	Property	297	0	0	297
IT	Fatalities	7	1	0	8
	Serious injuries	2	0	0	2
	Light injuries	0	1	0	1
	Unknown	0	1	0	1
NO	Fatalities	2	5	2	9
	Serious injuries	2	2	0	4
	Light injuries	3	1	2	6
	Property	4	8	8	20
	Unknown	1	0	0	1
ES	Fatalities	0	2	24	26
	Serious injuries	0	4	8	12
	Light injuries	0	1	24	25
	Property	3	6	31	40
TR	Fatalities	12	3	0	15
	Serious injuries	6	2	0	8
	Light injuries	3	2	0	5
	Property	4	0	0	4

4.4.7. Inclination

The inclination of the road in the accident location was typically less than 1.5% (flat) (Table 16). In Finland there was a relatively high share of level crossing accidents (46%) where the inclination was at least 1.5% (hill). These are typically minor roads and the tracks are located higher from the sea level than the passing road.

Table 16. Distribution of inclination in accident location by country and severity of injury.

Country		INCLINATION				Total
		Less than 1.5% (flat)	At least 1.5% (slope)	At least 1.5% (hill)	Unknown	
EL	Fatalities	15	1	0	0	16
	Serious injuries	6	0	0	0	6
	Light injuries	11	0	0	0	11
	Property	49	5	0	1	55
	Unknown	2	1	0	0	3
FI	Fatalities	18	7	22	9	56
	Light injuries	2	0	0	0	2
	Property	0	0	1	2	3
FR	Fatalities	0	0	0	134	134
	Injuries	0	0	0	147	147
	Property	0	0	0	297	297
IT	Fatalities	5	2	1	0	8
	Serious injuries	2	0	0	0	2
	Light injuries	0	0	1	0	1
	Unknown	0	1	0	0	1
NO	Fatalities	7	2	0	0	9
	Serious injuries	2	1	1	0	4
	Light injuries	4	2	0	0	6
	Property	11	3	1	5	20
	Unknown	1	0	0	0	1
ES	Fatalities	0	0	0	26	26
	Serious injuries	0	0	0	12	12
	Light injuries	0	0	0	25	25
	Property	0	0	0	40	40
TR	Fatalities	10	2	3	0	15
	Serious injuries	4	0	4	0	8
	Light injuries	4	0	1	0	5
	Property	3	1	0	0	4

4.4.8. Crossing angle (between road and track)

The crossing angle between the road and the track was typically 70–110 degrees (Table 17). France was the only country where the crossing angle was most often (80% of accidents) less than 70 degrees.

Table 17. Distribution of crossing angle (between road and track) in accident location by country and severity of injury.

Country		CROSSING ANGLE (between road and track)				Total
		<70 degrees	70–110 degrees	> 110 degrees	Unknown	
EL	Fatalities	4	11	1	0	16
	Serious injuries	1	4	1	0	6
	Light injuries	2	9	0	0	11
	Property	22	28	4	1	55
	Unknown	0	2	1	0	3
FI	Fatalities	6	36	5	9	56
	Light injuries	1	1	0	0	2
	Property	0	1	0	2	3
FR	Fatalities	110	1	23	0	134
	Injuries	117	0	30	0	147
	Property	236	7	54	0	297
IT	Fatalities	0	7	1	0	8
	Serious injuries	0	0	2	0	2
	Light injuries	0	0	1	0	1
	Unknown	0	1	0	0	1
NO	Fatalities	3	6	0	0	9
	Serious injuries	1	3	0	0	4
	Light injuries	0	6	0	0	6
	Property	2	13	0	5	20
	Unknown	0	1	0	0	1
ES	Fatalities	0	0	0	26	26
	Serious injuries	0	0	0	12	12
	Light injuries	0	0	0	25	25
	Property	0	0	0	40	40
TR	Fatalities	0	15	0	0	15
	Serious injuries	0	8	0	0	8
	Light injuries	0	5	0	0	5
	Property	0	4	0	0	4

4.5. Railway environment

4.5.1. Train traffic volume

The daily train traffic volumes (including both passenger and freight trains) are presented in Table 18 for Greece, in Table 19 for Norway and in Table 20 for the rest of the countries. The used categories vary somewhat between countries. In general, train traffic volumes were on average rather low at accident level crossings in Greece, in Norway, in Finland and in Turkey. Higher train traffic volumes could be found at level crossings in France, Italy and Spain.

Table 18. Distribution of train traffic volume of accident LCs by severity of injury in Greece.

Country		TRAIN TRAFFIC VOLUME				Total
		High	Medium	Low	Not known	
EL	Fatalities	2	3	11	0	16
	Serious injuries	3	0	3	0	6
	Light injuries	0	0	11	0	11
	Property	18	12	25	0	55
	Unknown	1	1	1	0	3

Table 19. Distribution of train traffic volume of accident LCs by severity of injury in Norway.

Country		TRAIN TRAFFIC VOLUME (number of trains per day)					Total
		1−50	51−70	71−90	91−110	Not known	
NO	Fatalities	6	1	1	1	0	9
	Serious injuries	4	0	0	0	0	4
	Light injuries	5	1	0	0	0	6
	Property	12	3	0	1	4	20
	Unknown	1	0	0	0	0	1

Table 20. Distribution of train traffic volume of accident LCs by country and by severity of injury.

Country		TRAIN TRAFFIC VOLUME (number of trains per day)						Total
		≤10	11−20	21−30	31−50	>50	Not known	
FI	Fatalities	17	21	3	6	0	9	56
	Light injuries	1	0	1	0	0	0	2
	Property	0	1	0	0	0	2	3
FR	Fatalities	9	15	15	33	59	3	134
	Injuries	19	29	18	21	60	0	147
	Property	69	49	37	44	98	0	297
IT	Fatalities	0	2	0	3	3	0	8
	Serious injuries	1	0	0	1	0	0	2
	Light injuries	0	1	0	0	0	0	1
	Unknown	1	0	0	0	0	0	1
ES	Fatalities	3	6	1	9	5	2	26
	Serious injuries	0	1	1	2	3	5	12
	Light injuries	4	9	0	0	10	2	25
	Property	8	8	5	2	6	11	40
TR	Fatalities	0	7	2	3	3	0	15
	Serious injuries	0	5	2	0	1	0	8
	Light injuries	0	3	0	0	2	0	5
	Property	0	2	1	1	0	0	4

4.5.2. Speed limit of passenger trains

Speed limit of passenger trains at accident locations vary somewhat between the countries (Table 21). 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.

Table 21. Distribution of speed limit for passenger trains (km/h) in accident location by country and severity of injury.

Country		SPEED LIMIT FOR PASSENGER TRAINS (km/h)										Total
		≤ 30	31–40	41–50	51–60	61–70	71–80	81–90	91–100	> 100	Unknown	
EL	Fatalities	0	0	1	0	0	8	1	3	3	0	16
	Serious injuries	0	1	1	0	0	2	1	1	0	0	6
	Light injuries	1	0	1	0	1	4	1	2	1	0	11
	Property	1	12	4	7	1	8	5	8	9	0	55
	Unknown	0	0	0	0	0	1	0	1	1	0	3
FI	Fatalities	2	0	0	4	2	10	1	9	19	9	56
	Light injuries	0	1	0	1	0	0	0	0	0	0	2
	Property	0	0	0	0	0	0	0	0	1	2	3
FR	Fatalities	0	1	1	6	2	4	10	16	93	1	134
	Injuries	2	4	5	9	5	7	18	16	81	0	147
	Property	11	8	63	14	8	15	19	30	127	2	297
IT	Fatalities	0	0	0	0	0	3			5	0	8
	Serious injuries	0	0	0	0	0	0	0	0	2	0	2
	Light injuries	0	0	0	0	0	0	0	0	2	0	2
	Unknown	0	0	0	0	0	0	0	0	1	0	1
NO	Fatalities	0	1	0	0	0	0	1	3	4	0	9
	Serious injuries	0	0	0	0	0	1	0	1	2	0	4
	Light injuries	0	0	0	0	0	2	2	2	0	0	6
	Property	0	1	1	0	2	1	2	3	4	6	20
	Unknown	0	0	0	0	0	0	1	0	0	0	1
ES	Fatalities	0	0	0	0	0	0	0	0	0	26	26
	Serious injuries	0	0	0	0	0	0	0	0	0	12	12
	Light injuries	0	0	0	0	0	0	0	0	0	25	25
	Property	0	0	0	0	0	0	0	0	0	40	40
TR	Fatalities	1	0	1	2	1	1	0	3	4	2	15
	Serious injuries	1	0	0	0	3	0	1	0	2	1	8
	Light injuries	2	0	0	0	1	0	0	0	1	1	5
	Property	2	0	0	0	1	0	0	0	0	1	4

4.5.3. Speed limit of freight trains

The speed limits are somewhat lower for freight trains than for passenger train (Table 22). For example, in Finland 74% of LC accidents occurred at locations which had 80 km/h speed limit for freight trains. For France the speed limits for passenger and freight trains are the same since this is the speed limit of the line and it does not separate the type of train.

Table 22. Distribution of speed limit for freight trains (km/h) in accident location by country and severity of injury.

Country		SPEED LIMIT FOR FREIGHT TRAINS (km/h)										Total
		≤ 30	31–40	41–50	51–60	61–70	71–80	81–90	91–100	> 100	Unknown	
EL	Fatalities	0	0	1	0	0	8	1	3	3	0	16
	Serious injuries	0	1	1	0	0	2	1	1	0	0	6
	Light injuries	1	1	0	0	1	4	1	2	1	0	11
	Property	1	12	4	7	1	9	5	8	8	0	55
	Unknown	0	0	0	0	0	1	0	1	1	0	3
FI	Fatalities	2	0	0	4	2	36	0	3	0	9	56
	Light injuries	0	1	0	1	0	0	0	0	0	0	2
	Property	0	0	0	0	0	1	0	0	0	2	3
FR	Fatalities	0	1	1	6	2	4	10	16	93	1	134
	Injuries	2	4	5	9	5	7	18	16	81	0	147
	Property	11	8	63	14	8	15	19	30	127	2	297
IT	Fatalities	0	0	0	0	0	3			5	0	8
	Serious injuries	0	0	0	0	0	0	0	0	2	0	2
	Light injuries	0	0	0	0	0	0	0	0	1	0	1
	Unknown	0	0	0	0	0	0	0	0	1	0	1
NO	Fatalities	0	1	0	0	0	1	2	1	4	0	9
	Serious injuries	0	0	0	0	0	1	1	0	2	0	4
	Light injuries	0	0	0	0	0	4	1	1	0	0	6
	Property	0	1	0	1	2	1	3	3	4	5	20
	Unknown	0	0	0	0	0	0	1	0	0	0	
ES	Fatalities	0	0	0	0	0	0	0	0	0	26	26
	Serious injuries	0	0	0	0	0	0	0	0	0	12	12
	Light injuries	0	0	0	0	0	0	0	0	0	25	25
	Property	0	0	0	0	0	0	0	0	0	40	40
TR	Fatalities	1	0	1	2	8	0	0	0	0	3	15
	Serious injuries	1	0	1	0	4	0	0	0	0	2	8
	Light injuries	2	0	0	0	2	0	0	0	0	1	5
	Property	1	0	0	0	1	0	0	0	0	2	4

4.5.4. Condition of wait platforms

The wait platform refers to the location where the car stops before the LC (if the stop is needed). The condition of the wait platform can be considered as good if the road before the LC is not too steep (i.e. there are no problems to proceed and cross the LC). The condition of wait platform was estimated as good in most level crossing accident locations in Spain (46%) and in Turkey (75%) (Table 23). The estimation was most often average in Italy (67%) and poor in Greece (41 %) and in Finland (43 %).

Table 23. Distribution of condition of wait platforms in accident LC by country and severity of injury.

Country		CONDITION OF WAIT PLATFORMS				Total
		Good	Average	Poor	Not known	
EL	Fatalities	4	1	11	0	16
	Serious injuries	4	0	2	0	6
	Light injuries	0	2	9	0	11
	Property	22	13	10	0	55
	Unknown	1	1	1	0	3
FI	Fatalities	17	8	21	10	56
	Light injuries	2	0	0	0	2
	Property	0	1	0	2	3
FR	Fatalities	0	0	0	134	134
	Injuries	0	0	0	147	147
	Property	0	0	0	297	297
IT	Fatalities	0	4	2	2	8
	Serious injuries	0	2	0	0	2
	Light injuries	0	0	1	0	1
	Unknown	0	0	0	1	1
NO	Fatalities	0	0	0	9	9
	Serious injuries	0	0	0	4	4
	Light injuries	0	0	0	6	6
	Property	0	0	0	20	20
	Unknown	0	0	0	1	1
ES	Fatalities	14	3	2	7	26
	Serious injuries	2	1	3	6	12
	Light injuries	2	2	2	19	25
	Property	8	14	3	15	40
TR	Fatalities	8	1	5	1	15
	Serious injuries	4	1	3	0	8
	Light injuries	2	0	1	2	5
	Property	3	1	0	0	4

4.5.5. Number of tracks

Level crossing accidents typically occurred at single-track railway sections in Finland (98%), in Norway (97%), in Spain (82%), in Turkey (74%) and in Greece (60%) (Table 24). Level crossing accidents occurring at double-track railway sections were common in France (61%) and in Italy (58%).

Table 24. Distribution of number of tracks in accident location by country and severity of injury.

Country		NUMBER OF TRACKS				Total
		1	2	3 or more	Unknown	
EL	Fatalities	12	2	2	0	16
	Serious injuries	2	1	3	0	6
	Light injuries	7	4	0	0	11
	Property	32	14	9	0	55
	Unknown	2	0	1	0	3
FI	Fatalities	47	0	0	9	56
	Light injuries	1	1	0	0	2
	Property	10	0	0	2	3
FR	Fatalities	27	96	11	0	134
	Injuries	58	83	6	0	147
	Property	112	171	14	0	297
IT	Fatalities	3	5	0	0	8
	Serious injuries	1	1	0	0	2
	Light injuries	0	1	0	0	1
	Unknown	1	0	0	0	1
NO	Fatalities	8	0	0	1	9
	Serious injuries	4	0	0	0	4
	Light injuries	6	0	0	0	6
	Property	17	1	0	2	20
	Unknown	1	0	0	0	
ES	Fatalities	21	5	0	0	26
	Serious injuries	8	3	0	1	12
	Light injuries	17	6	0	2	25
	Property	35	4	0	1	40
TR	Fatalities	10	4	0	1	15
	Serious injuries	6	2	0	0	8
	Light injuries	3	2	0	0	5
	Property	4	0	0	0	4

4.6. Level crossing characteristics

4.6.1. Type of level crossing

There were some variations by country on the type of level crossings the most LC accidents occur (Table 25). Level crossing accidents occurred typically at passive level crossings in Finland (68%), in Turkey (47%) and in Spain (40%) whereas most accidents occurred at level crossings equipped with automatic user side protection and warning in France (72%) and in Norway (45%). In Norway out of these level crossings, 59% were equipped with half barriers and 41% with full barriers. Most level crossings accidents occurred at LCs equipped with automatic user side protection and warning combined with rail side protection in Greece (57%) and in Italy (67%).

Table 25. Distribution of type of level crossing in accident location by country and severity of injury.

Country		TYPE OF LEVEL CROSSING									Total
		Automatic user side warning (e.g. acoustic or sound signals)	Automatic user side protection (e.g. barrier)	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	Other / Unknown	
EL	Fatalities	0	0	0	11	0	0	3	2	0	16
	Serious injuries	0	0	0	4	0	0	1	1	0	6
	Light injuries	0	0	0	6	0	0	0	5	0	11
	Property	0	0	0	31	0	0	8	16	0	55
	Unknown	0	0	0	1	0	0	1	1	0	3
FI	Fatalities	1	0	13	0	0	0	0	33	9	56
	Light injuries	0	0	2	0	0	0	0	0	0	2
	Property	0	0	0	0	0	0	0	1	2	3
FR	Fatalities	5	0	110	0	0	2	0	17	0	134
	Injuries	5	0	113	0	0	1	0	28	0	147
	Property	65	0	194	0	0	3	0	35	0	297
IT	Fatalities	0	3	0	4	0	0	0	1	0	8
	Serious injuries	0	0	0	2	0	0	0	0	0	2
	Light injuries	0	0	0	1	0	0	0	0	0	1
	Unknown	0	0	0	1	0	0	0	0	0	1
NO	Fatalities	1	1	5	1	0	0	0	1	0	9
	Serious injuries	1	0	0	0	0	0	0	3	0	4
	Light injuries	1	0	4	0	0	0	0	1	0	6
	Property	1	0	8	0	0	0	1	8	2	20
	Unknown	0	0	0	0	0	0	1	0	0	1
ES	Fatalities	0	0	5	14	0	0	0	6	1	26
	Serious injuries	0	0	4	3	0	0	0	5	0	12
	Light injuries	0	0	10	4	0	0	0	9	2	25
	Property	0	0	11	8	0	0	0	20	1	40
TR	Fatalities	0	0	5	0	0	1	0	9	0	15
	Serious injuries	0	0	3	0	0	1	0	4	0	8
	Light injuries	0	0	2	0	0	2	0	1	0	5
	Property	0	0	1	0	0	2	0	1	0	1

4.6.2. Location of level crossing

Most level crossing accidents occurred in urban environments in Greece (63%), in France (56%), in Italy (58%) and in Turkey (63%) (Table 26). In Norway 95% of level crossing accidents occurred in rural environment.

Table 26. Distribution of location of level crossing in accident location by country and severity of injury.

Country		LOCATION OF LEVEL CROSSING				Total
		Urban environment	Rural environment	Other	Unknown	
EL	Fatalities	8	8	0	0	16
	Serious injuries	6	0	0	0	6
	Light injuries	6	5	0	0	11
	Property	35	20	0	0	55
	Unknown	2	1	0	0	3
FI	Fatalities	0	0	0	56	56
	Light injuries	0	0	0	2	2
	Property	0	0	0	3	3
FR	Fatalities	83	51	0	0	134
	Injuries	87	60	0	0	147
	Property	151	146	0	0	297
IT	Fatalities	4	4	0	0	8
	Serious injuries	1	1	0	0	2
	Light injuries	1	0	0	0	1
	Unknown	1	0	0	0	1
NO	Fatalities	1	8	0	0	9
	Serious injuries	0	4	0	0	4
	Light injuries	0	6	0	0	6
	Property	1	17	0	2	20
	Unknown	0	1	0	0	1
ES	Fatalities	12	11	1	2	26
	Serious injuries	4	3	1	4	12
	Light injuries	6	18	0	1	25
	Property	4	26	0	10	40
TR	Fatalities	8	7	0	0	15
	Serious injuries	5	3	0	0	8
	Light injuries	5	0	0	0	5
	Property	2	2	0	0	4

4.6.3. Sight distances

The sight distance from the road means the possibility of the road user to see the approaching train. The sight distances were in most cases according to instructions in Finland (82%) and in Norway (91%) (Table 27). According to the received accident data there were rather high share of accident level crossings with poor visibility in Italy (75%) and in Turkey (69%).

Table 27. Distribution of sight distances in accident location by country and severity of injury.

Country		SIGHT DISTANCES (from the road)			Total
		According to instructions / good visibility	Not according to instructions / poor visibility	Not known	
EL	Fatalities	0	0	16	16
	Serious injuries	0	0	6	6
	Light injuries	0	0	11	11
	Property	0	0	55	55
	Unknown	0	0	3	3
FI	Fatalities	39	8	9	56
	Light injuries	1	1	2	2
	Property	1	0	2	3
FR	Fatalities	0	0	134	134
	Injuries	0	0	147	147
	Property	0	0	297	297
IT	Fatalities	2	6	0	8
	Serious injuries	1	1	0	2
	Light injuries	0	1	0	1
	Unknown	0	1	0	1
NO	Fatalities	4	0	5	9
	Serious injuries	2	0	2	4
	Light injuries	2	0	4	6
	Property	2	1	17	20
	Unknown	0	0	1	1
ES	Fatalities	0	0	26	26
	Serious injuries	0	0	12	12
	Light injuries	0	0	25	25
	Property	0	0	40	40
TR	Fatalities	6	9	0	15
	Serious injuries	1	7	0	8
	Light injuries	2	3	0	5
	Property	1	3	0	4

4.7. Circumstances

4.7.1. Weather

Little information was available in the received LC accident databases about the weather conditions at the time of the accident (Table B9, included as an Annex B). In Finland the weather was typically sunny (48%) or cloudy (43%). In Italy and in Turkey most of the accidents, for which the weather information was available, occurred during sunny weather. In France the most reported weather condition during LC accidents was snowy weather.

4.7.2. Lighting conditions

There was neither much information available in the received LC accident databases about the lighting conditions at the time of the accident (Table B10, included as an Annex B). Out of those accidents for which the information was available most occurred during day light in each country.

4.8. Train

4.8.1. Type of involved train

The train involved in level crossing collisions was typically a passenger train (Table 28).

Table 28. Distribution of involved train / rail vehicle of accident by country and severity of injury.

Country		TYPE OF TRAIN				Total
		Passenger	Freight	Other	Unknown	
EL	Fatalities	14	2	0	0	16
	Serious injuries	4	0	0	2	6
	Light injuries	11	0	0	0	11
	Property	49	5	0	1	55
	Unknown	3	0	0	0	3
FI	Fatalities	0	0	0	56	56
	Light injuries	0	0	0	2	2
	Property	0	0	0	3	3
FR	Fatalities	0	0	0	134	134
	Injuries	0	0	0	147	147
	Property	0	0	0	297	297
IT	Fatalities	8	0	0	0	8
	Serious injuries	2	0	0	0	2
	Light injuries	0	1	0	0	1
	Unknown	1	0	0	0	1
NO	Fatalities	8	1	0	0	9
	Serious injuries	2	2	0	0	4
	Light injuries	3	2	0	1	6
	Property	16	1	0	3	20
	Unknown	1	0	0		1
ES	Fatalities	2	0	0	24	26
	Serious injuries	0	0	0	12	12
	Light injuries	0	0	0	25	25
	Property	0	0	0	40	40
TR	Fatalities	11	1	0	3	15
	Serious injuries	7	0	0	1	8
	Light injuries	4	1	0	0	5
	Property	3	1	0	0	4

4.9. Effect

Information on delays (in minutes) caused by level crossing accidents was only reported in the Greek and the Turkish databases (Table 29). No clear conclusion can be drawn about the typical length of delay based on the limited amount of data.

Table 29. Distribution of delays (in minutes) caused by LC accidents by country and severity of injury.

Country		DELAY MIN							Total
		≤ 30	31–60	61–120	121–180	181–240	> 240	Unknown	
EL	Fatalities	0	0	2	1	0	2	11	16
	Serious injuries	0	2	0	0	0	0	4	6
	Light injuries	1	0	1	0	0	1	8	11
	Property	2	2	1	1	0	1	48	55
	Unknown	1	1	1	0	0	0	0	3
TR	Fatalities	1	0	4	3	3	1	3	15
	Serious injuries	0	0	2	2	1	0	3	8
	Light injuries	4	0	0	0	1	0	0	5
	Property	4	0	0	0	0	0	0	4

Information on delays in terms of number of trains affected (Table 30) and the costs originated from LC accidents (in euros) (Table 31) was documented only in the Turkish database. The costs reported in the Turkish in-depth database consisted of the cost of delay and the cost of property damage to the involved train and/or road vehicle. No clear conclusion can either be drawn on these topics due to the limited amount of data.

Table 30. Distribution of delays (number of trains affected) caused by LC accidents by country and severity of injury.

Country		NUMBER OF TRAINS AFFECTED						Total
		0	1	2	3	4	Unknown	
TR	Fatalities	0	3	1	2	2	7	15
	Serious injuries	0	2	2	1	0	3	8
	Light injuries	1	3	0	1	0	0	5
	Property	1	3	0	0	0	0	4

Table 31. Distribution of costs originated from LC accidents by country and severity of injury.

Country		TOTAL COST (€)							Total
		< 500	501–1000	1001–5000	5001–10000	10001–20000	20001–30000	Unknown	
TR	Fatalities	1	1	3	2	0	1	7	15
	Serious injuries	1	0	1	0	0	0	6	8
	Light injuries	1	0	3	0	0	0	1	5
	Property	2	0	0	0	0	0	2	4

4.10. Main factors affecting the accident

Main factors affecting the accident could be found from the Greek (Table 32), the French (Table 33), the Norwegian (Table 34) and the Turkish databases (Table 35). The French database included the information for each accident and the other databases regarding some selected accidents. No information on main factors affecting the accident was directly available from Spain and Finland. The Finnish database included in formation on secondary task and those are reported in section 4.4.6 of this deliverable.

The following list includes some examples of the main factors affecting the realisation of LC accidents:

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

Table 32. Main factors affecting the accidents by type of accident in Greece.

Type of accident	Main factors affecting the accident
Fatality	– Suicide
Serious injury	– A cyclists crashed on a train; according to the report cyclist was listening music – A man violated barricades and hit on the side of the train
Property damage	– Accident was caused by the car violating the barricades – Accident was caused by the train drifting abandoned car – Accident was caused by the train drifting motorbike that was abandoned on the railway line – Accident was caused by the train crashing on an abandoned car
Unknown	– A car was abandoned in the LC because of mechanical failure – A car was abandoned in the LC because of mechanical failure – A barrier closed the LC causing delays

Table 33. Main factors affecting the accidents by type of accident in France.

Main factors affecting the accident	Fatalities	Injuries	Property
Abandoned vehicle			4
Accident before LC		1	
Alcohol	1	1	7
Breakdown of the car at the LC	2	6	17
Carelessness		1	
Breaking of rules (truck did not manage to cross the LC in 7 seconds; delay between the beginning of red light and the beginning of the fall down of the barrier)			3
Caught in the gauge (the vehicle was too engaged and entered in the dangerous zone)	7	10	22
Confusion between railway track and road		2	6
Crossing without looking		1	
Distraction	10	3	2
Driving error		1	
Error of judgement			1
Excessive speed	2	2	16
Falling asleep		1	
Health problem	4		
Inattention	2		
LC malfunction	1		
Loss of control (vehicles or bicycles)	1	4	22
Manoeuvring on the LC (vehicles reverse/realize maneuvers on LC)		3	5
Misinterpretation of the risk	2		
Non-observance of road signage	37	27	82
Not looking before crossing	1	3	2
Overgrown vegetation			1
Overtaking queueing traffic	4	7	11
Playing a game to dodge train		1	
Poor management of the site			1
Pre-emptive start (the vehicle didn't wait the barrier to go completely up before the start)		1	2
Slipstream effect in the dangerous zone (the airstream from the train caused the accident)	3	2	
Stopping on the LC	1	4	3
Stuck on the LC due to the ground profile	3	1	3
Stuck on the tracks due to spin		1	2
Train crossing (the second train caused the accident; double tracks)	5		
Forcing through the barriers	5	9	15
Travelling between the barriers		1	
Travelling beyond the barrier	1		
Travelling over the barrier		1	
Travelling under the barrier	6	3	
Turning problem (there was a perpendicular road with an angle at 90°)			2
Visibility: glare from the sun	2	11	15
Weather conditions		4	10
Weaving through the barriers	28	31	30
Wedged on the LC (the vehicle stalled on the LC and stayed on tracks)	1	2	10
Unknown	5	2	3
Total	**134**	**147**	**297**

Table 34. Main factors affecting the accidents by type of accident in Norway.

Type of accident	Main factors affecting the accident
Fatality	– Accident occurred at a level crossing which was not allowed for cars (there was a permanent road barrier) – The motorcyclist did not stop in front of the barrier which was down. The person got the barrier into his/her chest and was thrown into the track. The person was most likely unconscious since he/she did not respond to several sound signals.
Serious injuries	– Train driver gave the sound signal according to the rules, but the tractor did not stop. The private level crossing seemed to be in poor state.
Light injuries	– Car collided into train (wagon behind locomotive) on unsecured crossing – Car drove into the side of the train – Car ran down the barrier gate, car driver was not able to get out of the car and was hit by the car. Train driver used the emergency break, but was not able to stop the train before hitting the car. – Tractor drove slowly towards track and train driver thought the tractor would stop. Tractor drove onto the track just in front of the train. – Train collided with a car standing at the level crossing between the barriers
Property damage	– Car drove into train. Car passed the gate barrier which was down. – Car got motor stop at crossing. Passengers left the car when the barrier gate when down – Collision of the train and car in private level crossing. All persons were able to get out of the car before the collision – Train collided with car standing at the coring between the barriers. There was no person inside the car when collision happened. – Access to the crossing was blocked by the service machine, but the trailer was still able to enter the crossing – Train collided with a car stuck in snow on the crossing. People got out of the car when the barriers went down – Car got stuck at the level crossing, the driver was able to evacuate the car before it was hit by the train. – Car was standing at the track in between the barriers, persons were able to leave the car before the collision – The driver entered the level crossing even though the barriers were down – Train hit tractor parked at level crossing – Tractor driver did not notice the “train is coming” signal – Car driver crossed the track even though train red signal and sound signal was given – Accident occurred due to the poor visibility

Table 35. Main factors affecting the accidents by type of accident in Turkey.

Type of accident	Main factors affecting the accident
Fatality	– Low sight distance from train – No adverse weather condition that would affect the accident. It was dark when the accident happened
Serious injury	– Alcohol, violation (risk-taking)
Property damage	– Snow, low sight distance from road, due not seeing the coming of train, car driver tried to brake but could not stop because of the snow – Violation (risk-taking)

5. SUMMARY, DISCUSSION AND CONCLUSIONS

The aim of this deliverable was to produce an in-depth review of level crossing (LC) accident data collected from seven countries, namely Greece, Finland, France, Italy, Norway, Spain and Turkey. The involved partners were responsible for collecting the data from relevant sources in their country. The proposed main data sources were accident investigation reports from railway operators and national accident investigation bodies.

5.1. Summary and description of the collected data

There was some variation in the data sources the involved partners used to collect the in-depth LC accident data. The collected data was investigated and reported both by organisations independent from railways (Greece, Finland and Italy) and by railway stakeholders (France, Norway, Spain and Turkey). The list of accident investigation bodies can be found below:

- Greece: The Local Authority for Railway Accidents and Incidents (independent from railways and supervised by the Minister of Infrastructure, Transportation and Networks)
- Finland: The Road Accident Investigation Teams (independent from railways)
- 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
- Italy: DiGIFEMA (Direzione Generale per le Investigazioni Ferroviarie e Marittime) (independent from railways)
- Norway: Investigation and Analysis Unit of Bane NOR (the Norwegian infrastructure manager)
- Spain: The main sources of accident data for Spain 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 which own and operate all public railways in Turkey). In case of the higher victim number, the investigation is conducted by the accident research and investigation board of Ministry

The original aim of this work was to cover accident data from the past 5-year period. In practice, the extent of data period varied between 4–10 years. Most of the countries provided the requested five years of data (France, Italy, Norway and Turkey) whereas the Spanish data covered 4 years, the Greek data 6 years and the Finnish data 10 years.

The coverage of the in-depth LC accident data varied among countries when comparing the number of cases reported to European Union of Railways (ERA) database and the number of cases included in the in-depth LC accident data. 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. For example, in Finland the difference is most probably due to the fact that the Road Accident Investigation Teams focus on fatal motor vehicle accidents and therefore e.g. some pedestrian fatalities are missing from the sample. Other possibility is that the information on fatal accident was received so late that the investigation was not started (e.g. person was killed later at the hospital).

When comparing the received in-depth accident data to the number of cases reported to the ERA database, we can also see that our in-depth sample includes information on some light injuries and property damage accidents which are not reported to the ERA database.

The coverage of in-depth LC accident samples with regards to the different requested variables varied between variable categories. The summary of the categories and the coverage of each group of variables is provided in the following:

- Collision related information (time of accident, outcome, type of involved vehicle): All variables were covered by the accident data samples from all countries
- Victim related information (type of victim, gender, age etc.): Finnish, Italian and Turkish data samples covered all or almost all variables. French had more limited data and Greek, Norwegian and Turkish data samples included no (or little) information on victims.
- Road environment (road traffic volume, type of road etc.): Most data samples covered all variables. French and Spanish data samples included limited amount of information on road related variables.
- Railway environment (train volume, train speed limits etc.): These variables were covered rather well; Spanish data sample did not include information on train speeds and French and Norwegian data did not include information on wait platforms
- LC characteristics (type of LC, location of LC etc.): Type of LC covered by all countries; more limited information regarding location of LC and sight distances
- Circumstances (weather, lighting conditions): The information related to these variables were mostly missing
- Train: No information from Finland and France; other countries had a limited or full coverage
- Effect (delays, costs): Mostly missing. Some information was received from Turkey, Italy and Greece
- Main factors affecting the accident: Relatively well covered

5.2. Representativeness of the collected data

5.2.1. Representativeness of collected data with regards to the LC safety situation

This chapter focuses on the representativeness of collected LC in-depth accident data with regard to the general LC safety situation in each country. This comparison was proposed to be done, for example, based on a longer period and/or larger sample of LC accident data than the collected data sample.

Greece

The comparison between the data collected by ERA and the data collected by the Greek Authorities for the two periods (2011–2015, 2012–2017) shows that there is a decrease in accidents taking place in LCs in Greece. The overlapping of three years (2012–2015) emphasizes this fact, as the difference is even larger. This is in agreement with the fact that safety is LCs in Greece has been slightly improved during the last years.

Finland

The representativeness of the Finnish in-depth LC accident data was analysed by comparing the results with the findings from Laapotti (2016) who investigated fatal motor vehicle accidents at level crossings in Finland from 1991–2011 (also investigated by Road Accident Investigation Teams). She found out that most accidents took place at passive level crossings. Furthermore, Laapotti found out that almost all the immediate risk factors in the LC accidents were of the human error type. Observation errors on the part of the road user were typical at passive level crossings, and risk taking at active crossings. The environment did not support safe crossing in most of the accidents at passive level crossings. The speed limits of both the road and rail were high, visibility was insufficient, and the level crossing was often situated on a hill. Our in-depth data sample supports most of the findings of Laapotti. The slight difference concerns the visibility of the accident level crossings. According to our sample the visibility was good in 82% of LC accidents. Laapotti concluded that the visibility was sufficient on 63% of LC accidents at passive LCs and on 93% of LC accidents at active LCs.

France

In general, a reduction of LC accidents (collisions and fatalities) has been observed from 1990 to 2016. Compared with the accident numbers in 1990, there has been a decrease of 53% of collisions and 43% of fatalities. At the same time, the number of LCs in France has been reduced by 25%.

Italy

The investigated and collected data represent in a satisfactory way the LC safety situation in Italy.

Turkey

Because of missing accident reports, rubbed out reports and missing data, the in-depth accident data collection in Turkey focused on analysing specific accident reports which covered nearly all of the required variables and LC accidents occurring between the years 2012–2016.

According to the database of Turkish Railways (TCDD) 116 of the 196 LC accidents occurred at passive LCs and 42 at LCs with automatic user side protection and warning. Regarding the distribution on the type of level crossings and severity of injury, the accident analysis showed that the accident numbers are highest for passive LCs followed by LCs equipped with automatic user side protection and followed by warning. The most serious problem related to the LC accidents occurring in Turkey is risk taking and violation.

As mentioned above, due to various reasons it was not possible to analyse all the LC accidents occurring between the years 2012–2016. However, it was realised that during 2012–2016, three separate LC accidents were reported in one specific LC in Turkey. It is the highest number of accidents occurring at the same LC. The first occurred in 2011 and the last in 2016, the second report is missing. In addition, there were also additional LCs in which two separate accidents have occurred.

5.2.2. Comparison of collected data with regards to the LC inventory

This text focuses on the comparison of LC in-depth accident data with regards to the LC inventory in each country.

Comparison of collected data with regards to the type of LCs

In order to simplify this analysis the level crossings were divided into two types: ‘passive level crossing’ and ‘active level crossing’ (EU DIRECTIVE 2016/798). A ‘passive level crossing’ is one without any form of warning system or the protection is activated when it is unsafe for the user to traverse the crossing. An ‘active level crossing’ is one where the crossing users are protected from or warned of the approaching train by devices which are activated when it is unsafe for the user to traverse the crossing. These active level crossings can be either manual or automatic.

As mentioned earlier, there are some variations by country on the type of level crossings the most LC accidents occur (Table 36). If using the above-mentioned simplification to active and passive LCs, Finland is the only country where LC accidents are more common in passive than in active level crossings (68% vs. 32%). This is not surprising since 77% of level crossings are passive in Finland. The share of LC accidents occurring at active level crossings is the highest in Italy (92%), followed by France (86%) and Greece (73%). When looking at the share of LCs in each country we can see that in these countries the share of active LCs is also the highest: 78% in France, 77% in Italy and 52% in Greece.

Table 9. Share of different types level crossings in LC accidents and the share of different types of level crossings by country.

	Country	TYPE OF LEVEL CROSSING: 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	TOTAL
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	34	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.

In Norway 66% of LC accidents occur at active level crossings even though the share of active LCs in Norway is only 14%. The results of in-depth data analysis indicate that LC accidents at active level crossings are overrepresented in Norway. Both in Spain and in Turkey somewhat higher share of LC accidents occur at active LCs compared to the share of active LCs of all LCs in these countries.

Comparison of collected data with regards to other LC related variables

Finland

Most level crossing accidents (52%) occur at level crossings with road speed limit of 80 km/h. When looking at all LCs 76% of them have this road speed limit so the level crossings with road speed limit of 80 km/h are somewhat underrepresented in LC accidents. The high share of road speed limits of 80 km/h is due to the fact that it is a general speed limit in Finland (i.e. the valid speed limit if not stated otherwise).

Most level crossing accidents (63%) in Finland occur at LCs with low daily road traffic volumes (100 road vehicles per day or less). However, when looking at the distribution of LCs by road traffic volume we can see that in 79% of Finnish LCs the daily road traffic volume is 100 road vehicles per day or less. Based on this the LCs with low road traffic volume are underrepresented in LC accident statistics. This same applies to train traffic volume: most level crossing accidents (68%) in Finland occur at LCs with low train traffic volume (20 trains per day or less) whereas 85% of LCs have this low train traffic volume.

France

The comparison of accident data to LC inventory reveals, for example, that urban areas are overrepresented in LC accidents. In France 55% of LC accidents occur in urban areas while 31% of LCs are located in urban areas.

Italy

The investigated data used for the in-depth accident analysis are relevant also in comparison with the LC Italian inventory. The distribution of road traffic volume in LCs with accidents is similar to all LCs. The LCs in Italy are typically located on roads with low traffic volumes and the traffic level changes mainly according to the area (rural or urban). The distribution of train traffic volume in LCs with accidents is not similar to all LCs in Italy. The train traffic volume in Italy varies geographically: the train traffic in the North of Italy is different from the South of Italy where the level of traffic is smaller.

Turkey

As seen in the analysis, LC accidents happen in both the LCs which are equipped with automatic barriers, have very good sight distances and very good design and at passive LCs which are located in rural areas with very bad design criteria. A majority of LC accidents in Turkey occurred at passive LCs. Turkish Railways builds passive LCs to locations where the daily average number of trains in a year multiplied by the daily average number of road vehicles in a year is up to 3000 and the maximum speed limit is 120 km/h.

In general, there are several variables, which can be used as indication of the safety of LCs. According to the LC accident prediction models (see e.g. Peltola 2013) the main factor affecting the prediction of level crossing accidents is the exposure which refers to the number of road and rail vehicles using the level crossing. According to the accident prediction model of Peltola the other factors affecting the prediction are existence of warning devices, speed limit on the road and rail, sight distances and type of road surface.

When looking at the LC related variables from the safety improvement viewpoint the type of road surface could, for example, indicate something about the type of environment (rural or urban) where the LC is located. This could in turn indicate something about the ease of installation, operation and maintenance of protection devices especially with regards to LCs in isolated rural locations.

The analysis conducted in this deliverable focused mainly on information included in one data table at the time. Therefore no in-depth analysis of accidents in relation to other variables to understand the significance of such variables as risk factors was not conducted (e.g. different characteristics of the road environment in relation to the proportion of LCs that can be found in such circumstances). This would have been interesting but within the scope of this study such depth of analysis was not reasonable. We rather gathered data available for further analyses based on the needs in WP2.

5.3. Recommendations regarding in-depth LC accident databases

The main aim of this task was to produce recommendations of LC accident database contents in general and concerning the accident database which will be used in later stages of SAFER-LC project for the assessment of the innovative measures to improve the safety of level crossings. The variables which are especially interesting from human factors point of view are the victim details. The detailed information about the victim profile such as type of victim, his/her qualities, motives and/or behaviour provide valuable input data when assessing the possible effects of LC safety measures. The coverage of victim details varied between countries and in several cases they were lacking. The coverage of victims details could be improved e.g. by a close cooperation of different parties involved in accident investigation. In addition, the road infrastructure managers could be better involved in the LC accident investigation process to collect and share information regarding LC accidents with railway stakeholders and/or independent accident investigation bodies. If needed, the cooperation could also be done at international level e.g. to consult colleagues in other countries to share practices used in collecting data in their country related to some specific variables.

Moreover, the information on the type of victim is important from the traffic safety point of view. The more detailed information on victims of level crossing accidents supports the authorities and railway stakeholders in their decision making process when deciding on how to allocate the funds for the traffic safety work and to decide on which audiences to target. Here the traffic safety work refers to implementation of different LC safety measures including safety campaigns. The more detailed information on victims of level crossings accidents might also increase the awareness and concern about the level crossing accidents and the importance of their prevention in general.

Other interesting variables from WP2 point of view are related to road and railway environment, LC characteristics and circumstances. The detailed information of the surroundings of LCs and the types of LCs were the LC accidents occur, for example, allow the planning and identification of different safety measures to different types of level crossings.

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. In addition, the victim information could ideally also be available to research purposes. In this case of open data the anonymity of the data should be respected and taken care of with appropriate procedures.

One major challenge is that the data collection procedures and the amount and details of documented data vary between countries. It was clear that this is the current situation in Europe. However, it was surprising to note that the yearly number of fatalities and serious injuries did not perfectly match with the number of cases reported to the ERA database in each country. Therefore, the recommendation is to increase the cooperation between the organisations conducting the in-depth LC accident investigations and the organisations which report the yearly accident numbers to the ERA database. Furthermore, it would be useful to have a European wide recommendation on LC accident data collection including proposal on most useful variables to be collected. A more detailed European wide LC accident data would enable more detailed analysis of LC accidents and would lead to useful conclusions.

The in-depth LC accident data available in each country was not in most cases directly available in the format as requested in this task. This might be due to several different and often culturally related factors which affect the collection of accident data or the extent in which the accident data is made available. It must also be noted that since there was a need to structure the information requested in a comparable way according to the pre-defined template, some information collected and documented in the accident reports may have been missed.

Even though the collected in-depth LC accident data does not in most cases cover all the occurred LC fatalities and/or accidents in that specific country, the added value of our analysis compared to the data available in the ERA database is a) that from some countries we have also information on accidents causing light injuries and accidents causing property damage only, and b) we have information on wide variety of variables related to the LC accidents.

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ANNEX A: VARIABLES AND LEVELS OF INFORMATION USED IN IN-DEPTH DATA COLLECTION

Table A1. The variables and levels of information for in-depth data collection.

TITLE	VARIABLE	LEVEL
Collision	Outcome (choose the most severe consequence)	Fatality Serious injury Light injury Property damage only Unknown
	Type of road vehicle	Passenger car Bus Van Truck Tractor Other No vehicle involved
	Month	January February March April May June July August September October November December Unknown
	Day of the week	Monday Tuesday Wednesday Thursday Friday Saturday Sunday Unknown
	Hour	0–3 3–6 6–9 9–12 12–15 15–18 18–21 21–24 Unknown
	Year	Specific year, *add here* Unknown
Victim	Type of victim	Car driver Car passenger Pedestrian Cyclist Mopedist Motorcyclist Other
	Type of road user	Local inhabitant

		Random user Unknown
	Outcome	Fatality Serious injury Light injury Unknown
	Gender	Male Female Unknown
	Age	0–9 10–19 20–29 30–39 40–49 50–59 60–69 70–79 80–89 Unknown
	Intentionality	Suicide (intentional) Accident (Unintentional) Unknown event
	Involvement in secondary tasks	Yes No Unknown
	Intoxication	Alcohol, medicines and/or drugs No intoxication Unknown
Road environment	Road traffic volume (AADT)	<10 10–100 101–200 201–300 301–400 401–500 501–1000 1001–2000 2001–3000 3001–4000 4001–5000 5001–10000 >10000
	Type of road	Highway Street Private road
	Road speed limit	<=30 km/h 40 km/h 50 km/h 60 km/h 70 km/h 80 km/h 100 km/h >100 km/h
	Number of lanes per direction	1 2 3 or more
	Type or road surface	Asphalt Gravel / unpaved road Other
	Existence of level crossing sign before LC	Yes No Not known
	Inclination	Less than 1.5% (flat) At least 1.5% (slope)

		At least 1.5% (hill)
	Crossing angle (between road and track)	<70 degrees 70–110 degrees >110 degrees
Railway environment	Daily train volume (passenger + freight)	*Add here*
	Speed limit for person trains (km/h)	*Add here*
	Speed limit for freight trains (km/h)	*Add here*
	Condition of wait platform	Good Average Poor Not known
	Number of tracks	1 2 3 or more
LC characteristics	Type of LC	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 Other
	Location of LC	Urban environment Rural environment Other
	Sight distances (from the road)	According to the instructions / good visibility Not according to instructions / poor visibility Not known
Circumstances	Weather	Rainy Snowy Cloudy Sunny/bright Foggy Other Unknown
	Lighting conditions	Dawn Light Dusk Dark Unknown
Train	Train	Passenger Freight Unknown
Effect	Delay (number of minutes)	*Add here*
	Delay (number of trains cancelled)	*Add here*
	Costs (euros)	*Add here*
Main factors affecting the accident according to the accident report		*Add here*
Additional details		*Add here*

ANNEX B: ADDITIONAL DATATABLES

Table B1. Distribution of month of accident by country and severity of injury.

Country		MONTH													Total
		Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Unknown	
EL	Fatalities	1	0	2	2	2	1	1	3	0	0	3	1	0	16
	Serious injuries	3	0	0	0	0	0	0	1	0	2	0	0	0	6
	Light injuries	2	2	0	0	0	0	2	0	2	0	2	1	0	11
	Property	6	10	7	6	1	2	4	2	6	3	2	6	0	55
	Unknown	0	0	1	0	0	0	0	1	0	0	1	0	0	3
FI	Fatalities	2	6	4	5	8	2	5	5	4	5	3	7	0	56
	Light injuries	0	0	0	0	0	1	0	1	0	0	0	0	0	2
	Property	1	1	0	1	0	0	0	0	0	0	0	0	0	3
FR	Fatalities	14	7	9	7	10	7	17	14	10	14	12	13	0	134
	Injuries	15	16	9	13	9	13	14	11	11	12	11	13	0	147
	Property	30	24	30	20	16	17	20	16	27	26	30	41	0	297
IT	Fatalities	0	2	0	0	2	0	1	0	1	0	2	0	0	8
	Serious injuries	0	0	0	0	1	0	1	0	0	0	0	0	0	2
	Light injuries	0	0	0	0	0	0	0	0	1	0	0	0	0	1
	Unknown	0	0	0	0	0	1	0	0	0	0	0	0	0	1
NO	Fatalities	2	1	1	2	0	2	1	0	0	0	0	0	0	9
	Serious injuries	0	0	1	0	0	1	1	0	0	0	0	1	0	4
	Light injuries	0	2	1	1	0	0	0	2	0	0	0	0	0	6
	Property	3	0	3	2	2	1	1	1	1	0	2	4	0	20
	Unknown	0	0	0	0	0	0	0	0	0	0	1	0	0	1
ES	Fatalities	1	2	4	2	2	0	2	1	3	4	2	3	0	26
	Serious injuries	0	1	1	0	3	1	2	3	0	0	0	1	0	12
	Light injuries	1	3	1	0	1	3	2	4	2	6	2	0	0	25
	Property	8	5	2	3	2	7	0	4	2	2	3	2	0	40
TR	Fatalities	1	0	2	2	0	0	3	2	3	2	0	0	0	15
	Serious injuries	1	0	0	1	0	2	0	0	1	2	1	0	0	8
	Light injuries	0	0	1	0	1	1	1	1	0	0	0	0	0	5
	Property	2	1	0	1	0	0	0	0	0	0	0	0	0	4

Table B2. Distribution of weekday of accident by country and severity of injury.

Country		WEEKDAY								Total
		Mon	Tue	Wed	Thu	Fri	Sat	Sun	Unknown	
EL	Fatalities	1	1	5	1	3	2	3	0	16
	Serious injuries	0	1	1	2	0	1	1	0	6
	Light injuries	0	1	2	3	2	2	1	0	11
	Property	10	9	9	1	10	5	11	0	55
	Unknown	0	0	1	0	1	0	1	0	3
FI	Fatalities	9	8	8	7	11	6	7	0	56
	Light injuries	0	0	1	0	0	0	1	0	2
	Property	0	1	0	1	1	0	0	0	3
FR	Fatalities	17	18	19	21	22	20	17	0	134
	Injuries	5	25	34	23	22	21	17	0	147
	Property	27	50	46	42	40	53	39	0	297
IT	Fatalities	1	0	3	1	0	1	2	0	8
	Serious injuries	0	1	0	0	0	0	1	0	2
	Light injuries	0	0	0	0	1	0	0	0	1
	Unknown	0	1	0	0	0	0	0	0	1
NO	Fatalities	0	1	1	0	2	4	1	0	9
	Serious injuries	1	0	0	0	1	2	0	0	4
	Light injuries	0	3	1	1	1	0	0	0	6
	Property	2	5	2	3	5	1	2	0	20
	Unknown	0	0	0	1	0	0	0	0	1
ES	Fatalities	4	4	6	5	2	2	3	0	26
	Serious injuries	0	1	1	3	5	1	1	0	12
	Light injuries	4	5	7	3	3	1	2	0	25
	Property	4	6	7	7	6	5	5	0	40
TR	Fatalities	3	0	1	2	5	3	1	0	15
	Serious injuries	0	0	2	1	3	0	2	0	8
	Light injuries	1	1	1	2	0	0	0	0	5
	Property	2	0	0	2	0	0	0	0	4

Table B3. Distribution of 3-hour periods of accident by country and severity of injury.

Country		HOUR									Total
		00–03	03–06	06–09	09–12	12–15	15–18	18–21	21–24	Unknown	
EL	Fatalities	1	1	4	2	3	3	2	0	0	16
	Serious injuries	0	1	0	1	1	3	0	0	0	6
	Light injuries	0	0	1	0	3	2	1	4	0	11
	Property	1	6	10	13	6	6	8	5	0	55
	Unknown	0	0	0	0	0	0	1	2	0	3
FI	Fatalities	0	2	6	13	16	12	5	1	1	56
	Light injuries	0	0	1	0	0	1	0	0	0	2
	Property	0	0	1	1	1	0	0	0	0	3
FR	Fatalities	7	1	20	17	22	34	17	6	10	134
	Injuries	3	4	24	36	11	25	34	5	5	147
	Property	2	18	48	41	57	47	62	18	4	297
IT	Fatalities	0	0	1	1	1	2	1	2	0	8
	Serious injuries	0	0	2	0	0	0	0	0	0	2
	Light injuries	0	0	1	0	0	0	0	0	0	1
	Unknown	0	0	1	0	0	0	0	0	0	1
NO	Fatalities	0	0	0	1	3	0	3	2	0	9
	Serious injuries	0	0	0	0	0	2	1	1	0	4
	Light injuries	0	1	0	0	1	3	1	0	0	6
	Property	0	1	3	4	3	2	3	4	0	20
	Unknown	0	0	0	1	0	0	0	0	0	1
ES	Fatalities	0	0	1	7	7	9	2	0	0	26
	Serious injuries	0	0	0	3	1	5	2	1	0	12
	Light injuries	0	0	1	6	5	10	3	0	0	25
	Property	0	0	3	14	9	7	5	2	0	40
TR	Fatalities	0	0	2	2	3	3	4	0	1	15
	Serious injuries	1	0	1	1	1	2	2	0	0	8
	Light injuries	2	0	0	0	0	1	2	0	0	5
	Property	0	1	0	0	1	2	0	0	0	4

Table B4. Distribution of gender of involved persons by country and severity of injury.

Country		GENDER			Total
		Female	Male	Unknown	
EL	Fatalities	0	14	2	16
	Serious injuries	1	4	1	6
	Light injuries	3	6	2	11
FI	Fatalities	22	43	0	65
	Serious injuries	3	3	0	6
	Light injuries	1	5	0	6
FR	Fatalities	37	94	3	134
	Injuries	32	104	11	147
IT	Fatalities	0	4	4	8
	Serious injuries	0	1	1	2
	Light injuries	0	1	0	1
	Unknown	0	0	1	1
NO	Fatalities	0	0	10	10
	Serious injuries	0	0	5	5
	Light injuries	0	0	6	6
	Unknown	0	0	1	1
ES	Fatalities	0	0	26	26
	Serious injuries	0	0	12	12
	Light injuries	0	0	25	25
TR	Fatalities	14	20	0	34
	Serious injuries	3	18	0	21
	Light injuries	0	5	0	5

Table B5. Distribution of age of involved persons by country and severity of injury.

Country		AGE										Total
		0–9	10–19	20–29	30–39	40–49	50–59	60–69	70–79	Over 80	Unknown	
EL	Fatalities	0	0	0	1	0	2	2	0	1	10	16
	Serious injuries	0	0	1	0	0	0	0	1	0	4	6
	Light injuries	0	0	0	0	2	0	0	0	0	6	11
FI	Fatalities	1	10	5	5	12	11	7	8	6	0	65
	Serious injuries	0	1	2	0	1	0	2	0	0	0	6
	Light injuries	0	1	1	1	3	0	0	0	0	0	6
FR	Fatalities	0	14	10	17	12	11	13	18	23	16	134
	Injuries	1	6	10	7	10	9	13	8	7	76	147
IT	Fatalities	0	0	1	0	1	0	0	0	1	5	8
	Serious injuries	0	0	0	0	0	0	0	0	0	2	2
	Light injuries	0	0	0	0	0	0	0	0	0	1	1
	Unknown	0	0	0	0	0	0	0	0	0	1	1
NO	Fatalities	0	0	0	0	0	0	0	0	0	10	10
	Serious injuries	0	0	0	0	0	0	0	0	0	5	5
	Light injuries	0	0	0	0	0	0	0	0	0	6	6
	Unknown	0	0	0	0	0	0	0	0	0	1	1
ES	Fatalities	0	0	0	0	0	0	0	0	0	26	26
	Serious injuries	0	0	0	0	0	0	0	0	0	12	12
	Light injuries	0	0	0	0	0	0	0	0	0	25	25
TR	Fatalities	2	2	2	3	2	2	3	1	0	17	34
	Serious injuries	1	0	4	1	3	0	1	0	0	11	21
	Light injuries	0	0	1	1	0	0	0	0	0	3	5

Table B6. Distribution of type of road in accident location by country and severity of injury.

Country		TYPE OF ROAD				Total
		Highway	Street	Private road	Unknown/Other	
EL	Fatalities	1	15	0	0	16
	Serious injuries	1	5	0	0	6
	Light injuries	2	8	1	0	11
	Property	1	52	1	1	55
	Unknown	0	3	0	0	3
FI	Fatalities	6	10	25	15	56
	Light injuries	1	1	0	0	2
	Property	0	0	1	2	3
FR	Fatalities	0	134	0	0	134
	Injuries	0	147	0	0	147
	Property	0	297	0	0	297
IT	Fatalities	0	7	1	0	8
	Serious injuries	0	2	0	0	2
	Light injuries	0	1	0	0	1
	Unknown	0	1	0	0	1
NO	Fatalities	2	7	0	0	9
	Serious injuries	0	1	3	0	4
	Light injuries	0	6	0	0	6
	Property	5	4	6	5	20
	Unknown	0	1	0	0	1
ES	Fatalities	5	7	5	9	26
	Serious injuries	2	1	1	8	12
	Light injuries	4	1	3	17	25
	Property	2	1	4	33	40
TR	Fatalities	0	15	0	0	15
	Serious injuries	0	8	0	0	8
	Light injuries	0	5	0	0	5
	Property	0	4	0	0	4

Table 10. Distribution of number of lanes per direction in accident location by country and severity of injury.

Country		NUMBER OF LANES PER DIRECTION				Total
		1	2	3 or more	Unknown	
EL	Fatalities	14	2	0	0	16
	Serious injuries	4	2	0	0	6
	Light injuries	9	2	0	0	11
	Property	48	6	0	1	55
FI	Fatalities	47	0	0	9	56
	Light injuries	2	0	0	0	2
	Property	1	0	0	2	3
FR	Fatalities	0	0	0	134	134
	Injuries	0	0	0	147	147
	Property	0	0	0	297	297
IT	Fatalities	7	1	0	0	8
	Serious injuries	2	0	0	0	2
	Light injuries	1	0	0	0	1
	Unknown	1	0	0	0	1
NO	Fatalities	9	0	0	0	9
	Serious injuries	4	0	0	0	4
	Light injuries	5	0	0	1	6
	Property	13	0	0	7	20
	Unknown	1	0	0	0	1
ES	Fatalities	0	0	0	26	26
	Serious injuries	0	0	0	12	12
	Light injuries	0	0	0	25	25
	Property	0	0	0	40	40
TR	Fatalities	15	0	0	0	15
	Serious injuries	7	0	1	0	8
	Light injuries	4	0	1	0	5
	Property	2	0	2	0	4

Table B8. Distribution of type of road surface in accident location by country and severity of injury.

Country		TYPE OF ROAD SURFACE				Total
		Asphalt	Gravel / unpaved road	Other	Unknown	
EL	Fatalities	16	0	0	0	16
	Serious injuries	6	0	0	0	6
	Light injuries	10	1	0	0	11
	Property	53	1	0	1	55
	Unknown	3	0	0	0	3
FI	Fatalities	22	25	0	9	56
	Light injuries	1	1	0	0	2
	Property	0	1	0	2	3
FR	Fatalities	0	0	0	134	134
	Injuries	0	0	0	147	147
	Property	0	0	0	297	297
IT	Fatalities	7	1	0	0	8
	Serious injuries	2	0	0	0	2
	Light injuries	1	0	0	0	1
	Unknown	1	0	0	0	1
NO	Fatalities	5	3	0	1	9
	Serious injuries	0	4	0		4
	Light injuries	2	2	0	2	6
	Property	5	8	0	7	20
	Unknown	0	1	0	0	1
ES	Fatalities	12	2	11	1	26
	Serious injuries	3	0	6	3	12
	Light injuries	2	2	20	1	25
	Property	4	8	22	6	40
TR	Fatalities	5	6	4	0	15
	Serious injuries	3	2	3	0	8
	Light injuries	0	1	4	0	5
	Property	0	1	3	0	4

Table B9. Distribution of weather in accident location by country and severity of injury.

Country		WEATHER							Total
		Rainy	Snowy	Cloudy	Sunny/bright	Foggy	Other	Unknown	
EL	Fatalities	0	0	0	1	0	0	15	16
	Serious injuries	0	0	0	0	0	0	6	6
	Light injuries	0	0	0	0	0	0	11	11
	Property	0	0	0	2	0	0	53	55
	Unknown	0	0	0	0	0	0	3	3
FI	Fatalities	3	0	24	25	1	0	3	56
	Light injuries	0	0	0	2	0	0	0	2
	Property	1	0	1	1	0	0	0	3
FR	Fatalities	0	0	0	0	0	0	134	134
	Injuries	2	2	0	0	0	0	143	147
	Property	2	7	0	1	1	0	286	297
IT	Fatalities	0	0	0	5	0	0	3	8
	Serious injuries	0	0	0	1	0	0	1	2
	Light injuries	0	0	0	1	0	0	0	1
	Unknown	0	0	0	1	0	0	0	1
NO	Fatalities	0	0	0	0	0	0	9	9
	Serious injuries	0	0	0	0	0	0	4	4
	Light injuries	0	0	0	0	0	0	6	6
	Property	0	0	0	0	0	0	20	20
	Unknown	0	0	0	0	0	0	1	1
ES	Fatalities	0	0	0	0	0	0	26	26
	Serious injuries	0	0	0	0	0	0	12	12
	Light injuries	0	0	0	0	0	0	25	25
	Property	0	0	0	0	0	0	40	40
TR	Fatalities	0	0	0	7	0	0	8	15
	Serious injuries	0	0	1	0	0	0	7	8
	Light injuries	0	0	0	1	0	0	4	5
	Property	0	3	0	1	0	0	0	4

Table 11. Distribution of lighting conditions in accident location by country and severity of injury.

Country		LIGHTING CONDITIONS					Total
		Dawn	Light	Dusk	Dark	Unknown	
EL	Fatalities	0	1	0	0	15	16
	Serious injuries	0	0	0	0	6	6
	Light injuries	0	0	0	0	11	11
	Property	0	4	0	0	51	55
	Unknown	0	0	0	0	3	3
FI	Fatalities	1	46	2	5	2	56
	Light injuries	0	1	0	1	0	2
	Property	0	3	0	0	0	3
FR	Fatalities	0	0	0	0	134	134
	Injuries	0	0	0	0	147	147
	Property	0	0	0	0	297	297
IT	Fatalities	0	5	0	3	0	8
	Serious injuries	1	1	0	0	0	2
	Light injuries	0	1	0	0	0	1
	Unknown	0	1	0	0	0	1
NO	Fatalities	0	0	0	0	9	9
	Serious injuries	0	0	0	0	4	4
	Light injuries	0	0	0	0	6	6
	Property	0	0	0	0	20	20
	Unknown	0	0	0	0	1	1
ES	Fatalities	0	0	0	0	26	26
	Serious injuries	0	0	0	0	12	12
	Light injuries	0	0	0	0	25	25
	Property	0	0	0	0	40	40
TR	Fatalities	0	11	0	3	1	15
	Serious injuries	0	3	0	2	3	8
	Light injuries	0	1	0	3	1	5
	Property	0	3	0	1	0	4