Safety Overview 2023

Main figures based on CSI data (up to 2021)

March 2023

EUROPEAN
UNION
AGENCY
FOR RAILWAYS

Foreword

This overview is one of the visible results of the Agency's activities in monitoring the progress of safety and interoperability. It is also part of the Agency's effort to provide to its stakeholders a regular overview of the development of railway interoperability and safety in the Single European Railway Area (SERA). This overview focuses on the progress in safety, while a second overview for covering the progress in interoperability will be published at the latest by the end of September 2023.

The basis for this overview is information provided by the National Safety Authorities. They have a legal obligation to report to the Agency a set of defined data that can be used to assess the development of railway safety in the SERA. Notably, the National Safety Authorities gather Common Safety Indicators (CSIs), defined in the Railway Safety Directive (EU) 2016/798, from the railway undertakings and infrastructure managers which provide a footprint for safety performance. This report is based on these data as submitted to the Agency by the National Safety Authorities. The EU-27 countries, Norway and Switzerland are considered as members of the SERA for the purpose of this report. The data extraction date for this report was 30 November 2022 and the latest figures refer to 2021 (2022 only for the figures on major accidents). In particular, they do not include the tragic train collision occurred in Tempi, central Greece, on the 28th of February 2023.

The interpretation of the figures is the sole responsibility of the reader, who may wish to refer to the Report on Railway Safety and Interoperability in the EU 2022 for guidance.

Annual overviews on Safety and Interoperability in SERA (2023): Safety

In 2021 an increase in significant accidents and serious injuries have been recorded compared to 2020 (which was impacted by the COVID pandemic, in terms of rail traffic/volumes), after the overall positive progress of the last decade.

With 1,389 significant accidents, 683 fatalities (suicides excluded) and 513 serious injuries, the overall toll of railway accidents remains high: the economic cost of significant accidents alone is estimated in around 3.2 billion EUR per annum.

The decrease in significant accidents over the last decade has been driven by "external" accidents (in which third party, i.e. trespassers and level crossing users, are involved) while the "internal" accidents (collisions, derailments and fires in rolling stock) appear stagnating; the progress has also been very uneven across the EU Member States, with the variance in safety levels remaining high (although the variance for safety accidents and related casualties has declined in the last decade).

A fast implementation of the common safety methods for assessing safety level and safety performance (CSM ASLP), with the associated systematic and comprehensive EU-wide safety incidents reporting scheme, would be beneficial to provide an additional angle to assess and improve how safety is managed across Europe.

- *The overall cost of railway accidents remains high (around 3.2 billion EUR per annum only for significant accidents)*
- *Significant accidents and serious injuries increased in 2021 compared to 2020 (which was highly impacted by the COVID pandemic)*
- *Although major accidents (i.e. with 5 or more fatalities) have become rare in the last years (e.g. none occurred in 2018, 2020 and 2021), in 2022 three of such accidents were registered.*
- *Large differences in casualty rates still exists between Member States, with at least a ten-fold difference in fatality rates for countries with the lowest and highest values.*
- *The overall decrease in significant accidents since 2010 has been mainly driven by "external" accidents, while 'internal' accidents (collisions, derailments, fires in rolling stock and other accidents) show a more stable trend in the last years.*
- *Although safety at level crossings has been improving over the period 2010-2016, a more stable/flat trend was observed in the last years (over the period 2017-2021).*
- *No clear progress can be deducted from the figures on precursors to accidents, also due to differences in data collection and reporting for some of them in several Member States. Signal passed at Danger (SPAD) incidents have not decreased in the last years, showing instead an increase trend for the incidents in which a danger point was passed (even if they represent less than one fourth of total SPADs in 2021).*

Accidents and their outcomes

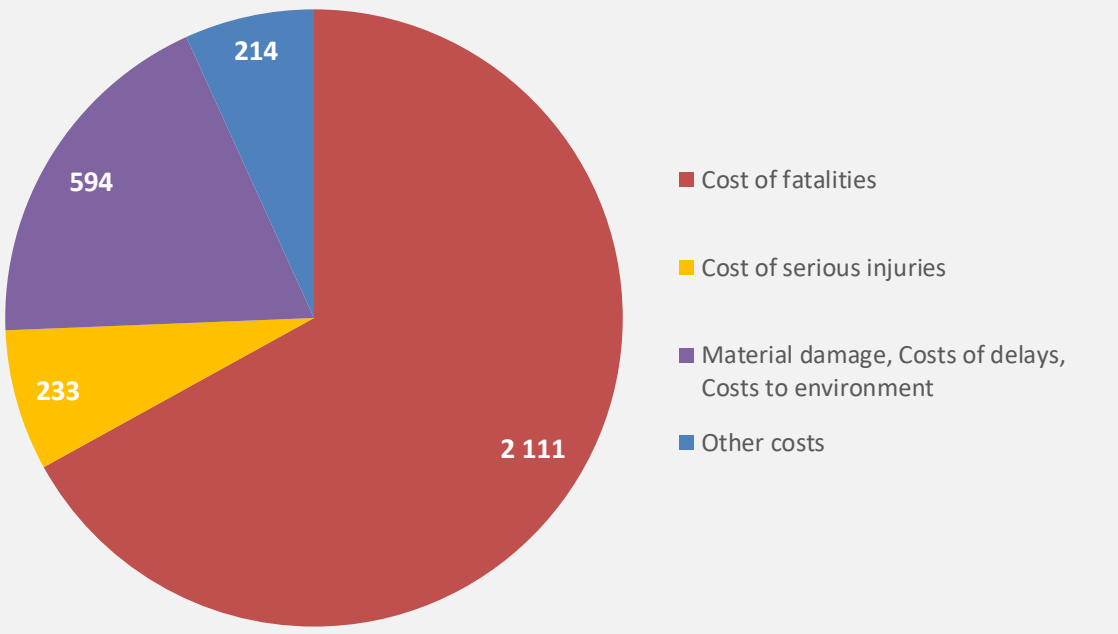
With 1389 significant accidents in 2021 resulting in 683 fatalities and 513 serious injuries (see Fig. 2), the total cost of railway accidents is estimated at around 3.2 billion EUR (see Fig. 1).

Despite the decrease in significant accidents and resulting casualties recorded in the last decade, for which harmonised data are available across the Union, in 2021 a rise in significant accidents and serious injuries and a constant/flat trend in fatalities have been recorded compared to 2020 (which was highly impacted by the COVID Pandemic).

Despite the overall downward trend observed since 1988 and despite no single major accident occurred in 2018, 2020 and 2021, three accidents with five or more fatalities were recorded in 2022[1] (two level crossing accidents and one derailment), resulting in a total of 17 fatalities (see Fig. 3).

Figure 1 - Costs of railway accidents (EU-27, 2021)

Estimated costs in million EUR



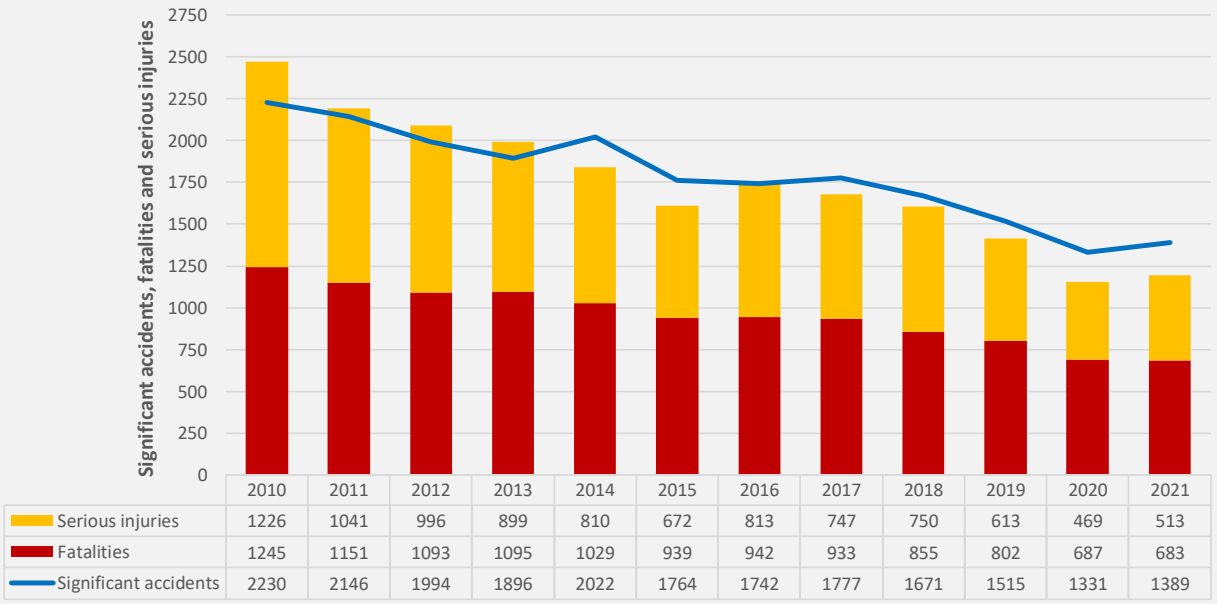
Notes: Other costs: Modal shift, Air polution, Administrative, Rerouting, Reputational damage, Productivity losses, estimated from unit costs developed by consultant for ERA

Source: Common Safety Indicators (CSIs) as reported by National Safety Authorities (NSAs) to the Agency

[1] Data consulted in February 2022 based on the submissions from National Investigating Bodies (NIBs)

Figure 2 - Main safety outcomes (EU-27, 2010-2021)

Significant accidents, fatalities and serious injuries

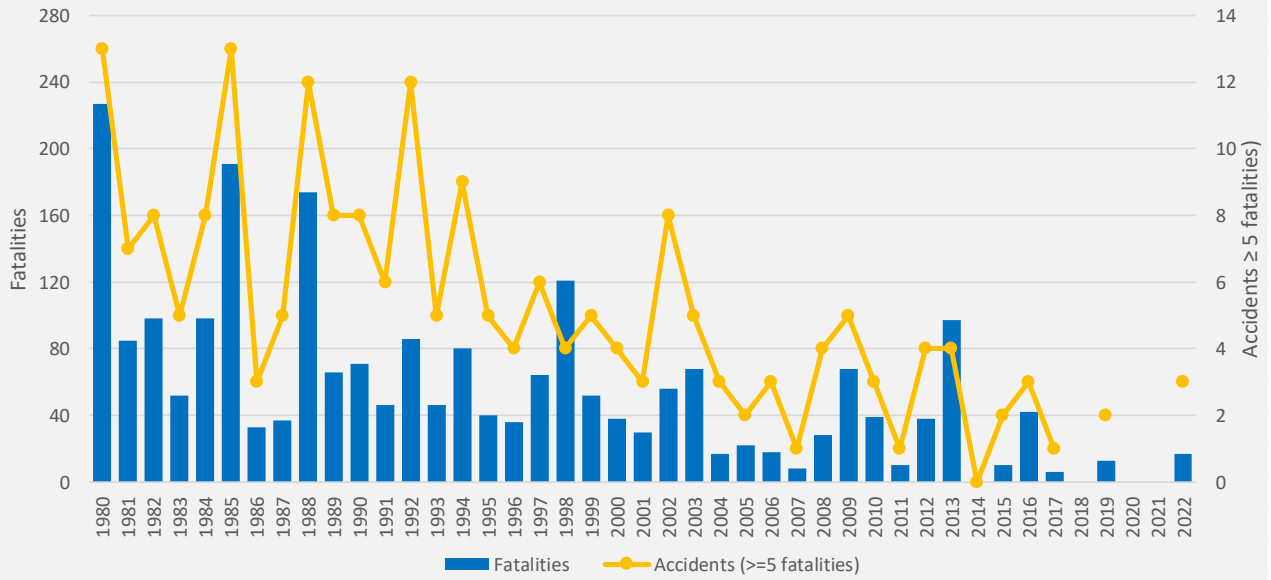


	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Serious injuries	1226	1041	996	899	810	672	813	747	750	613	469	513
Fatalities	1245	1151	1093	1095	1029	939	942	933	855	802	687	683
Significant accidents	2230	2146	1994	1896	2022	1764	1742	1777	1671	1515	1331	1389

Source: Common Safety Indicators (CSIs) as reported by National Safety Authorities (NSAs) to the Agency

Figure 3 - Major accidents in Europe (EU-27+CH+NO+UK*, 1980-2022)

Railway accidents resulting in five or more fatalities



Notes: *Data for UK available until end 2020

Source: ERAIL and Database of historical accidents - courtesy of prof. Andrew Evans, Imperial College London

Trends in accident, fatality rates and their variations

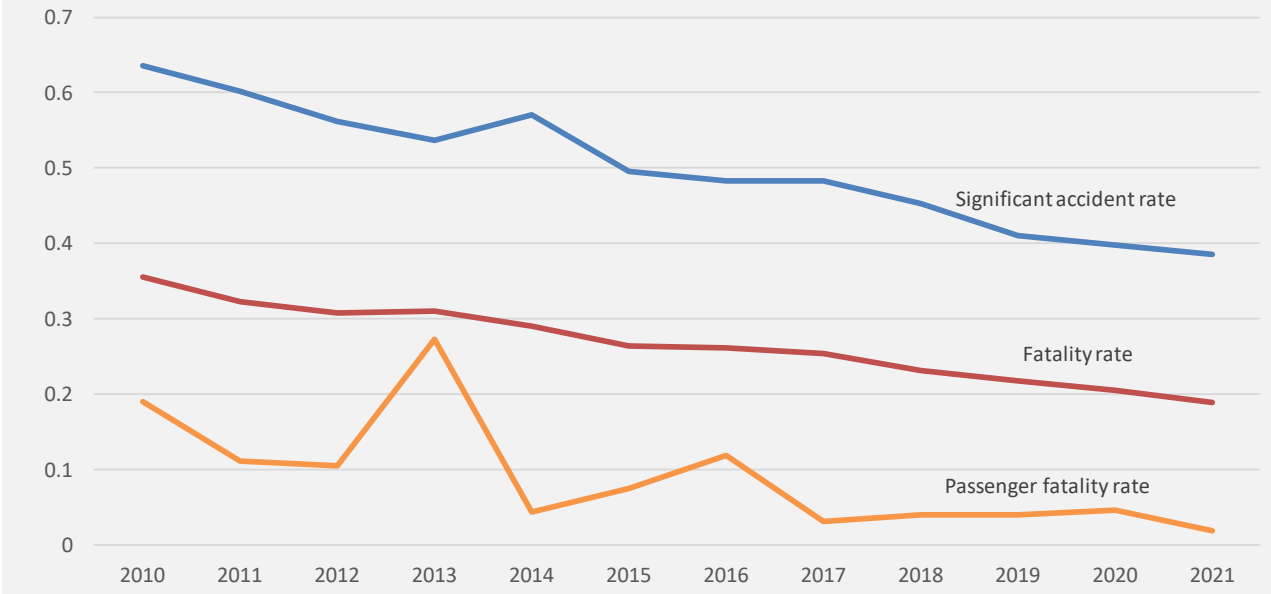
Three main indicators are reported for the monitoring of trends in accident and casualty rates: significant accidents and railway fatalities normalized by train kilometres, capturing the manifested overall risk in railway operation, as well as passenger fatality rate (passenger fatalities per passenger kilometres) capturing the personal manifested risk for people using trains.

All three rates have decreased substantially since 2010 (see Fig. 4). The railway fatality rate is currently below 0.2 fatalities per million train kilometres (one fatality each 5 million train kilometre on average), whereas the passenger fatality rate is around 0.019 passenger fatalities per billion passenger kilometre (one fatality each 50 billion passenger kilometres) (see Fig. 4).

Large differences in casualty rates exists between Member States, highlighting the extent of existing disparities in safety levels (although the variance of the number of safety accidents and related casualties has declined in the last decade). The figures of fatality rates and passenger fatality rates for individual Member States still show at least a ten-fold difference for countries with the lowest and highest values (see Fig. 5 and 6). Both the graphs indicate a big cluster (of 11 or 13 countries) with higher values compared to the remaining EU Member States (i.e. above the EU average).

Figure 4 - Trends in accident and fatality rates (EU-27, 2010-2021)

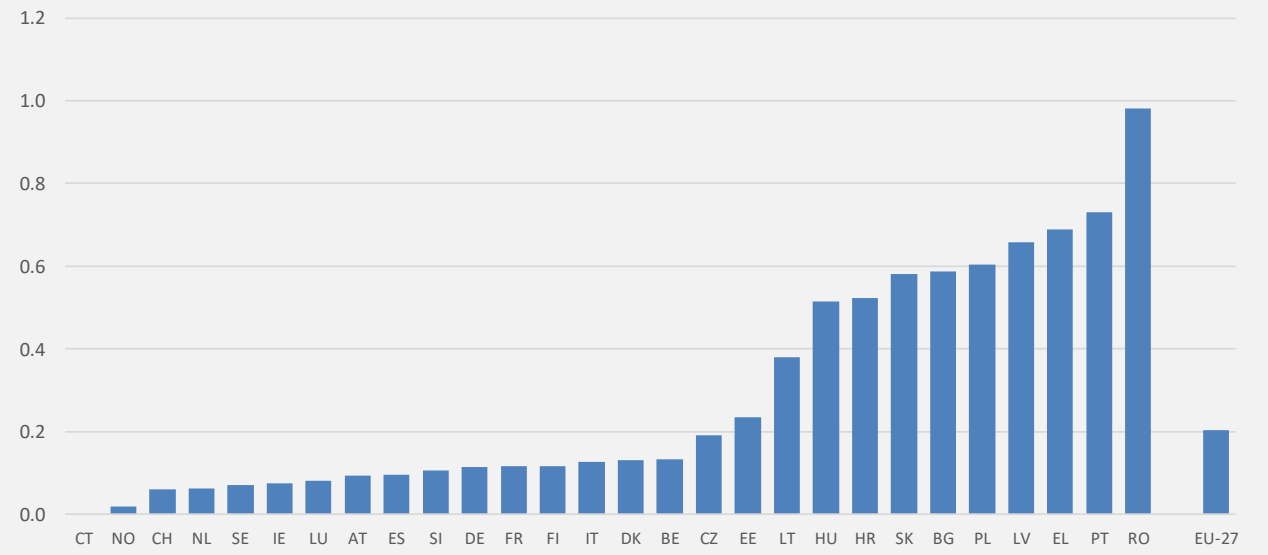
Significant accidents and fatalities per million train-km. Passenger fatalities per billion passenger kilometers



Source: Common Safety Indicators (CSIs) as reported by National Safety Authorities (NSAs) to the Agency.

Figure 5 - Railway fatality rates

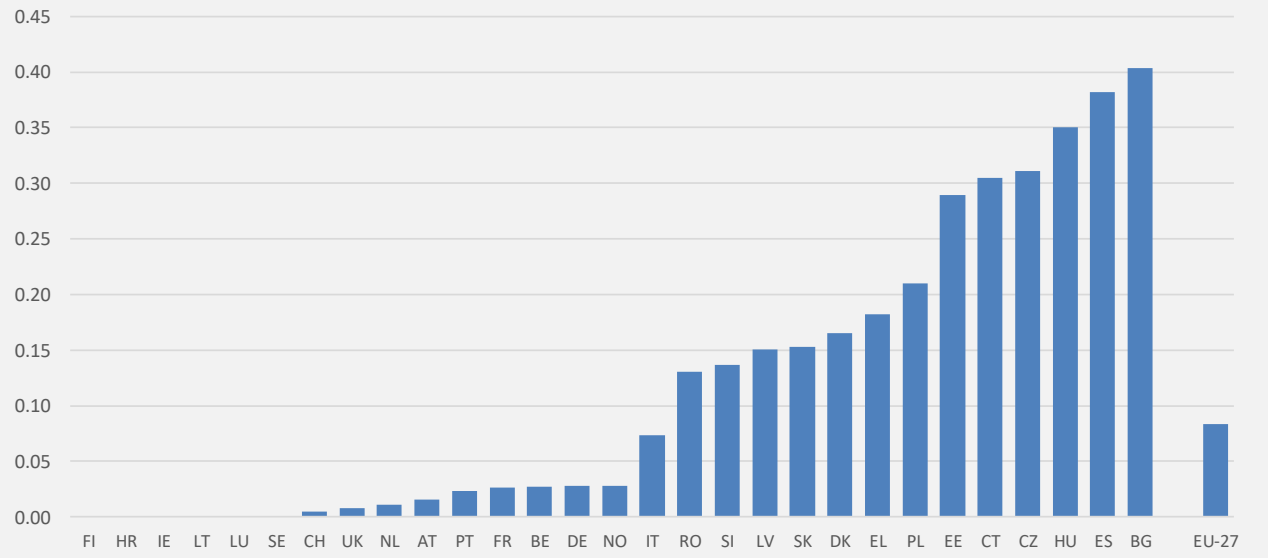
All fatalities per million train kilometers (average over 2019-2021)



Source: Common Safety Indicators (CSIs) as reported by National Safety Authorities (NSAs) to the Agency

Figure 6 - Railway passenger fatality rates

Passenger fatalities per billion passenger kilometers (average over 2011-2021)



Source: Common Safety Indicators (CSIs) as reported by National Safety Authorities (NSAs) to the Agency

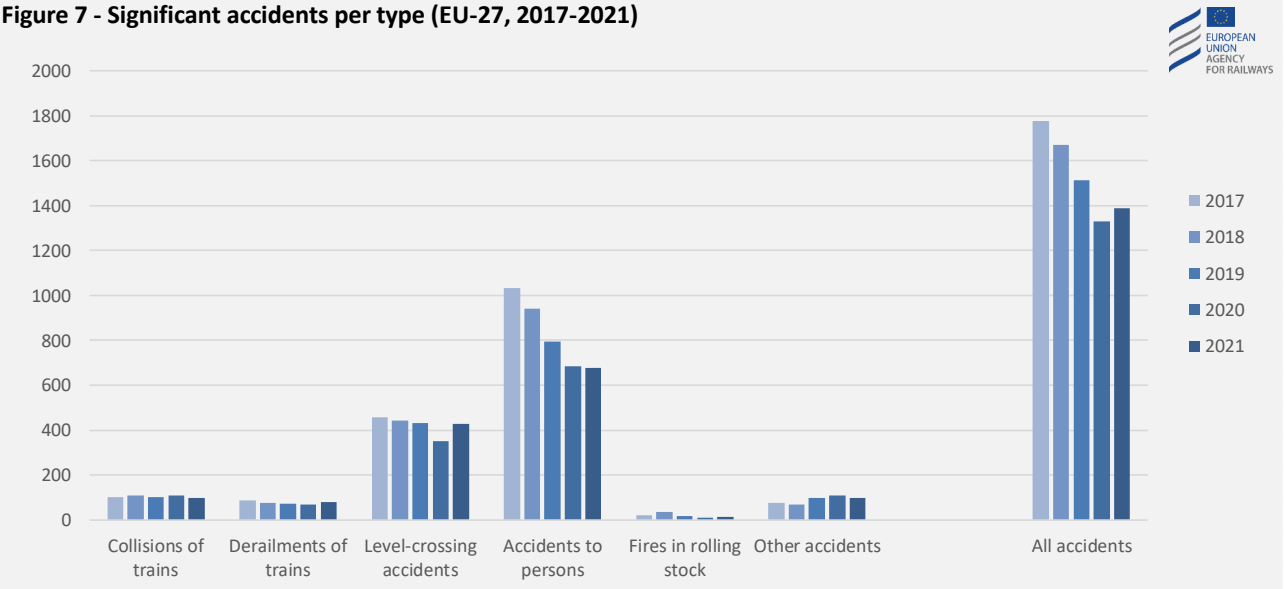
Internal and external accidents

Member States reported in total 1389 significant accidents for 2021, with an increase compared to 2020 (see Fig. 7), after the positive evolution over the last decade which has been mainly driven by "external" accidents (in which third parties, i.e. trespassers and level crossing users, are involved); the trend for "internal" accidents, instead, has been quite flat in recent years (see Fig. 8).

The increase in "external" accidents in 2021 was mainly due to the rise in level crossing accidents, while accident to persons stayed almost at the same level of 2020. Regarding "internal" accidents, derailments and accidents included in the category 'fire in rolling stock' registered an increase in 2021 compared to 2020, while the number of collisions and other accidents went down (see Fig. 7).

The category "other accidents" include a wide range of accidents not included within the specific types, such as persons hit on platforms, collisions and derailments of shunting rolling stock/maintenance machines, dangerous goods released during transport, objects projected by the running train and electrocution in connection with rolling stock in motion[2].

Figure 7 - Significant accidents per type (EU-27, 2017-2021)

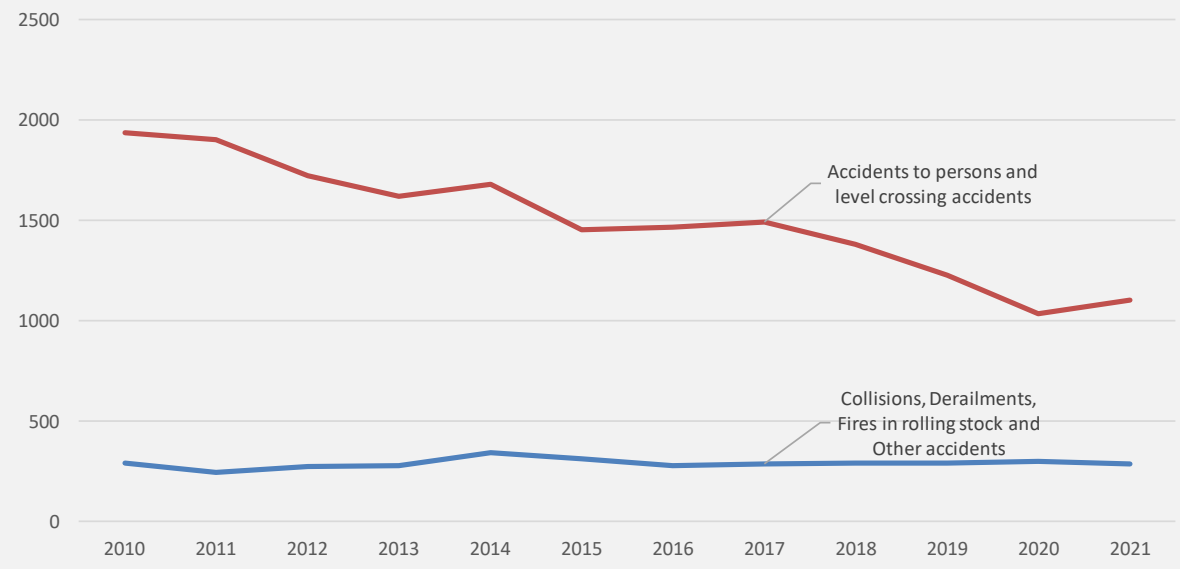


Source: Common Safety Indicators (CSIs) as reported by National Safety Authorities (NSAs) to the Agency.

[2] For more details on CSIs definitions, see the Implementation guidance on CSIs (available on the ERA website from this page)

Figure 8 - Railway "internal" and "external" significant accidents (EU-27, 2010-2021)

Collisions, derailments, fires in rolling stock and other accidents against accidents to persons and level-crossing accidents



Source: Common Safety Indicators (CSIs) as reported by National Safety Authorities (NSAs) to the Agency.

Railway fatalities and suicides

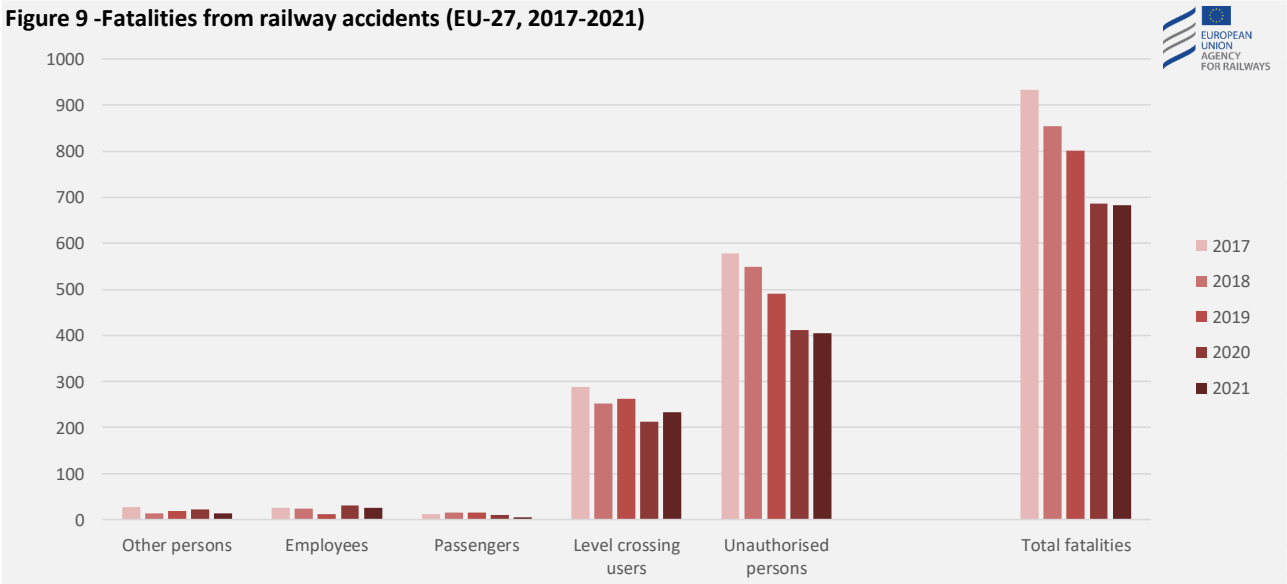
The total number of fatalities, excluding suicides, has fallen steadily in recent years (see Fig. 9), even if in 2021, with 683 fatalities, it remained almost at the same level of 2020 (i.e. 687); this was mainly due to the rise in level crossing users' fatalities, while fatalities of employees, passengers, unauthorised persons and other persons decreased.

If suicides are excluded, the majority of fatalities on railway premises in the last five years were from accidents to persons (66%). Fatalities from level-crossing accidents accounted for 32% of the total, while fatalities from collisions and derailments represented 1.6 % of all railway fatalities (see Fig. 10).

Suicides are reported separately from accident fatalities. In 2021, 2234 suicides (six each day on average) were recorded on the EU railways, with an increase compared to the previous year despite the clear downward trend since 2016. They represented 77% of all fatalities on railways and, together with the unauthorised person fatalities, constituted 90% of all fatalities occurring within the railway system (see Fig. 9 and 11); trespass fatalities, instead, have seen a steady decrease since 2006, although much more attenuated in 2021 (see Fig. 11).

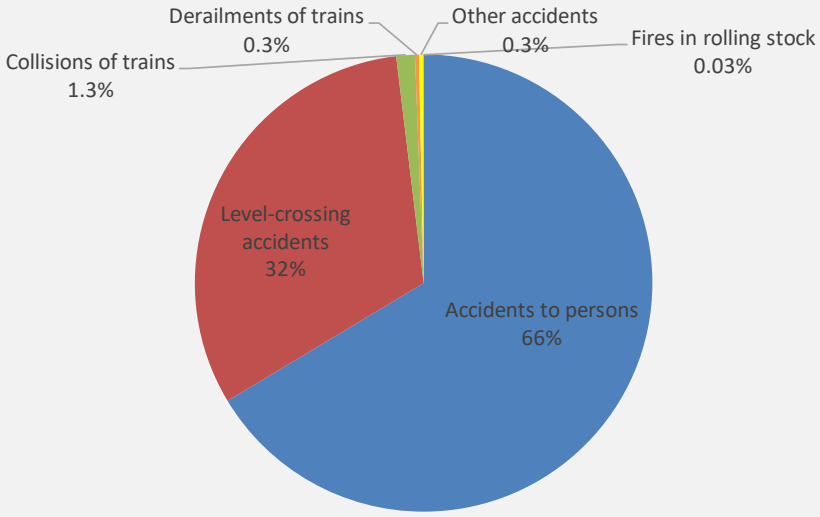
Since 2017, despite a drop in 2019, no clear progress is observed in reducing railway workers fatalities (with 25 fatalities in 2021 compared to the 26 in 2017, see Fig. 12). A decreasing evolution is, instead, more evident for employees' serious injuries, with the lowest value since 2010 registered in 2021 (i.e. 33 casualties).

Figure 9 -Fatalities from railway accidents (EU-27, 2017-2021)



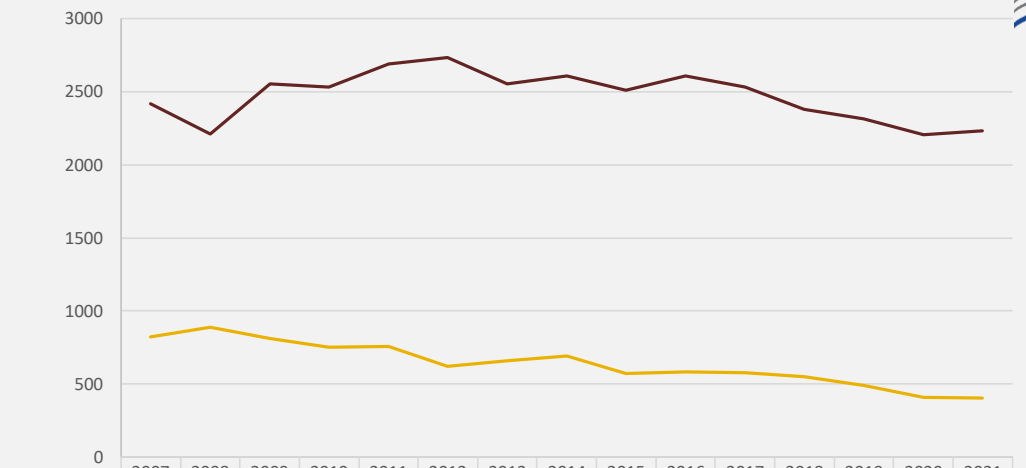
Source: Common Safety Indicators (CSIs) as reported by National Safety Authorities (NSAs) to the Agency.

Figure 10 - Fatalities per type of accident (EU-27, 2017-2021)



Source: Common Safety Indicators (CSIs) as reported by National Safety Authorities (NSAs) to the Agency.

Figure 11 - Railway suicides and trespasser fatalities (EU-27, 2007-2021)

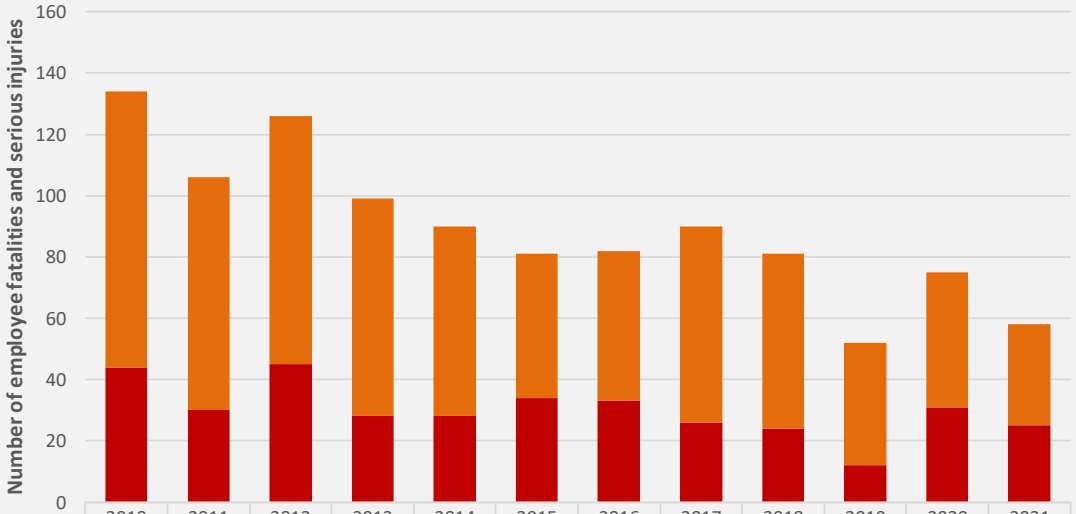


	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Suicides	2417	2211	2552	2532	2687	2734	2552	2608	2511	2608	2532	2379	2313	2204	2234
Trespasser fatalities	822	887	813	750	759	622	659	692	572	585	579	549	491	411	405

Source: Common Safety Indicators (CSIs) as reported by National Safety Authorities (NSAs) to the Agency

Figure 12 - Railway employee casualties (EU-27, 2010-2021)

Fatalities, serious injuries



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Seriously injured	90	76	81	71	62	47	49	64	57	40	44	33
Killed	44	30	45	28	28	34	33	26	24	12	31	25

Source: Common Safety Indicators (CSIs) as reported by National Safety Authorities (NSAs) to the Agency

Level crossing safety

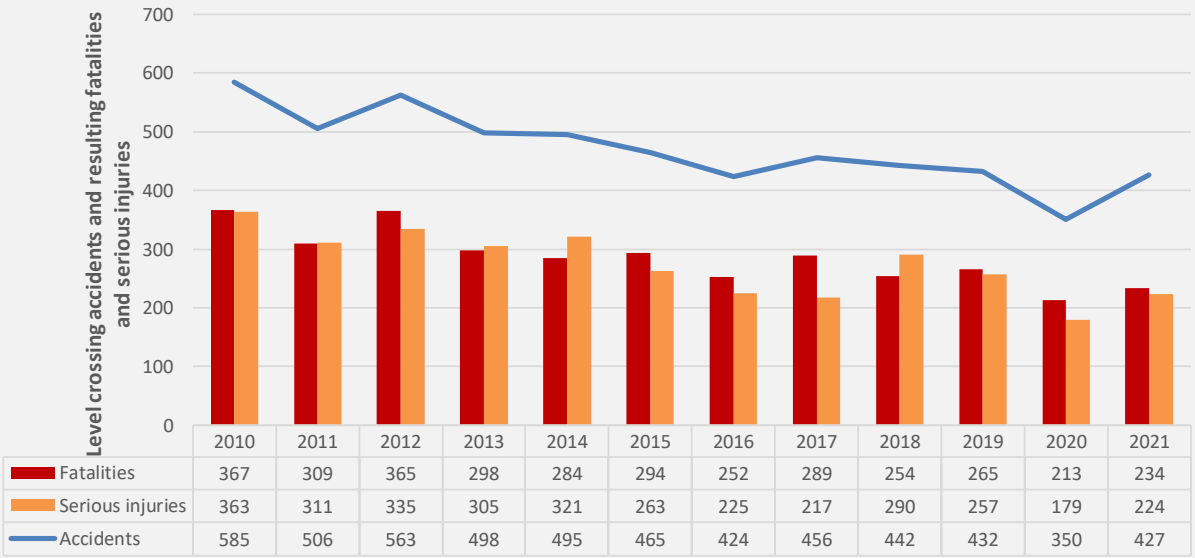
After an improvement in level crossing safety over the period 2010-2016, in the following five years a more stable trend was observed. Besides a drop in 2020 (partially linked to the lockdown measures and the subsequent travel restrictions imposed during the COVID-19 pandemic), the number of accidents (and related serious injuries) occurring at level-crossing in 2021 went back to the values of 2016 (see Fig. 13).

The numbers of level crossing and level crossing accidents vary considerably among ERA countries (see Fig. 14). In 2021 around 96 000 level crossings were reported in the EU-27 Member States, with passive level crossings accounting for around 42% of the total; these level crossings are usually equipped with a St Andrew's cross traffic sign, but do not provide any active warning to road users.

Passive level crossings and level crossings in general are being eliminated at a quite slow rate. There is a possible relationship between the average number of total and passive level crossings in each Member State and the average number of level crossing accidents. In all but a few countries (e.g. Finland, Norway and Sweden), where further analysis is merited, a higher number of passive level crossings is associated with a higher number of level crossing accidents (see Fig. 14 and 15). The possible correlation patterns between the number of (passive, active and total) level crossings and the average number of level crossing accidents could be further explored/analysed. The higher level of granularity of the information in the CSM ASLP could help in further/better analysing possible patterns.

Figure 13 - Level crossing accidents and resulting casualties (EU-27, 2010-2021)

Significant accidents, fatalities and serious injuries

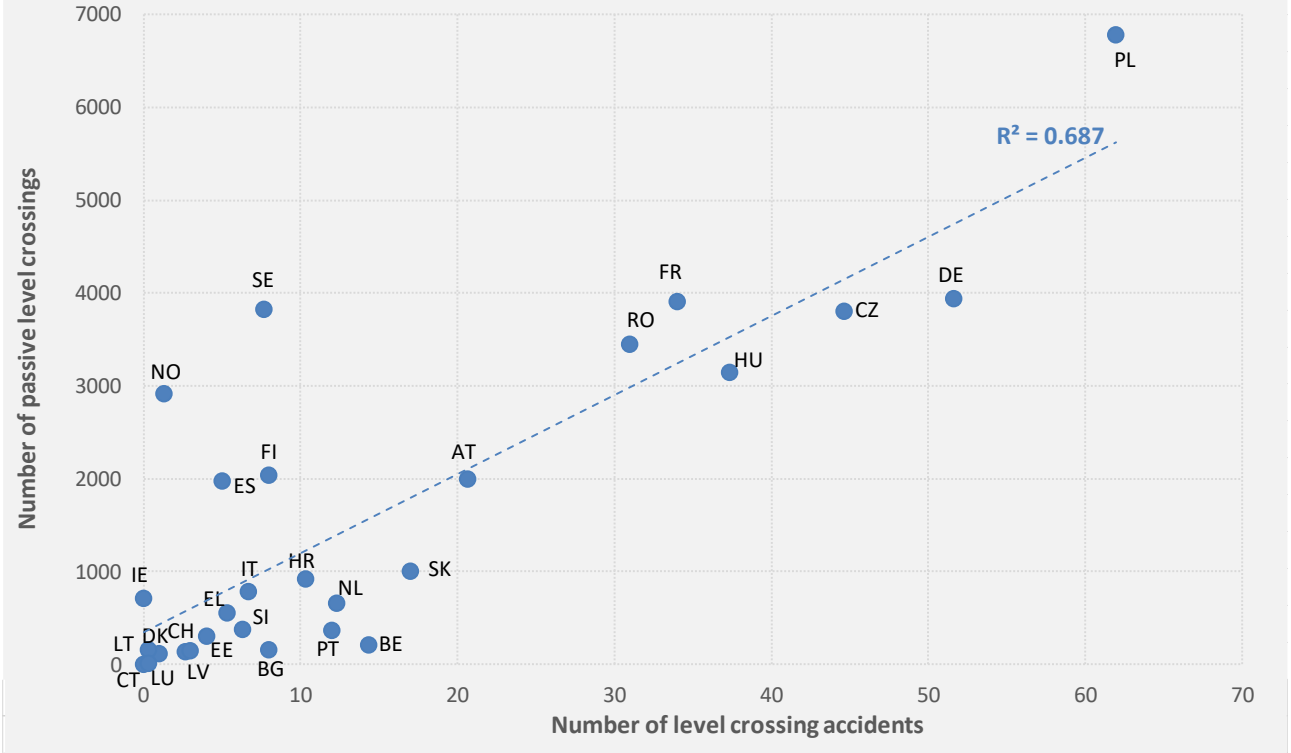


	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Fatalities	367	309	365	298	284	294	252	289	254	265	213	234
Serious injuries	363	311	335	305	321	263	225	217	290	257	179	224
Accidents	585	506	563	498	495	465	424	456	442	432	350	427

Source: Common Safety Indicators (CSIs) as reported by National Safety Authorities (NSAs) to the Agency

Figure 14 - Number of level crossing accidents and number of passive level crossings per country

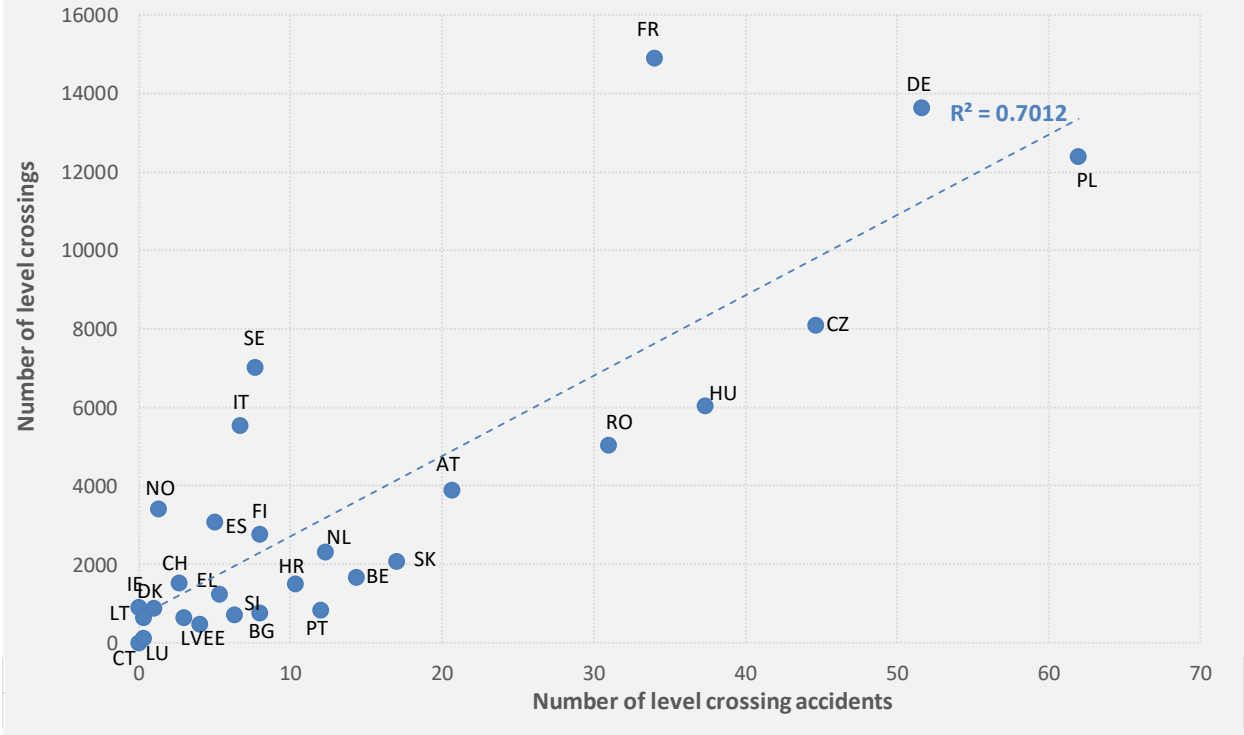
EU-27+CH+NO (average 2019-2021)



Source: Common Safety Indicators (CSIs) as reported by National Safety Authorities (NSAs) to the Agency

Figure 15 - Number of level crossing accidents and number of level crossings per country

EU-27+CH+NO (average 2019-2021)



Source: Common Safety Indicators (CSIs) as reported by National Safety Authorities (NSAs) to the Agency

Precursors

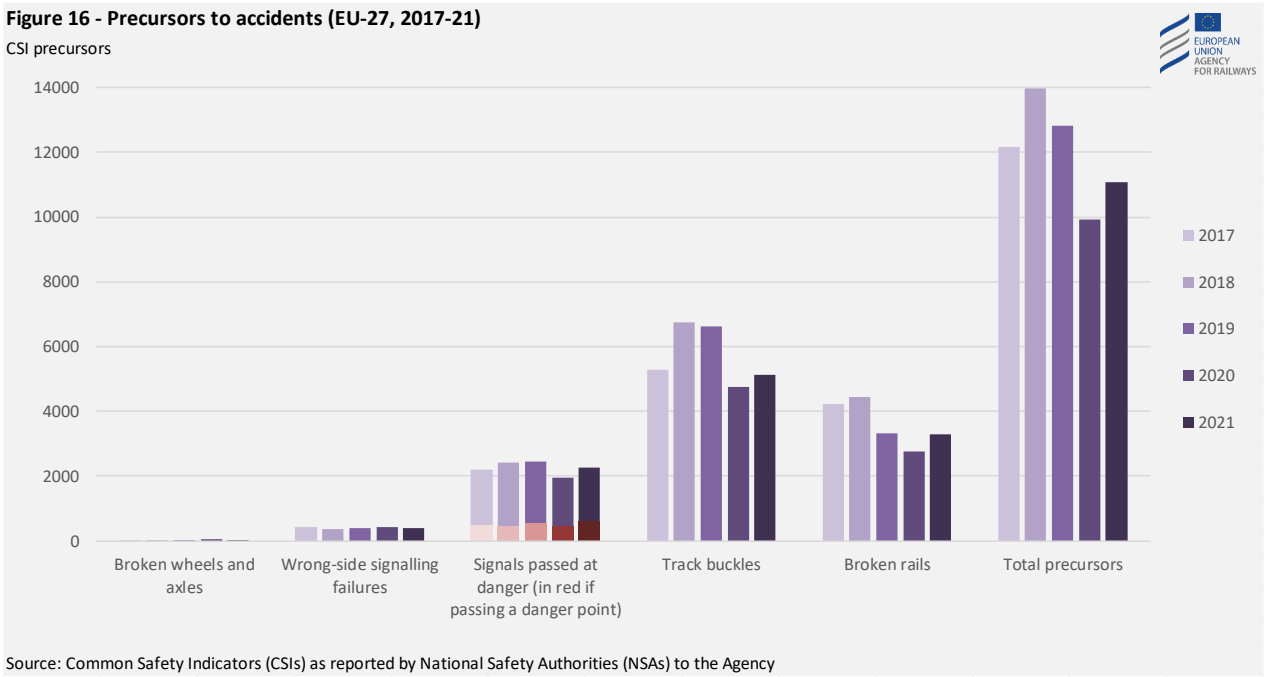
Precursors to accidents are incidents that, under other circumstances, could have led to an accident. Monitoring events with no harmful consequences that occur on railways is an essential tool of a proactive safety management system (SMS) for RUs and IMs.

Over the period 2017-2021, EU Member States reported on average around 12000 precursors to accidents as defined under the CSIs each year (see Fig. 16). This number implies that there is a ratio of about eight precursors to one significant accident. However, if we discard accidents to persons caused by rolling stock in motion, the ratio between the precursors and accidents rises to 17:1. This highlights the learning potential of precursors to accidents.

After a drop in 2020, the number of reported SPADs, track buckles and broken rails increased in 2021. Of the 2200 SPAD incidents recorded on EU railways each year during the period 2017–2021 (see Fig. 16), less than one quarter are incidents in which a danger point was passed (representing a particularly high risk of collision). However, there has been an increasing trend in the last five years for this type of SPADs.

The variation in yearly occurrence of track buckles and broken rails does not provide a genuine picture of the situation being influenced by differences in data collection practice and reporting of these occurrences in several Member States. This is further illustrated by plotting the ratio of accident precursors to accidents (see Fig. 17). Since the availability of consistent and good quality data is of high importance, further analysis and discussions are foreseen in order to identify possible differences and ways forward to harmonise the data collection and reporting among the different countries.

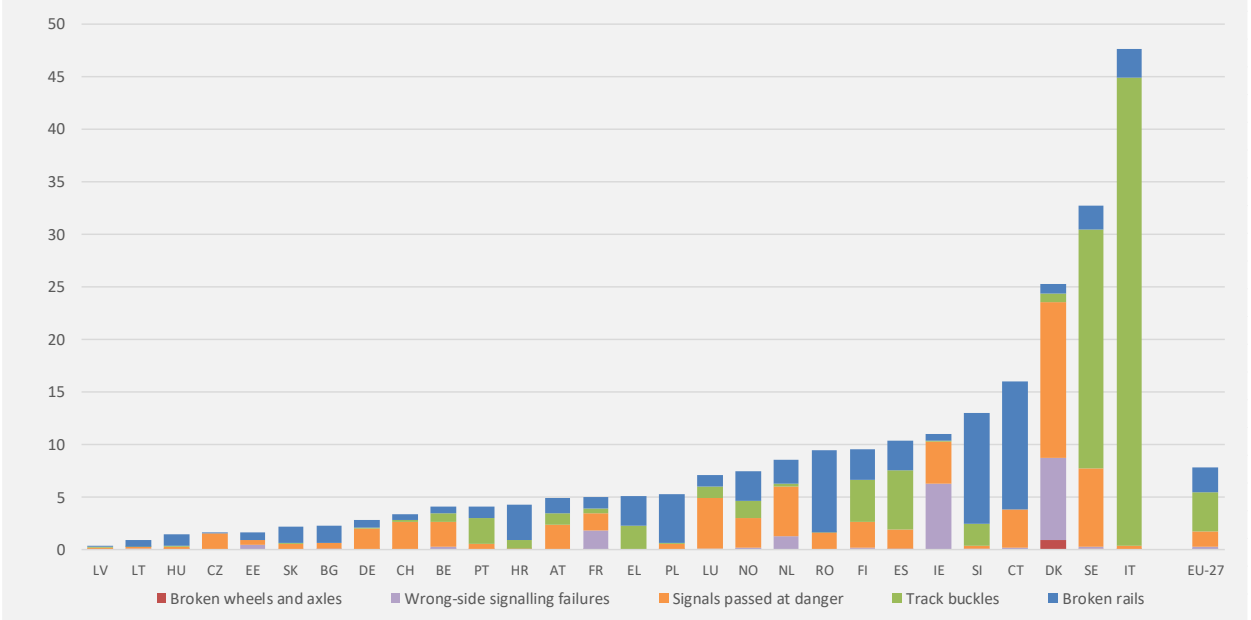
Figure 16 - Precursors to accidents (EU-27, 2017-21)



Source: Common Safety Indicators (CSIs) as reported by National Safety Authorities (NSAs) to the Agency

Figure 17 - Accident precursors to accidents ratios per country (EU-27+CH+NO, 2017-21)

Ratios of CSI precursors to total number of CSI significant accidents



Source: Common Safety Indicators (CSIs) as reported by National Safety Authorities (NSAs) to the Agency

Concluding remarks

The data collected for 2021 and reported in the figures above indicate that an increase in significant accidents and serious injuries have been recorded in 2021 compared to 2020 (which was highly impacted by the COVID pandemic, in terms of rail traffic/volumes), after the overall positive progress of the last decade.

The figures confirm that caution is still needed. The overall cost of railway accidents remains high (almost 3.3 billion EUR per annum only for significant accidents), three major accidents were registered in 2022, and the decrease in significant accidents (until 2020) has been mainly driven by “external” accidents, while ‘internal’ accidents (collisions, derailments and fire in rolling stock) show a more stable trend in the last years.

Moreover, large disparities in safety levels still exists between Member States. The latest figures still show, for example, at least a ten-fold difference in fatalities rates for countries with the lowest and highest values. A fast implementation of the common safety methods for assessing safety level and safety performance (CSM ASLP), with the associated systematic and comprehensive EU-wide safety incidents reporting scheme, would be beneficial to provide an additional angle to assess and improve how safety is managed across Europe.

These facts urge us all to continue to work relentlessly and tirelessly to improve railway safety.