Report on **Railway Safety and Interoperability in the EU**

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© APchanel (p. 13) / stock.adobe.com, Engineer under inspection and checking construction process railway switch and checking work on railroad station. Engineer wearing safety uniform and safety helmet in work

© Markus Mainka (p. 63) / stockadobe.com, French TGV and German ICE high-speed train Paris Est railway station in France

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Abbreviations

CCS	Control command and signalling
CEF	Connecting Europe Facility
CINEA	European Climate, Infrastructure and Environment Executive Agency
CNC	Core network corridor
CSI	Common safety indicator
CSM ASLP	Common safety methods on assessment of safety level and safety performance
ECM	Entity in charge of maintenance
ERA	European Union Agency for Railways
ERADIS	European Railway Agency Database of Interoperability and Safety
ERAIL	European Railway Accident Information Links
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
EU	European Union
FWSI	Fatality and weighted serious injury
IM	Infrastructure manager
NIB	National investigation body
NoBo	Notified body
NSA	National safety authority
OBU	On-board unit
OP	Operational point
OSS	One-Stop Shop
PRM	Persons with reduced mobility
RID	Regulation concerning the international carriage of dangerous goods by rail
RINF	Register of Infrastructure
RNE	RailNetEurope
RSD	Railway Safety Directive
RU	Railway undertaking
SERA	Single European Railway Area
SoL	Section of lines
SPAD	Signal passed at danger
SSC	Single safety certificate
TAF	Telematics applications for freight services
TAP	Telematics applications for passenger services
TDD	Train Drivers Directive
TDG	Transport of dangerous goods
TEN-T	Trans-European transport network
TIS	Train Information System
TPS	Train protection system
TSI	Technical specification for interoperability
UNIFE	European Rail Supply Industry Association
TIS	Train Information System
TPS	Train Protection System
TSI	Technical Specification for Interoperability
UNECE	The United Nations Economic Commission for Europe

Country codes

AT	Austria
BE	Belgium
BG	Bulgaria
CH	Switzerland
CY	Cyprus
CT	Channel Tunnel
CZ	Czechia
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
MT	Malta
NL	Netherlands
NO	Norway
PL	Poland
PT	Portugal
RO	Romania
SE	Sweden
SI	Slovenia
SK	Slovakia
UK	United Kingdom

Foreword by the Executive Director

Josef Doppelbauer

Dear reader

I am very pleased to introduce the 2024 edition of the European Union Agency for Railways (ERA) report on monitoring progress on the safety and interoperability of the European Union (EU) railway system. This report is a key element of our continuous effort to better understand the safety and interoperability of European railways and its development over time. The data contained in this report can be used to identify areas for improvement to achieve a more efficient and effective railway system for all citizens of Europe: the Single European Railway Area. The report is also an important source of information for decision-making at the EU and Member State levels.

The EU is facing an unprecedented period characterised by pandemic threats and an ongoing military conflict with consequences for energy supply, overlapping with trends such as climate change and sociopolitical instability. The scenario is even more complex considering the expected increase in transport demand, the shortage of rail network capacity, and rail modal shift policies that have not yet reached their goals. At the same time, the current situation has created an opportunity to thoroughly reflect on how to move Europe towards a sustainable and safe railway system without barriers. Let us all make the best of this period by carefully analysing the data in this report to align and improve our future actions.

The methodology used for this report, as explained in detail in Annex I, proposes indicators for outcomes, as well as outputs and underlying processes and conditions. Those indicators are primarily drawn from the data reported to ERA under the EU legal framework. However, several indicators rely on non-statutory data provided voluntarily by national bodies and other stakeholders. We warmly thank the national safety authorities, RailNetEurope, the European Climate, Infrastructure and Environment Executive Agency and other data providers for their active contribution to this report.

Progress with railway safety

European railways remain among the safest in the world, with major accidents (those with five or more fatalities) becoming rare and significant accidents decreasing in the last two decades. However, in 2021 and 2022, an increase in the number of accidents (and related casualties) was recorded, going back to pre-COVID-19 levels; in addition, the overall cost of railway accidents remains high, and progress has also been very uneven across the EU Member States, with significant variation in safety levels. The railway community cannot overlook these warnings and must continue to work relentlessly and tirelessly to improve railway safety. We can never afford to be complacent.

Unlike the European aviation and maritime industries, railways have not yet implemented a systematic and comprehensive EU-wide safety occurrence reporting scheme, which would enable us to learn more effectively not only from major accidents but also from incidents without victims. Several areas in which safety has been stagnating recently, such as level crossing and railway workers' safety, would particularly benefit from wider reporting and information sharing across countries. However, we should not only count accidents and incidents. ERA has received a mandate to draft common safety methods for assessing the safety levels and the safety performance of railway operators at national and EU levels. These common safety methods introduce two important new elements: (1) an obligation to report on the occurrence scenarios to better understand the underlying mechanisms that (could) lead to accidents; and (2) the concept of safety performance, that is the level of maturity of a railway operator to manage the risk control measures put in place to control the risks of its operations. When implemented, these elements should provide additional angles to assess how safety is managed. Similarly to aviation, a common IT reporting platform should be set up to support the collection and analysis of these new safety data.

I invite all railway parties to commit strongly to enhancing railway safety by rigorously applying a robust safety management system and by creating the conditions for the development of a positive railway safety culture. ERA is actively fostering a positive common European railway safety culture. Safety is not only about regulations, rules and procedures. Safety is about a continuous and collective commitment. By developing useful instruments to support the sector, ERA is demonstrating its engagement in developing a positive safety culture. However, we need the commitment of all players to achieve sustainable and safe performance across the Single European Railway Area. You can find more information about safety culture on our website ([1]).

Progress with railway interoperability

Our records confirm that we have already come far in terms of improving the interoperability of railways in Europe. However, we are still a long way from reaching our targets in many areas. Although good progress can be seen in aligning operational frameworks in terms of rules, only modest improvements in making railway assets interoperable are visible. As a consequence, railways have been unable to increase their modal share in the transport mix in the past decade, despite being the most sustainable mode of transport.

In this edition of the report, for the second time, thanks to our valuable collaboration with RailNetEurope, we present indicators for monitoring cross-border rail traffic volumes, transfer times and punctuality at border sections, which may provide an indication of the seamlessness of international rail connections. Assessing the evolution of these indicators over the coming years will allow further monitoring of the development of rail interoperability across Europe. The weaknesses in railway interoperability are most visible at border crossings; even the core corridors in Europe suffer from a lack of technical interoperability due to patchy European Rail Traffic Management System deployment, national rules and non-conformity with technical specifications for interoperability (TSIs). In many areas, delays in the implementation of legal requirements in a few Member States have delayed the interoperable deployment of railways in other countries, preventing the EU from fully benefiting from the harmonised system. For example, the delayed implementation of TSIs for telematics applications for passenger services, telematics applications for freight services and persons with reduced mobility, and the lack of cross-border agreements in some Member States, negatively affect railway customers' daily experiences and the reputation of European railways as a whole. In most cases, the implementation of TSIs does not entail large costs for the sector, and there are no excuses for further delays in the implementation of requirements for which the deadline has already passed. The recent TSI revision package proposes a fair migration and transition framework to allow the railway sector to adapt to new regulatory requirements.

Rail is a sector with a large number of physical assets – tracks, vehicles, terminals and more – and digitalisation is key to increasing the efficiency of using these assets. Historically, the rail sector in Europe has been characterised by barriers between different systems and countries – similar concerns apply to railway data. ERA has introduced a new approach to digitalisation, based on semantic technologies, allowing for scalability, adaptation and extension, and with a low impact on IT systems. This approach also allows for flexibility for companies behind the interface, and it facilitates alignment with the interoperable Europe initiative that covers all the sectors and transport modes.

We all need to enhance our efforts in the area of railway data interoperability. High-quality interoperable and open railway data are essential in connecting the rail business across

([1]) European Agency for Railways, 'Safety culture' (https://www.era.europa.eu/activities/safety-culture_en).

borders and with other modes of transport. After years of building single-purpose databases, our focus must now shift to the synergies enabled by connected data and underlying IT systems, which could improve the railway sector's competitiveness. To significantly improve the current incompleteness and inaccuracy of data in certain ERA registers, I invite all parties involved to boost their efforts towards achieving better data quality.

The ongoing digital revolution offers both inspiration and potential solutions. The European Commission's strategy on sustainable and smart mobility sets out the direction to be taken to make all modes of transport greener. Therefore, we would like to emphasise the importance of a modal shift towards green transport and logistic chains. Rail is the most sustainable, affordable and effective transport mode for achieving the goal of decarbonisation, and it could be the backbone of European transport. However, trains need to run alongside other modes of transport in order to carry goods and people in the most effective way. Such a multimodal approach requires the seamless integration of the transport modes, facilitated by digital technologies.

In addition, our new approach to the revision of TSIs should enable ERA and the railway sector to allocate expert resources more efficiently, to enhance international standardisation and to react rapidly to emerging technologies to considerably shorten their time to market.

Lastly, since 2019, as part of its mandate under the fourth railway package, ERA has been issuing vehicle authorisations, granting single safety certificates and deciding on European Rail Traffic Management System trackside approvals across the whole of the EU through entirely paperless procedures. Our experience with this new role is positive overall and promising for the future.

I hope that you will find this report interesting and a valuable point of reference.
Enjoy reading!

Josef Doppelbauer

Introduction

This report is one of the visible results of the activities of the European Union Agency for Railways (ERA) in monitoring safety levels and performance. It is also part of the Agency's effort to provide its stakeholders with a comprehensive overview of the development of railway safety and interoperability in the EU. In accordance with EU legislation ([2]), the report has been published by ERA biennially since 2006.

Specifically, this publication is the fourth edition of the report on progress on safety and interoperability in the Single European Railway Area (SERA), a joint statutory report mandated by the recast Agency regulation. It follows the two thematic reports that have been published by ERA since 2006.

Monitoring the safety and interoperability of the EU railway system is one of the key tasks of ERA. The Agency collects, processes and analyses different sets of data to support its recommendations and opinions. In this way, ERA facilitates evidence-based policymaking at the EU (and country) level. By continuously monitoring and analysing the safety and interoperability performance of the EU railway system, the Agency tracks the development of the SERA.

Report scope

This report is based on data up to the 2022 reporting period, and, where available, up to 2023. As Cyprus and Malta do not have railway systems that are covered by EU legislation, the EU railway system is composed of the railway systems of 25 Member States. Data are also provided for Norway and Switzerland, while data for the United Kingdom are included until 2020. The Channel Tunnel is a separate reporting entity, and the relevant data are provided separately. Therefore, there were in total 28 reporting entities in 2022.

Information sources

This report is based on data from various EU databases and registers, as provided by national authorities, such as national safety authorities (NSAs) and national investigation bodies (NIBs), operators and other stakeholders.

In the area of safety, the national bodies have a legal obligation to report to ERA a set of defined information that can be used to assess the development of railway safety in the EU. Notably, the NSAs gather common safety indicators (CSIs), defined in legislation, from the railway undertakings (RUs) and infrastructure managers (IMs), which show safety levels in Member States and the EU.

In the area of interoperability, the report draws primarily from databases and registers hosted by ERA, complemented by an annual data survey among NSAs. Furthermore, official data available from the European Commission are used. Lastly, data from industry associations add to the picture.

Report and chapter overview

This report consists of two main parts: progress with safety (Part A) and progress with interoperability (Part B). To monitor the progress in these two aspects of the EU railway system, a series of standard indicators are used. A comprehensive methodological framework, outlined in Annex II, governs their selection. Indicators are based on the logical framework for evaluation, assessing three main areas: inputs, outputs and outcomes. For each indicator, further details are provided in the following sections:

([2]) This report is published in accordance with Art. 35(4) of Regulation (EU) 2016/796.

- the **purpose** section describes the reason for the indicator, its importance in the quest for safety and interoperability, its goal, or official target if available, and its expected use;
- the **indicators** section describes the measures of quantitative assessments used to track and compare performance;
- the **findings** section provides the main observations along with the results of the data analysis;
- the **sources and limitations** section provides additional information on the data source, data production and other aspects influencing the metric and its quality.

Metrics for each indicator are shown with the help of figures. Where available, two figures are presented: the first provides an overview, while the second provides further insight.

A. Progress with safety

Summary

The safety level of the EU railway system remains very high; it is in fact one of the safest railway systems in the world. In a multimodal comparison, rail appears the safest mode of land transport in the EU, with a fatality rate for passengers similar to that for aircraft passengers.

The numbers of significant accidents and resulting casualties have decreased steadily since 2010; however, in 2021 and 2022, an increase was recorded, going back to pre-COVID-19 levels.

Major accidents resulting in five or more fatalities have become rare: no such accidents occurred in 2018, 2020 and 2021, but five such accidents occurred in 2022 and 2023 (including the tragic accident in Tempi, Greece, in February 2023, which caused 57 fatalities). The number of fatal train collisions and derailments has decreased continuously since 1990. In recent years (2020–2022), however, a slight increase was registered, with 18 such accidents.

The rates of significant accidents, fatalities, and fatalities and weighted serious injuries (FWSIs) per million train-km have decreased substantially since 2010, with the lowest values registered in 2020 and 2021; however, in 2022, the rates returned to pre-COVID-19 levels. Despite the drop in 2021, the passenger fatality rate shows a worrying stagnating (even slightly rising) trend since 2017.

The results of the latest assessment of the achievement of safety targets (carried out annually by ERA) indicate that safety performance remains acceptable at the EU level, although possible deterioration in safety performance was identified in four instances. Such a result is in line with the previous assessments, which typically identified possible deterioration in safety performance in a few countries and categories.

Behind the overall positive trends of the recent decades are the realities requiring the attention of both the railway sector and policymakers. Despite an overall decrease in the number of significant accidents since 2010, in 2021 and 2022 an increase was recorded, going back to pre-COVID-19 levels; the number of 'internal' accidents (collisions, derailments, fires in rolling stock and other accidents) is stagnating (even slightly increasing in recent years), while in 2022 the largest number of 'external' accidents was recorded since 2019. The overall toll of railway accidents remains high: the economic cost of significant accidents alone was estimated at about EUR 4 billion in 2022. Progress in improving safety has also been very uneven across the Member States, with the variation in safety levels remaining high.

High variation in the number of accidents involving the transport of dangerous goods (TDG) was recorded in 2018–2022, but it cannot currently be established with certainty if this is the result of a decrease in safety or a variation in the interpretation of the applicable legislation.

Good results achieved in reducing third-party fatalities (trespassers and suicides) came with a similar reduction in overall suicide mortality rates and cannot therefore be fully attributed to the work carried out by the railway infrastructure managers.

No clear progress has been seen in reducing railway worker casualties in the last years. Each year (except in 2019), close to 30 fatalities among railway workers were reported. In addition, more than 40 employees were seriously injured annually. Since 2006, there has been a significant decrease in the railway employee fatality rate; however, in recent years, a slightly increasing trend has emerged.

Safety at level crossings improved over 2010–2016, but in the following years (2017–2022) a more stagnating trend is observed (despite a drop in 2020, probably linked to the COVID-19 pandemic). In addition, level crossing accident rates still vary considerably across Member States.

One of the main drivers of disparities in safety levels among Member States seems to be the level of safety of the railway infrastructure: the deployment of advanced train protection systems (TPSs) (including the European Train Control System (ETCS)) and trackside protected level crossing devices varies greatly across Europe.

The accident investigation reports and a large number of reported precursors highlight the potential for further safety improvements through learning from experience. This potential could be fully exploited if the information and knowledge was shared across the EU.

Although the trend over the last 4 years confirms the gradual transition towards single safety certificates (SSCs), despite quite significant scaling down, the number of Part A safety certificates appears still high, especially in some countries. This can be explained by, among other reasons, the renewal of these safety certificates before the transposition date of the fourth railway package into national law (which was in some cases extended).

All entities in charge of maintenance (ECMs) of vehicles are to comply with Commission Implementing Regulation (EU) 2019/779. At the end of 2023, in the European Railway Agency Database of Interoperability and Safety (ERADIS), 353 ECM certificates for vehicles other than freight wagons, 115 ECM certificates only for freight wagons and 413 ECM certificates for wagons and other vehicles were reported (for EU-27 + CH + NO).

As required by the Railway Safety Directive (RSD) (Directive EU 2016/798), the development of safety relies on a culture of mutual trust, confidence and learning in which all actors contribute. The Agency has developed the European railway safety culture model as a conceptual and evaluation framework to allow the user to assess safety culture and to identify areas for improvement. With the support of the European Commissioner for Transport, the Agency has promoted the European Railway Safety Culture Declaration to demonstrate the commitment of leaders and authorities, to raise awareness and to promote a positive safety culture. Since its launch at the first European Rail Safety Summit in Dubrovnik in 2018, more than 250 railway leaders and organisations have signed the European Railway Safety Culture Declaration – a strong symbolic act showing the organisation's commitment to continually improving its safety culture.

Overview of indicators and figures

Part A: Progress with safety

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Indicator	Figure	Indicator/Figure(s)	Category	Area
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A-1 Costs of railway accidents

Purpose

An unsafe railway system has direct and indirect negative impacts on society. Economic theory allows the expression of those impacts in monetary terms. This gives an idea of the costs of unsafe railway operation to both industry and society. The evaluation of socioeconomic costs is based on per-unit cost estimates from economic studies, which evolve with time, along with more empirical evidence.

Indicators

In the application of the RSD, the economic impact of accidents is measured by the economic impact of fatalities and serious injuries, the costs of delays, the costs of material damage to rolling stock or infrastructure and the costs to the environment. Other types of costs ([3]) have been recognised, but they represent a minor addition to the costs mentioned above.

Findings

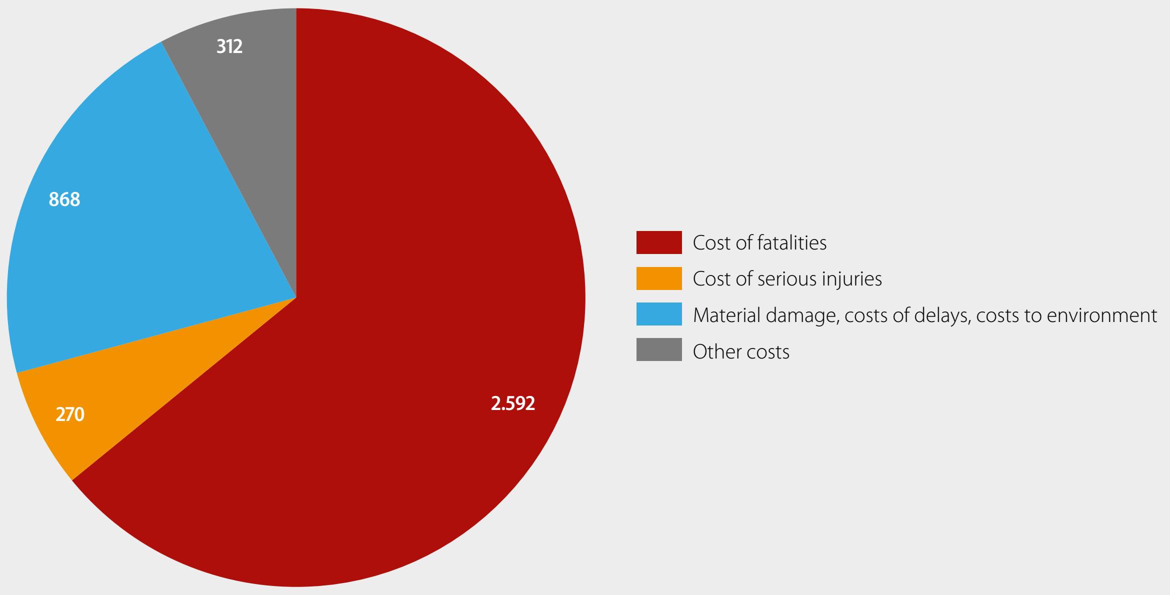
The total cost of significant railway accidents ([4]) in 2022 is estimated at about EUR 4 billion (in the EU-27). In more recent years, an update to the casualty unit costs has resulted in a significant increase in these costs. Fatalities account for around 65 % of total costs (see Figure A-1). The costs reported and estimated for individual Member States reflect both the accident outcomes and the economic situation, as per unit cost estimates for casualties.

Sources and limitations

While the economic impact of casualties can be estimated for all countries thanks to EU-wide studies on the unit costs, a few countries were not able to monetise the total material damage of significant accidents in 2022; the costs of delays (based on the minutes of delays for trains) in relation to those accidents are available for only 23 Member States and only seven countries recorded environmental damage related to significant accidents. Data have been reported by NSAs for more than 15 years, under Annex I to the RSD (CSIs), and detailed guidance material, which also contains fallback values, is available. In addition, some countries fail to report some types of costs, and so the reliability of cost data should be considered on a case-by-case basis.

([3]) Other costs are those associated with modal shift, air pollution, administration, rerouting, reputational damage and productivity losses and are estimated from unit costs developed by a consultant for the Agency.
([4]) The RSD defines a 'significant accident' as '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, excluding accidents in workshops, warehouses and depots'. The directive explains that ' "significant damage to stock, track, other installations or environment" means damage that is equivalent to EUR 150 000 or more', and that ' "extensive disruptions to traffic" means that train services on a main railway line are suspended for six hours or more'.

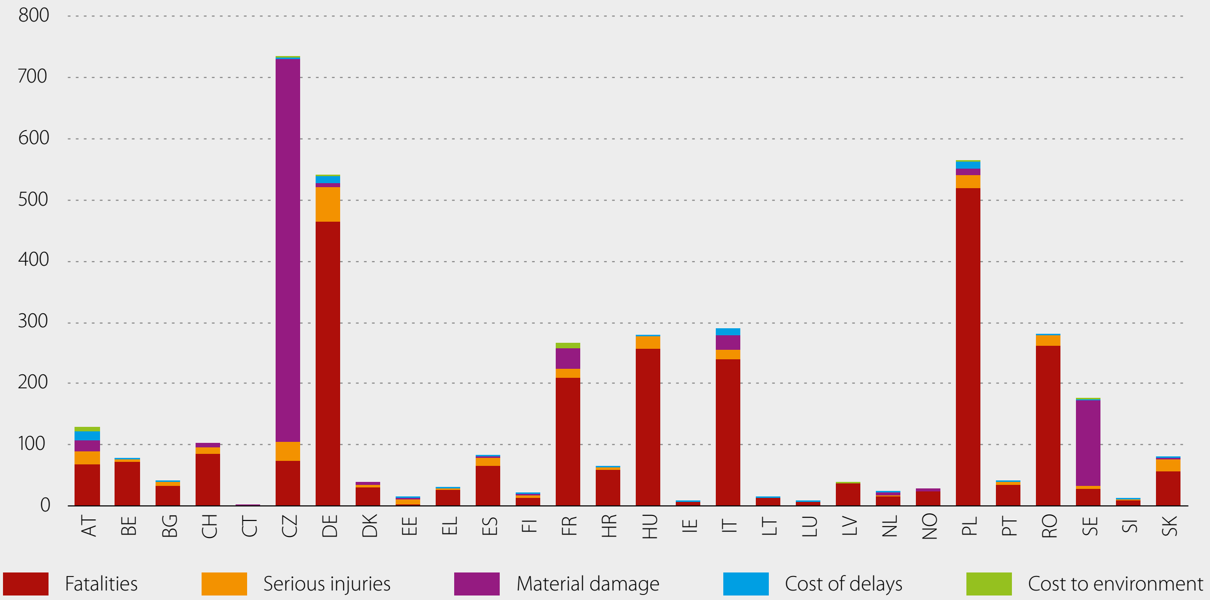
Figure A-1: Estimated costs of railway accidents, million EUR (EU-27, 2022)



N.B.: Other costs are those associated with modal shift, air pollution, administration, rerouting, reputational damage and productivity losses, and are estimated from unit costs developed by a consultant for ERA.

Source: CSIs as reported by NSAs to the Agency.

Figure A-2: Estimated costs of railway accidents per country, million EUR (EU-27 + CH + NO, 2022)



Source: CSIs as reported by NSAs to the Agency.

A-2 Accidents and their outcomes

Purpose

Significant accidents and the resulting casualties provide the ultimate insight into the safety level of railway systems. European legislation sets the goal to maintain or, where possible, improve railway safety in the SERA.

Indicators

The absolute numbers of significant accidents and resulting serious and fatal injuries are recorded ([5]).

Findings

Both the number of significant rail accidents and the number of resulting casualties, for which harmonised data are available across the EU, declined steadily over 2010–2020. After the overall positive progress of the last decade, in 2021 and 2022, an increase in significant accidents and related casualties was recorded, going back to pre-COVID-19 levels. In total, 1 569 significant accidents, 805 fatalities and 594 serious injuries were reported in the EU-27 in 2022.

The number of significant accidents increased by 12 % in 2022 compared with 2021 and by 6 % compared with the average of the 4 preceding years. The increase occurred across all accident categories except derailments and level crossing accidents.

Sources and limitations

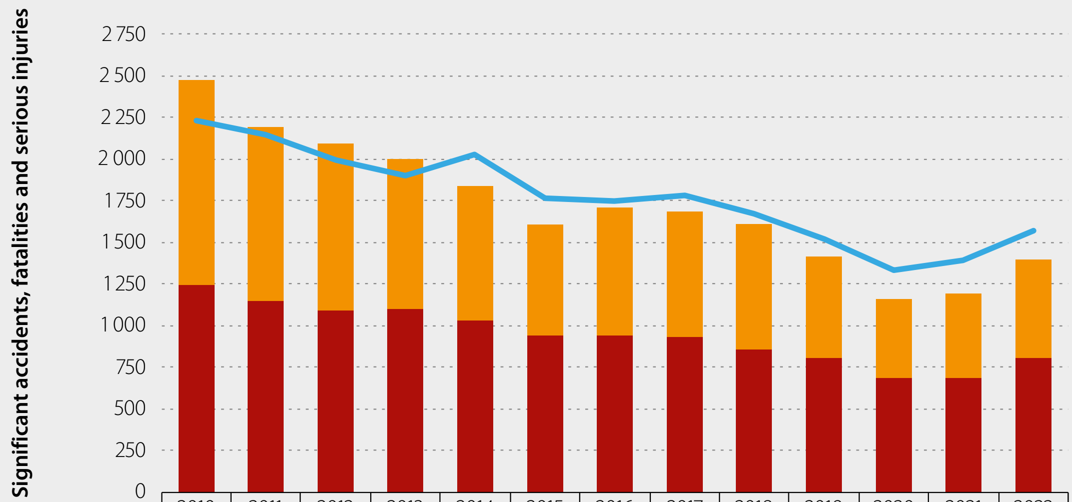
The data used to monitor progress with safety outcomes are part of the CSIs, as supplied by the NSAs to ERA. More than 15 years of continuous work on improving data quality in Member States and at the Agency provides assurance on the accuracy of the data ([6]).

([5]) For data at the country level (not only on significant accidents and related casualties), see the 'ERA Railway Factsheets' (https://www.era.europa.eu/content/era-railway-factsheets), providing statistics and insights from several sources in an accessible format.

([6]) See also the recent report of the ERA Economic Steering Group Task Force on Data Quality (*ESG Task Force on Data Quality: Final report,* https://www.era.europa.eu/system/files/2023-05/ESG-TF-Data-Quality-Final-report_en.pdf?t=1711547344), with the first subgroup focusing on CSIs.

Figure A-3: Main safety outcomes (EU-27, 2010–2022)

Significant accidents, fatalities and serious injuries



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Serious injuries	1 226	1 041	996	899	810	672	766	747	750	613	469	512	594
Fatalities	1 245	1 151	1 093	1 095	1 029	939	942	933	855	802	687	683	805
Significant accidents	2 230	2 146	1 994	1 896	2 022	1 764	1 743	1 778	1 671	1 518	1 336	1 395	1 569

Source: CSIs as reported by NSAs to the Agency.

Figure A-4: Significance of changes in annual counts of significant accidents (EU-27, 2018–2022)

Significance of change in outcomes	2022/2021	2022/(2018–2021)
Collisions of trains	29%	19%
Derailments of trains	-20%	-14%
Level crossing accidents	-3%	0%
Accidents to persons	25%	9%
Fires in rolling stock	53%	21%
Other accidents	0%	4%
All significant accidents	12%	6%
Fatalities	18%	6%
Serious injuries	9%	1%
Suicides	7%	5%

N.B.: A Poisson statistical significance test was performed at a significance level of 95 %. Statistically significant changes are highlighted orange.

Source: CSIs as reported by NSAs to the Agency.

A-3 Major accidents and fatal train collisions and derailments

Purpose

As past accident records may not always be complete in all Member States, narrowing the scope to railway accidents with severe consequences provides a more robust confirmation of the trends identified and, at the same time, highlights the most serious events that occurred and their impact on overall accident statistics. Accidents with multiple fatalities rarely escape the attention of the media and the public, and so data on these are assumed to be complete. Historical data on serious accidents that caused five or more fatalities in the EU-27, Norway, Switzerland and the United Kingdom, herein referred to as major accidents, are collected by ERA, in addition to regulatory data collection.

Indicators

Indicators are the number of accidents resulting in five or more fatalities and the number of fatal train collisions and derailments (the latter includes train collisions, train derailments and train fires following collisions or derailments in which one or more people are killed, covering thus the most serious operational accidents).

Findings

An overall downwards trend in major accidents (and in the number of corresponding fatalities) has been observed since 1980, despite the increase in the last 2 years. Even if no accidents resulting in five or more fatalities were registered in 2018, 2020 and 2021, five of such accidents occurred in 2022 and 2023 (including the recent tragic accident in Tempi, Greece).

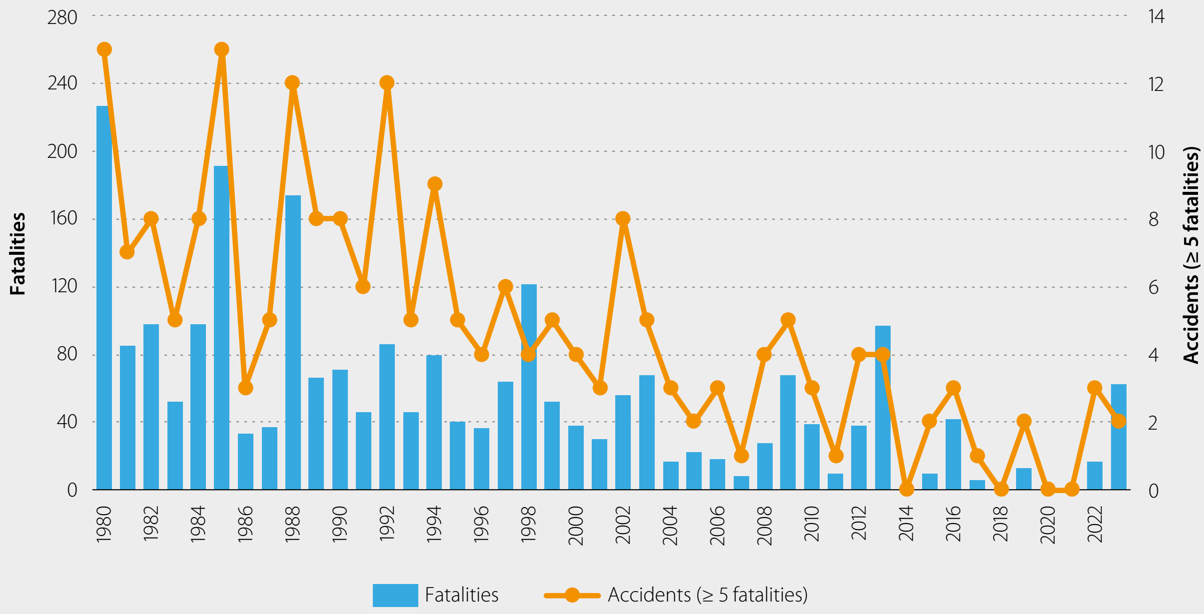
Fatal train collisions and derailments are situated between significant and major accidents; despite the downwards trend in the last decades, between 2020 and 2022, 18 fatal collisions and derailments were registered. The 5-year moving average and the accident rates (taking into account the underlying changes in traffic volume) follow a similar pattern, with an increase in the last few years (i.e. 2020–2022) after the overall positive trend since 1990.

Sources and limitations

Both major accidents and fatal train collisions and derailments rarely escape the attention of the media and the authorities, and several sources were used to compile the archive of historical accidents in Europe, originally developed by Professor Andrew Evans (Imperial College London) for ERA. The Agency continues to rely on that database for historical accident data and on the kind cooperation of Professor Evans.

Figure A-5: Major accidents in Europe (EU-27 + CH + NO + UK, 1980–2023)

Railway accidents resulting in five or more fatalities

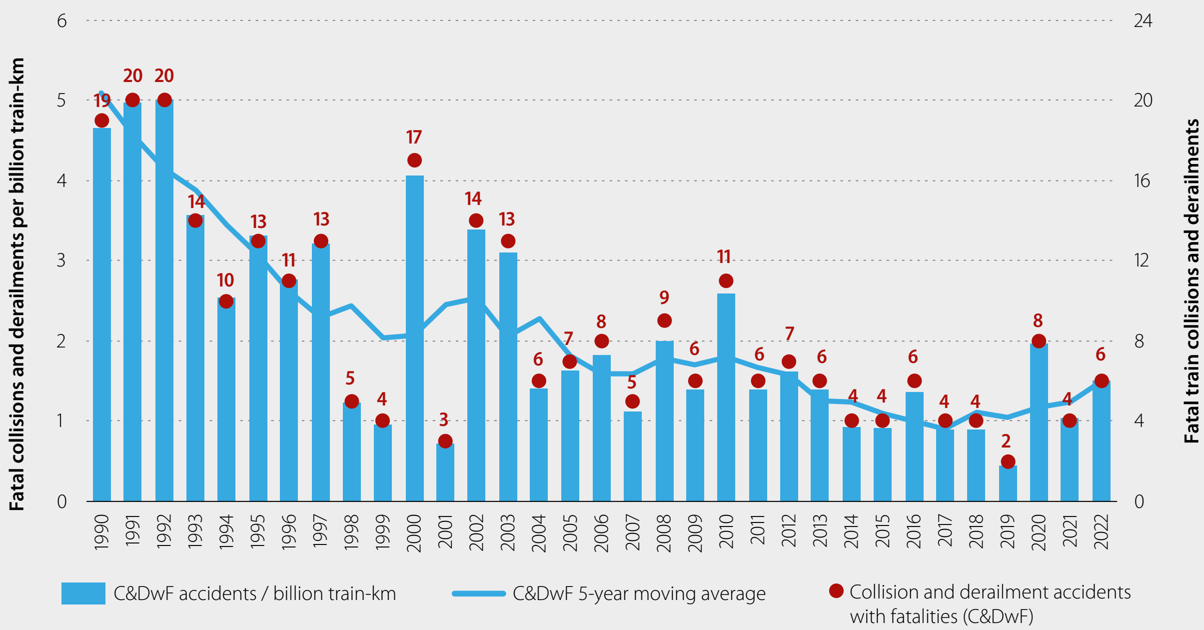


N.B.: Data for the United Kingdom available until end of 2020.

Sources: European Railway Accident Information Links (ERAIL) and database of historical accidents developed by Professor Evans (Imperial College London).

Figure A-6: Fatal train collisions and derailments in Europe (EU-27 + CH + NO + UK, 1990–2022)

Accidents and accidents rates per million train-km



N.B.: Data for the United Kingdom available until end of 2020.

Sources: ERAIL and database of historical accidents developed by Professor Evans (Imperial College London).

A-4 Trends in accident and casualty rates and their variations

Purpose

As traffic volume is the single most explanatory factor in the occurrence of accidents, accident statistics are often normalised against traffic data.

Indicators

The main indicators used here are significant accident and fatality rates, that is, significant accidents per million train-km, railway fatalities per million train-km (capturing the manifested overall risk of railway operation) and passenger fatalities per billion passenger-km (capturing the manifested risk for people using trains). In addition, the trend over years in the FWSI rate is analysed.

Findings

The overall fatality rate in 2022 was around 0.21 fatalities per million kilometres (one fatality for every 5 million train-km on average), whereas the overall passenger fatality rate was 0.051 passenger fatalities per billion passenger-km (around one fatality for every 20 billion passenger-km).

All the rates analysed have decreased substantially in the last decade, with the lowest value registered in 2021, but in 2022 the rates returned to pre-COVID-19 levels. Despite the drop in 2021, a slightly rising trend in passenger fatality rate has been observed since 2017.

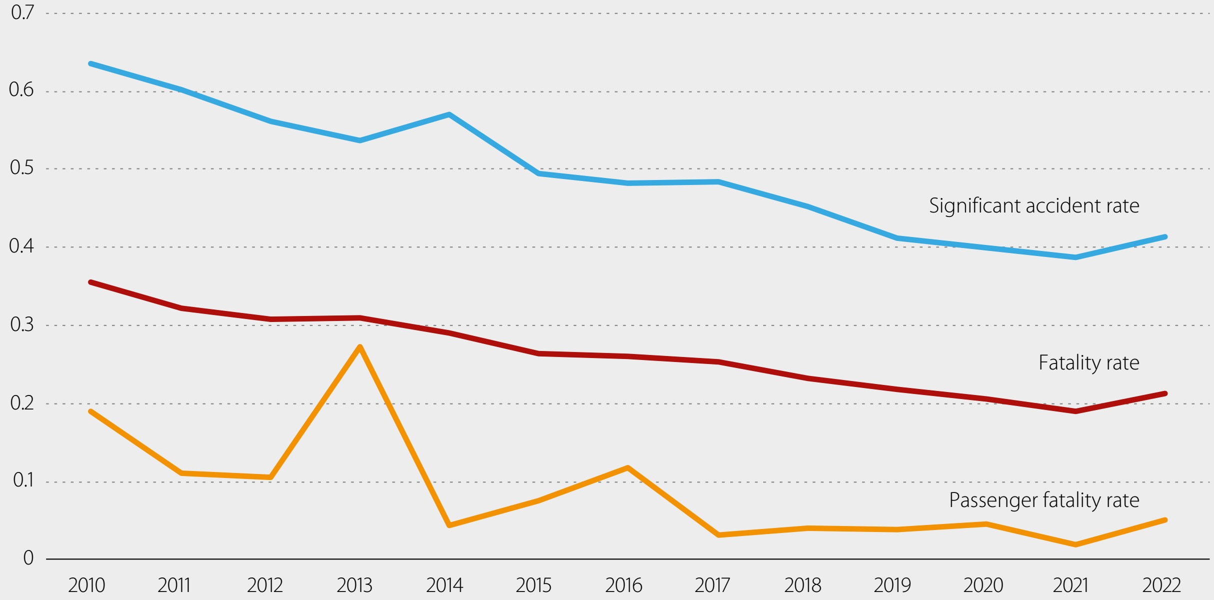
The variation in FWSI rate among Member States (measured through the standard deviation) decreased over 2010–2021, with an increase in 2022; the average FWSI rate showed a similar trend, with the coefficient of variation staying close to 1 because of the variability of the values around the mean.

Sources and limitations

Data used to monitor progress with safety outcomes are part of CSIs supplied by the NSAs to ERA. More than 15 years of continuous work on data quality in Member States and at the Agency provides assurance on the accuracy of the data.

Figure A-7: Trends in accident and fatality rates (EU-27, 2010–2022)

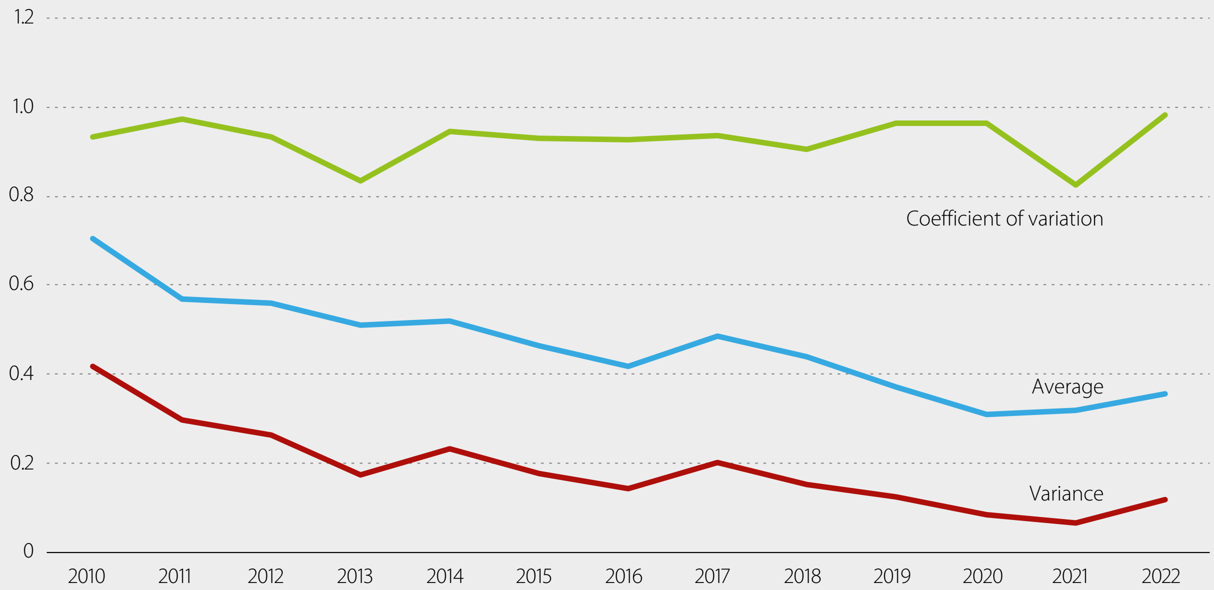
Significant accidents and fatalities per million train-km. Passenger fatalities per billion passenger-km



Source: CSIs as reported by NSAs to the Agency.

Figure A-8: Fatalities and weighted serious injuries rates (EU-27, 2010–2022)

FWSI per million train-km: average, variance and coefficient of variation



Source: CSIs as reported by NSAs to the Agency.

A-5 Railway and passenger fatality rates

Purpose

Behind the general EU picture, a much more diverse reality exists, with notably large differences in casualty rates among Member States. Plotting the fatality rates for individual Member States unveils the extent of the existing disparities in safety levels. Sorting the countries provides further insight into these differences.

Indicators

Two main indicators are used here: fatality rate (railway fatalities normalised by train-km, capturing the manifested overall risk of railway operation) and passenger fatality rate (passenger fatalities per passenger-km, capturing the personal manifested risk for people using trains).

Findings

The data reveal at least a 10-fold difference in fatality rates between countries with the lowest rates and those with the highest rates. In both cases, the median values are much lower than mean values, as the rates for Member States with relatively high rates are much higher than the rates for other countries. For railway fatality rate, a cluster of 10 countries emerges, with values that are in stark contrast to the remaining Member States. Similarly, the passenger fatality rate is significantly higher than the European average in more than half of the Member States. Achieving a single safety area implies comparable safety levels across EU countries, but the data still indicate large differences among Member States.

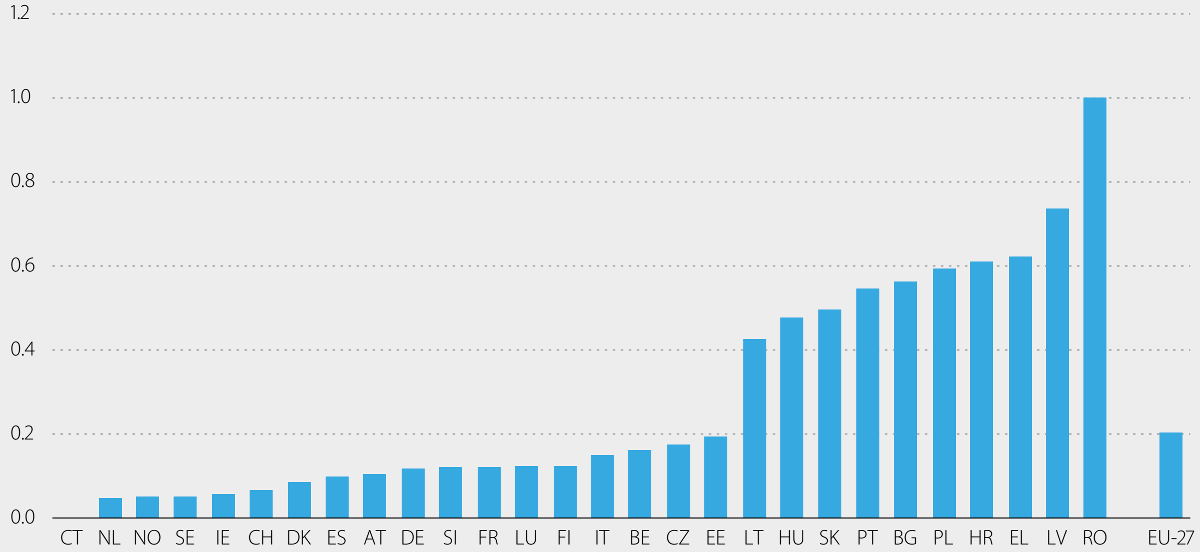
Sources and limitations

Although fatality rate and passenger fatality rate are estimated over a 3-year period and a 10-year period, respectively, major accidents with large numbers of passenger casualties still weigh heavily on the estimates. An extreme case is the derailment in Santiago de Compostela, Spain, which occurred in 2013 and has resulted in the passenger fatality rate for Spain being among the highest in Europe.

Data used to monitor progress with safety outcomes are part of CSIs supplied by the NSAs to ERA. More than 15 years of continuous work on data quality in Member States and at the Agency provides assurance on the accuracy of the data.

Figure A-9: Railway fatality rates (2020–2022)

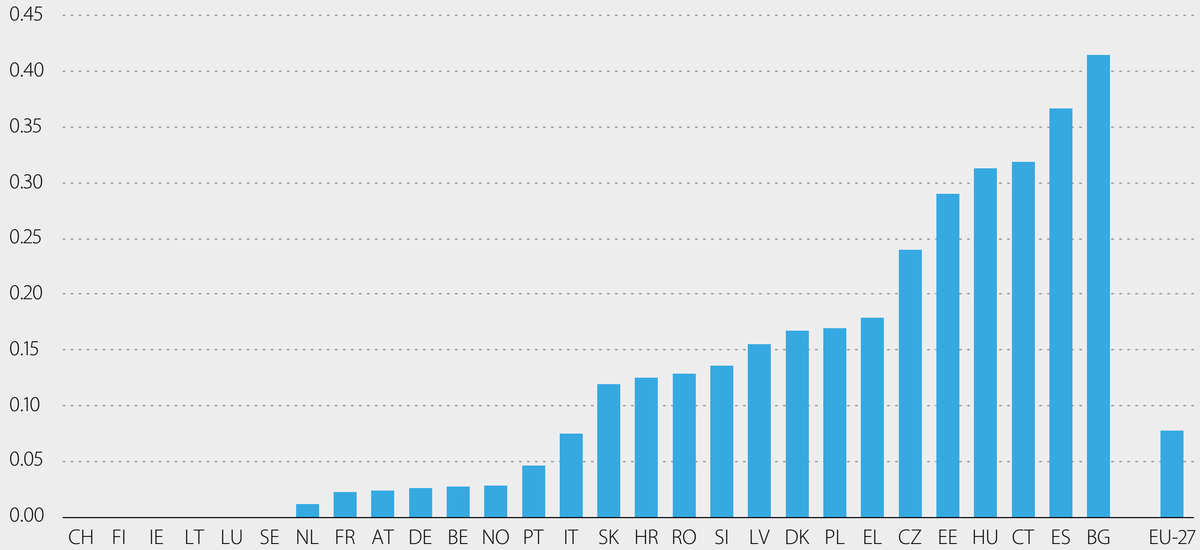
All fatalities per million train-km (average over 2020–2022)



Source: CSIs as reported by NSAs to the Agency.

Figure A-10: Railway passenger fatality rates (2012–2022)

Passenger fatalities per billion passenger-km (average over 2012–2022)



Source: CSIs as reported by NSAs to the Agency.

A-6 Safety of different transport modes

Purpose

Different means of transport have different levels of risk for travellers. In this section, the user fatality risk is estimated for the four main transport modes (i.e. bus/coach, car, commercial aircraft and rail) for which comparable data are available.

Indicators

The indicator measures the risk of death for a passenger travelling over a given distance using different transport modes. The indicator looks at a 10-year block of data (2012–2021). Although the use and nature of transport modes differ widely, a direct comparison of safety levels is possible using certain travel scopes.

Findings

The fatality risk for a train passenger is around one third of the risk for a bus/coach passenger, and almost similar to that for a commercial aircraft passenger. The use of individual means of transport, such as a passenger car, carries a substantially higher fatality risk: car occupants have a 30 times higher likelihood of dying than a train passenger travelling over the same distance. The fatality risk for an average train passenger (calculated over 10 years) is now about 0.077 fatalities per billion passenger-km, making it, comparatively, the safest mode of land transport in the EU.

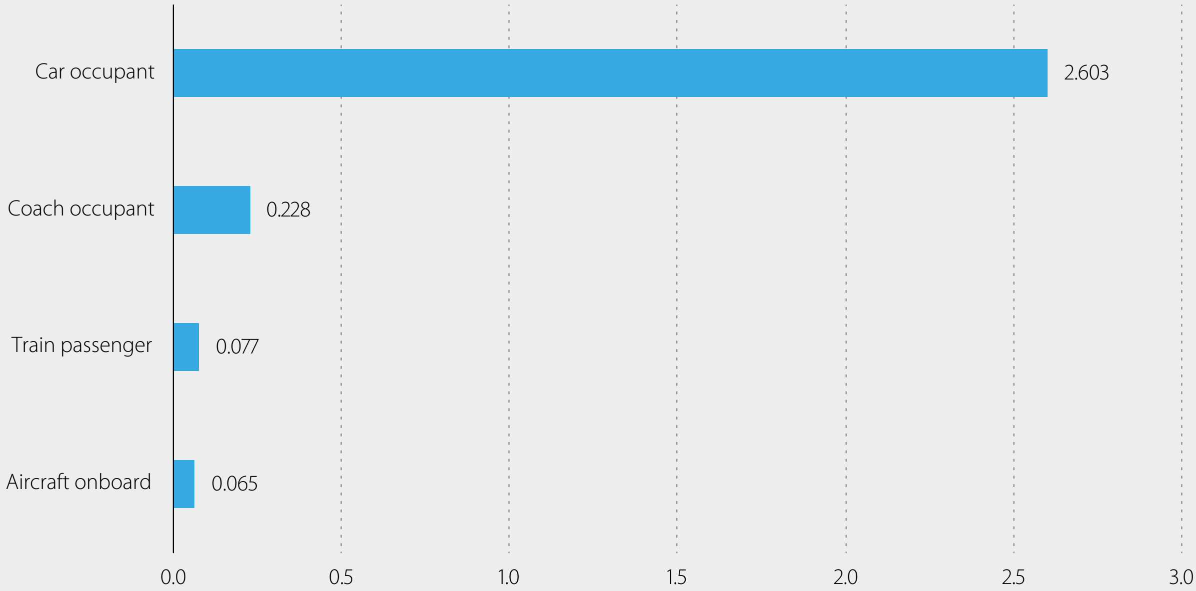
Sources and limitations

Data are retrieved from various sources (i.e. European Commission databases, the European Aviation Safety Agency, CSIs reported by NSAs to the Agency).

The risk estimated for commercial air travel, and also for bus and train travel, is subject to greater variation, as a single accident may result in dozens of fatalities. As the annual numbers of aircraft, train and coach accidents resulting in fatalities are relatively small, the risk estimated for a relatively short period should be interpreted with caution; this is why the fatality risk over 10 years is calculated. Lastly, the results of such a comparative exercise also strongly depend on the type of exposure data considered.

Figure A-11: Passenger and driver fatality rates for different transport modes (EU-27, 2012–2021)

Onboard fatalities per billion passenger-km



N.B.: Fatalities are for all people occupying the vehicle, except for rail (includes passengers only). Passenger-km for air include only domestic and intra-EU-27 transport.

Sources: CARE (Directorate-General for Mobility and Transport), European Aviation Safety Agency, *Statistical Pocketbook 2023* (Directorate-General for Mobility and Transport), CSIs reported to ERA.

A-7 Worldwide railway safety

Purpose

Despite structural differences, the overall safety level of the EU railway system can be benchmarked against safety levels in various countries worldwide. In ERA's view, the entire sector should aspire to make the EU railway system the safest in the world.

Indicators

The indicators used are the railway fatality rate and the passenger fatality rate, estimated for a 5-year period. This longer period is used to account for fluctuations between individual years and for randomness in the data. A more accurate comparison is available as a result.

Findings

Based on railway fatality rates estimated in six jurisdictions, the EU railway system is among the safest after South Korea and Australia ([7]).

A passenger on board a train in the EU railway system enjoys, relatively, the lowest risk after passengers in South Korea and Japan. No passenger fatalities were registered in Japan between 2017 and 2021. The gap in passenger fatality rate between Europe and Japan may be challenging to close in the medium term.

Sources and limitations

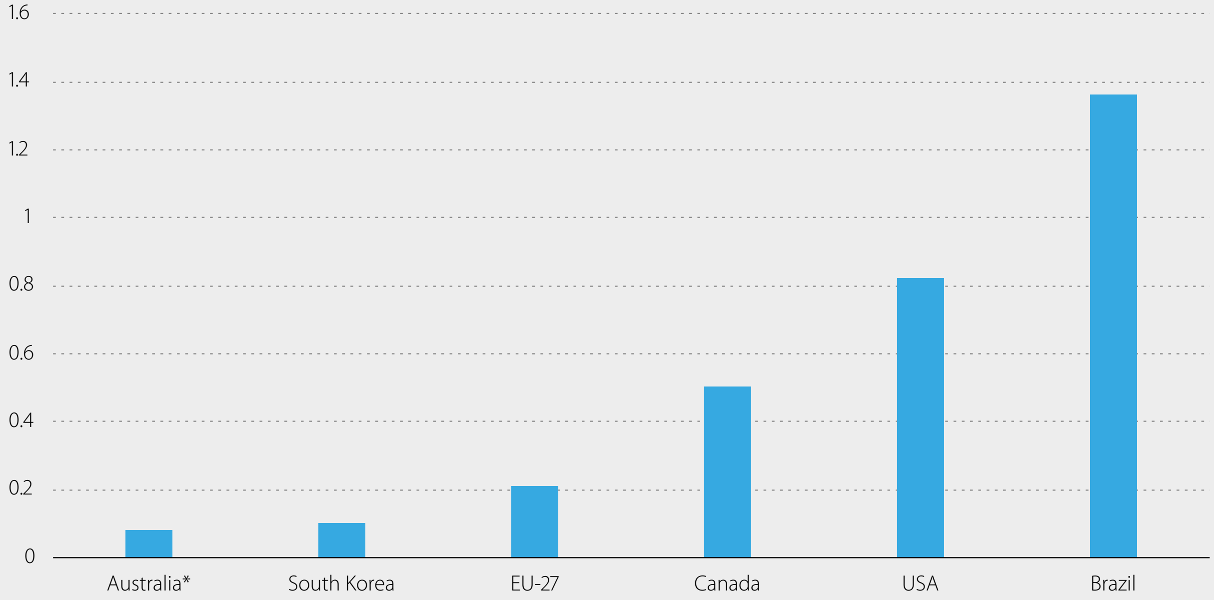
Data used for this indicator are taken from statutory reports and public databases from national railway safety administrations or safety administrations of the jurisdictions concerned. Unfortunately, it was not possible to collect reliable and comparable data for other countries (e.g. China, India and Japan).

It is not confirmed that all the countries use the same, internationally agreed, definition of a railway fatality, that is, a fatality occurring 'within 30 days of [the] accident', or that train-km are recorded in the same fashion for all RUs. The possible exclusion of trespasser fatalities (to exclude possible suicide fatalities) is also likely to be an issue. Nevertheless, the comparability of the data may be satisfactory for the given purpose of an international benchmark. Lastly, the selection of countries used in the two benchmark figures is driven by the comparability of the railway system in terms of size and volume and the availability of comparable data.

([7]) The definitions and recording of trespassers and suspected suicides may differ across the countries.

Figure A-12: Railway fatality rates for different countries worldwide (2018–2022)

All railway fatalities (excluding suicides) per million train-km



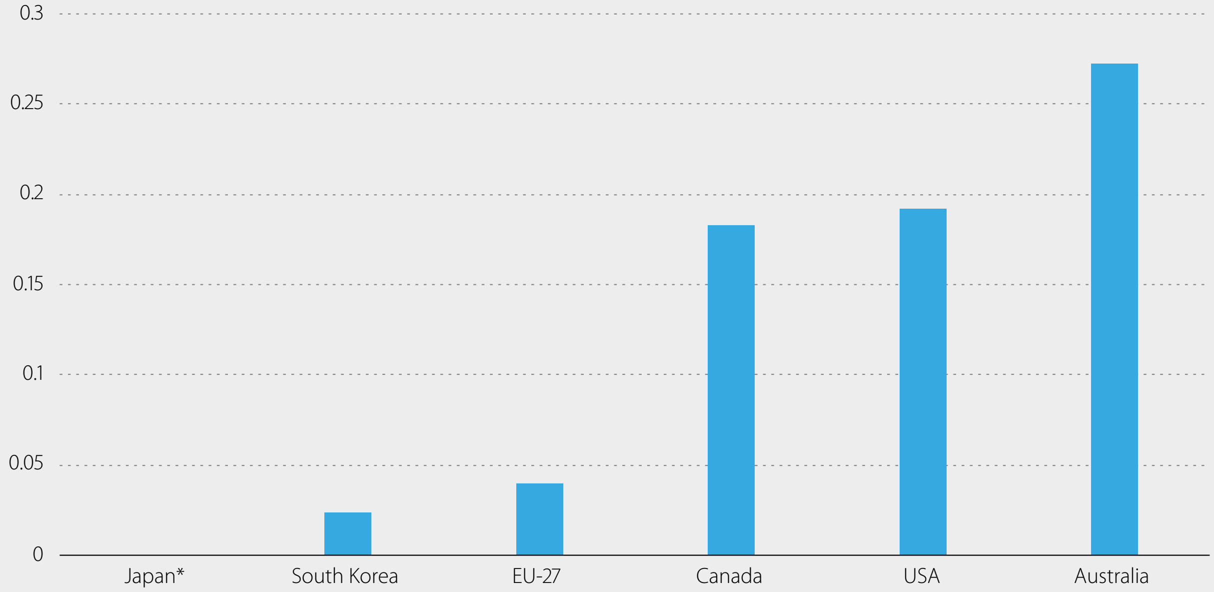
(*) Data for Australia exclude suspected suicides and were extracted from the 2022 rail safety report of the Office of the National Rail Safety Regulator.

N.B.: Data (referring to high-speed rail and conventional lines) for South Korea were provided by the Korean Transportation Safety Authority's railway safety division.

Source: Statutory reports produced by national administrations of the jurisdictions concerned.

Figure A-13: Passenger fatality rates for different countries worldwide (2018–2022)

Railway passenger fatalities (excluding suicides) per billion passenger-km



(*) Data for Japan are for 2017–2021.

N.B.: Data (referring to high-speed rail and conventional lines) for South Korea were provided by the Korean Transportation Safety Authority's railway safety division.

Source: Statutory reports produced by national administrations of the jurisdictions concerned.

A-8 Achievement of safety targets

Purpose

Common safety targets are the acceptable safety levels prescribed for the railway systems of the EU and of Member States. They are used as a reference when assessing if the current safety levels are at least maintained. In the long term, they could also help to drive efforts to reduce the current variation in safety levels across the EU. Rail is the only mode of transport for which targets have been prescribed by EU legislation. The achievement of safety targets is annually assessed by ERA using the common safety method on common safety targets ([8]). The latest assessment available is the 2024 assessment ([9]), which compares the 2022 safety levels with the set reference values ([10]).

Indicators

The safety level is measured in terms of the number of FWSIs per train-km and is assessed for the following categories: passengers, employees, level crossing users, unauthorised persons on railway premises and society as a whole.

Findings

The results of this latest assessment (March 2024) indicates that safety levels remain acceptable at the EU level, whereas a possible deterioration in safety performance was identified in four instances. Such a result is in line with the previous assessments, which typically identified possible deteriorations in a few countries and categories.

Member States are more likely to achieve acceptable safety performance in the category of passengers than in any other category. A possible or probable deterioration in safety performance is most frequently registered for employees and unauthorised persons on railway premises, and in recent years this has also been observed for the category 'others'. Although possible or probable deterioration has been identified in 17 countries, in only one Member State was this the finding in the large majority of assessments. In a further four countries, eight or more instances have been identified since 2008.

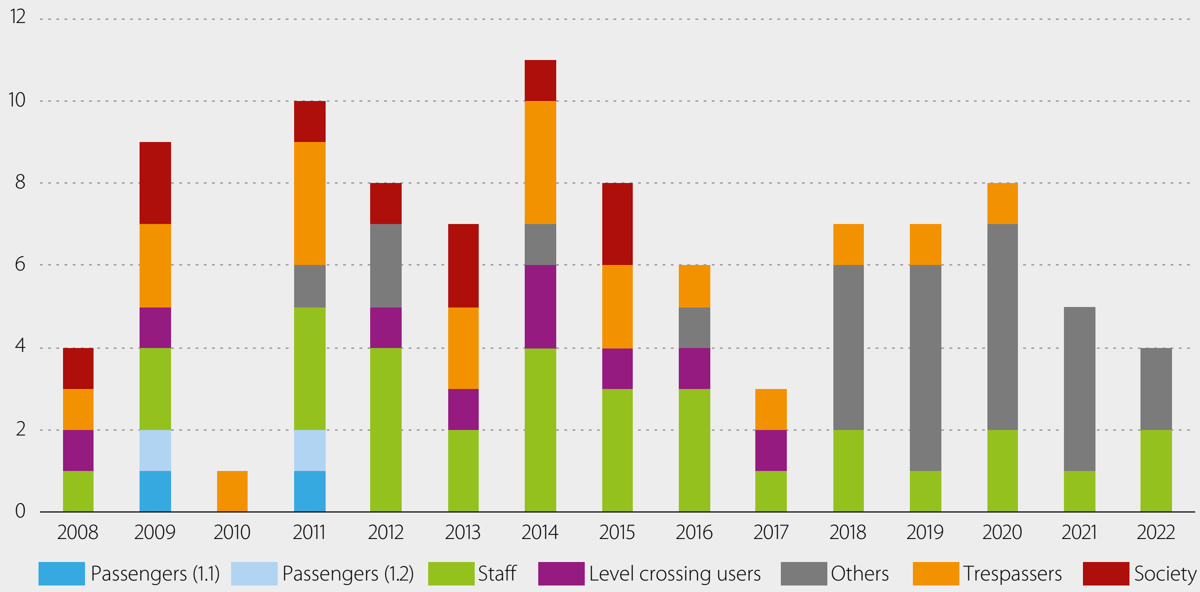
Sources and limitations

Risk categories as defined in the RSD are used. For the passenger category, two measures are applied: FWSI per passenger train-km (1.1) and FWSI per passenger-km (1.2). FWSIs are a measurement of the consequences of significant accidents combining fatalities and serious injuries, where one serious injury is considered statistically equivalent to 0.1 fatalities. For more information on the weaknesses and strengths of the method, see the *ex post evaluation of the Common safety method for assessment of achievement of safety targets* ([11]).

([8]) Commission Decision 2009/460/EC on the adoption of a common safety method for assessment of achievement of safety targets (also contains detailed information on the method and definitions of the categories).
([9]) European Union Agency for Railways, *Report Assessment of Achievement of Safety Targets – 2024* (https://www.era.europa.eu/content/report-assessment-achievement-safety-targets-2024).
([10]) Commission Decision 2012/226/EU on the second set of common safety targets as regards the rail system.
([11]) European Union Agency for Railways (2021), *Ex-post evaluation of the common safety method for assessment of achievement of safety targets* (https://www.era.europa.eu/system/files/2022-11/report_ex-post_csm_cst_final_public_en.pdf).

Figure A-14: Instances of possible/probable deterioration in safety performance by risk category (EU-27 + NO, 2008–2022)

Probable or possible deterioration of safety performance as per annual common safety targets assessment



Source: Annual common safety target assessment reports published by ERA.

Figure A-15: Instances of possible/probable deterioration in safety performance by country (EU-27 + NO, 2008–2022)

Instances across all risk categories

	BE	HR	LT	LV	ES	DE	NL	CZ	PT	IT	FR	HU	SE	BG	NO	RO	SK	Total
2008	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	4
2009	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	4	4	9
2010	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
2011	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	4	4	10
2012	0	1	0	0	0	0	0	0	0	0	0	0	1	2	1	2	1	8
2013	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2	1	2	7
2014	0	0	0	0	0	0	0	0	0	1	1	2	1	1	2	1	2	11
2015	0	0	0	0	0	0	0	0	0	1	0	0	1	1	3	0	2	8
2016	0	0	0	0	0	0	0	0	0	1	0	2	0	2	0	0	1	6
2017	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	3
2018	0	0	0	1	0	0	0	1	1	0	1	1	0	1	0	0	1	7
2019	1	0	0	0	0	1	1	1	1	0	1	0	1	0	0	0	0	7
2020	0	0	0	0	1	1	1	1	1	0	1	0	1	0	0	0	1	8
2021																	2	5
2022						1		1					1				1	4
Total	1	1	1	1	1	2	2	4	4	4	5	5	8	9	9	16	22	

N.B.: Colours correspond to the number of occurrences.

Source: Annual common safety target assessment reports published by ERA.

A-9 Significant accidents

Purpose

Significant accidents represent the basis for the harmonised monitoring of safety occurrences across the EU and beyond. Their scope is limited to accidents resulting in significant harm, such as fatal or serious injuries, significant damage or major traffic disruption. Categorising significant accidents helps to identify the parts of the railway systems with a relatively high prevalence of accidents and those parts relatively underperforming over time.

Indicators

The indicators used are the absolute number of significant accidents disaggregated in two ways: (1) per type of railway accident, as prescribed by the RSD; and (2) per type that reflects the presence of a third party.

Findings

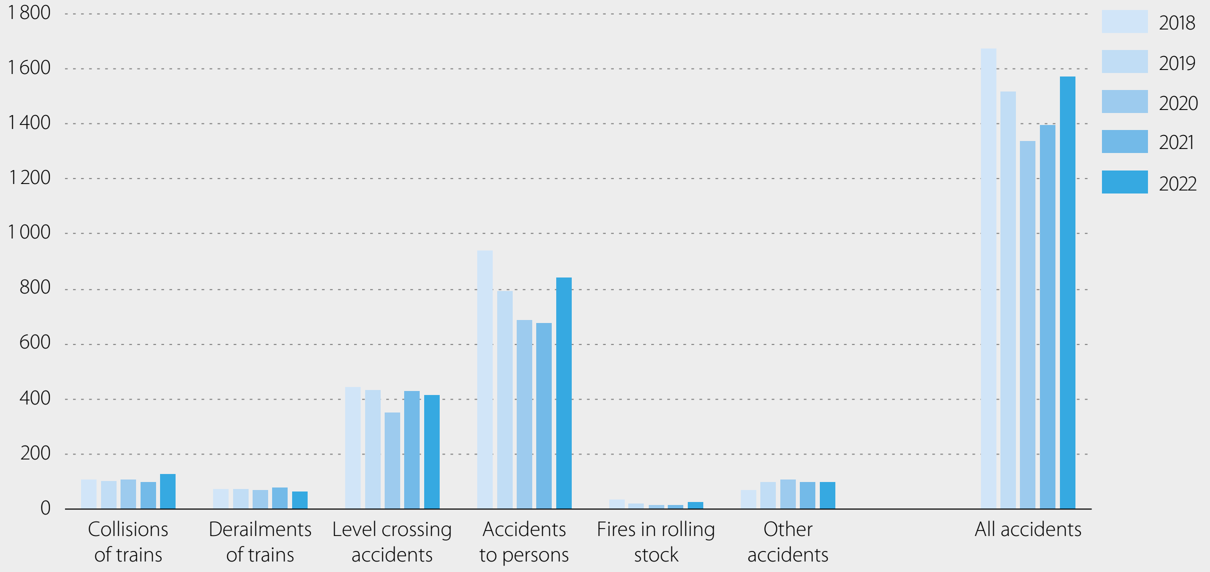
A total of 1 569 significant accidents were reported by Member States for 2022 alone, that is, more than four significant accidents per day on average. This is the largest number recorded since 2019. The overall decrease in the last decade has been mainly driven by a reduction in 'external' accidents involving a third party (trespasser and level crossing users) until 2020, while the trend for 'internal' accidents has been more stable and slightly increasing in recent years. The numbers of derailments and level crossing accidents decreased in 2022, compared with 2021, while all other types of accidents returned to pre-COVID-19 or earlier levels.

A wide range of accidents, not included in the specific types mentioned previously, are included in the category 'other accidents'. The 96 cases reported in 2022 include, for example, collisions and derailments of shunting rolling stock / maintenance machines, objects projected by trains (e.g. ballast) or electrocution in connection with rolling stock in motion.

Sources and limitations

Data used to monitor progress with safety outcomes are part of the CSIs supplied by the NSAs to ERA. More than 15 years of continuous work on data quality in Member States and at the Agency provides assurance on the accuracy of the data.

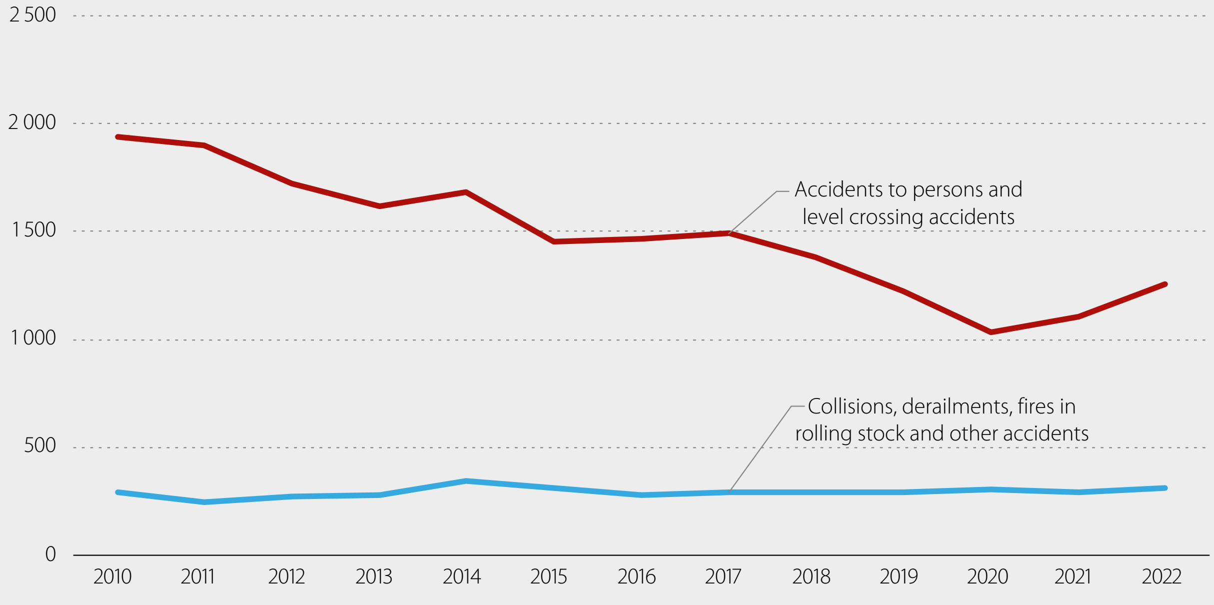
Figure A-16: Significant accidents per type (EU-27, 2018–2022)



Source: CSIs as reported by NSAs to the Agency.

Figure A-17: Railway 'internal' and 'external' significant accidents (EU-27, 2010–2022)

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



Source: CSIs as reported by NSAs to the Agency.

A-10 Accidents and incidents involving the transport of dangerous goods

Purpose

Owing to its potential for disastrous consequences, the transport of dangerous goods (TDG) is subject to extra regulatory provisions and supervision by NSAs and TDG-competent authorities. Nevertheless, accidents involving TDG continue to occur and, apart from being reported under the CSIs, are also subject to a particular reporting regime under the regulation concerning the international carriage of dangerous goods by rail (RID).

Indicators

The indicator used is the number of accidents involving TDG (as indicated in the RSD, that is, any accident or incident that is subject to reporting in accordance with Section 1.8.5 of the RID / the European agreement concerning the international carriage of dangerous goods by road - ADR), with or without the release of those goods.

Findings

The current reporting scheme for accidents involving TDG can be difficult to implement due to complex RID criteria relating to the definition of a TDG occurrence. As CSI reporting is based on this definition in the RID, it may possibly lead to non-homogeneous reporting across Member States.

In this context, a relatively large number of accidents involving TDG was recorded in 2018–2022, but it cannot currently be established with certainty whether this actually corresponds to a degradation in safety or to variations in the interpretation of the applicable legislation. The peak in 2018 and 2019 was mainly due to a single country reporting 34 accidents involving at least one railway vehicle transporting dangerous goods in those years. For 2022, Member States reported a total of 46 accidents involving dangerous goods, of which 24 involved a release of the dangerous goods being transported during the accident; these figures were also mainly driven by the number of accidents reported in one Member State.

As indicated in the following section, clarifications of the reporting criteria in the RID are under consideration in collaboration with RID experts.

Sources and limitations

A number of activities linked to the development and publication of the inland TDG risk management framework have taken place since 2018 ([12]), including a proposal for the clarification of the categories of releases to be reported, as suggested in the risk estimation guide.

In addition to the publication of the risk management framework, the development of a proposal for improving Section 1.8.5 of the RID / ADR / the European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterway (ADN) is currently being examined by an informal working group of the United Nations Economic Commission for Europe / Intergovernmental Organisation for International Carriage by Rail Joint Meeting.

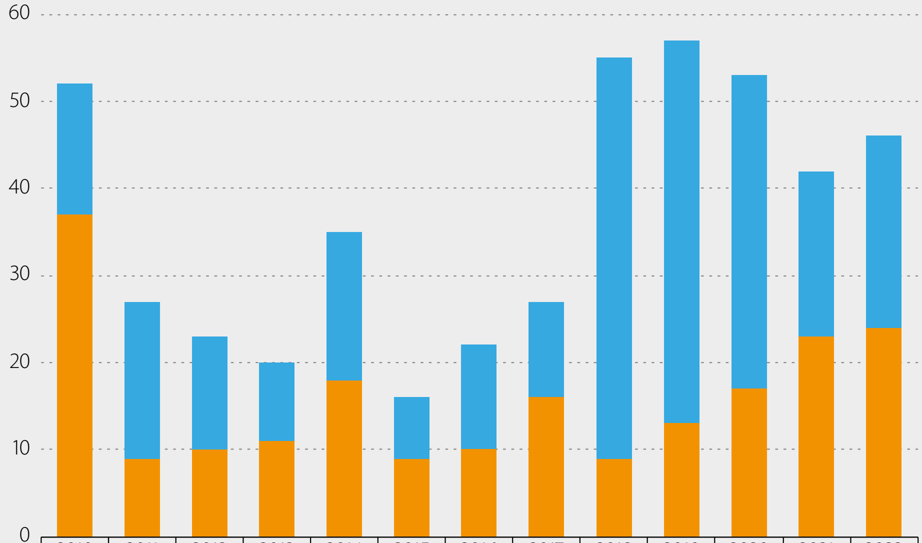
Moreover, the common safety methods on assessment of safety level and safety performance (CSM ASLP) regulation will soon establish a more consistent (and more complete) regime for reporting of TDG occurrences, combining, without duplication, the information from the reports under the RSD and under the RID.

Following the adoption of the CSM ASLP regulation, and on adoption of the multimodal improvement of Section 1.8.5 by the Joint Meeting, RID 2025 could integrate the amendments and be consistent with the CSM ASLP, allowing for the delivery of more reliable safety indicators in the field of TDG.

([12]) See also European Union Agency for Railways (2018), *Guide for Risk Estimation* (https://www.era.europa.eu/system/files/2022-11/Guide%20for%20risk%20estimation.pdf?t=1709804841).

Figure A-18: Accidents involving the transport of dangerous goods (EU-27, 2010–2022)

Railway accidents with and without release of dangerous goods



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Without dangerous goods release	15	18	13	9	17	7	12	11	46	44	36	19	22
With dangerous goods release	37	9	10	11	18	9	10	16	9	13	17	23	24

Source: CSIs as reported by NSAs to the Agency.

A-11 Casualties from significant accidents

Purpose

The severity of accidents, as reflected in the number of casualties, differs for different types of accidents. Monitoring the casualties per accident type thus enables the targeting of those types with relatively high impacts.

Indicators

The indicator used is the number of fatalities from significant accidents per type of accident, as set out in Annex I to the RSD.

Findings

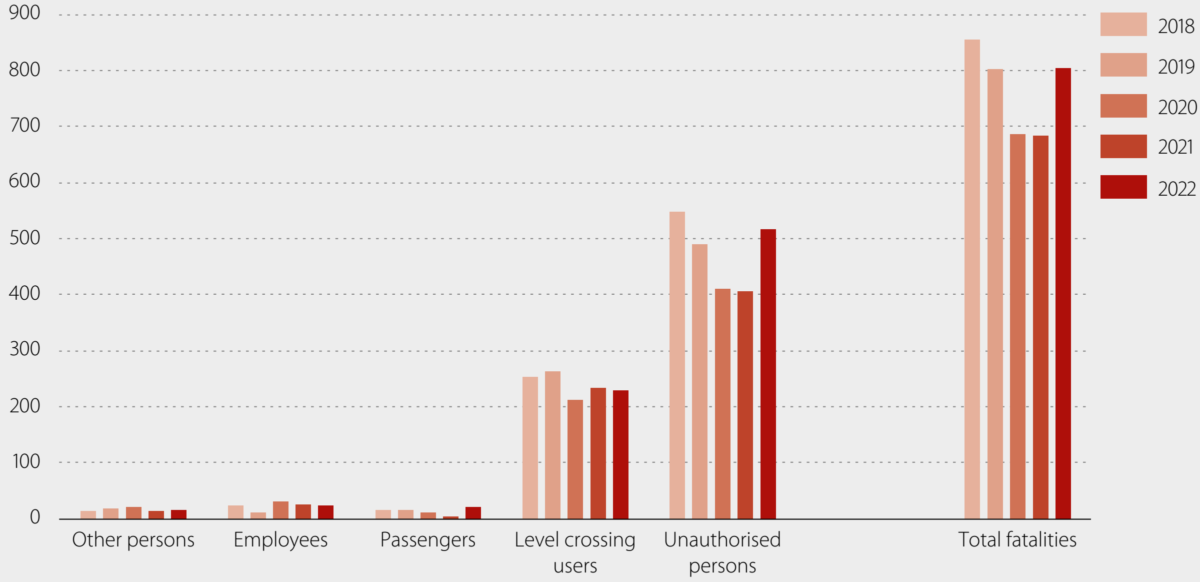
In parallel with the trend in railway accidents, the total number of fatalities excluding suicides, after a drop in 2020 and 2021, returned to pre-COVID-19 levels in 2022. A total of 805 fatalities were reported for 2022, that is, an 18 % increase from the previous year (i.e. 683 fatalities were recorded in 2021). This increase was mainly driven by a rise in fatalities of unauthorised persons on railways. If suicide fatalities are excluded, the majority of fatalities on railway premises are due to accidents to unauthorised persons. Fatalities resulting from level crossing accidents account for around 31 % of the total, while fatalities due to collisions and derailments represent 1.7 % of all railway fatalities. Around 7 % of people killed on EU railways in 2022 were internal to railway operation (passengers, employees and other persons).

Sources and limitations

Data on fatalities from railway accidents have been recorded for several decades. As a result, it is probably the most accurate metric of railway safety in the EU.

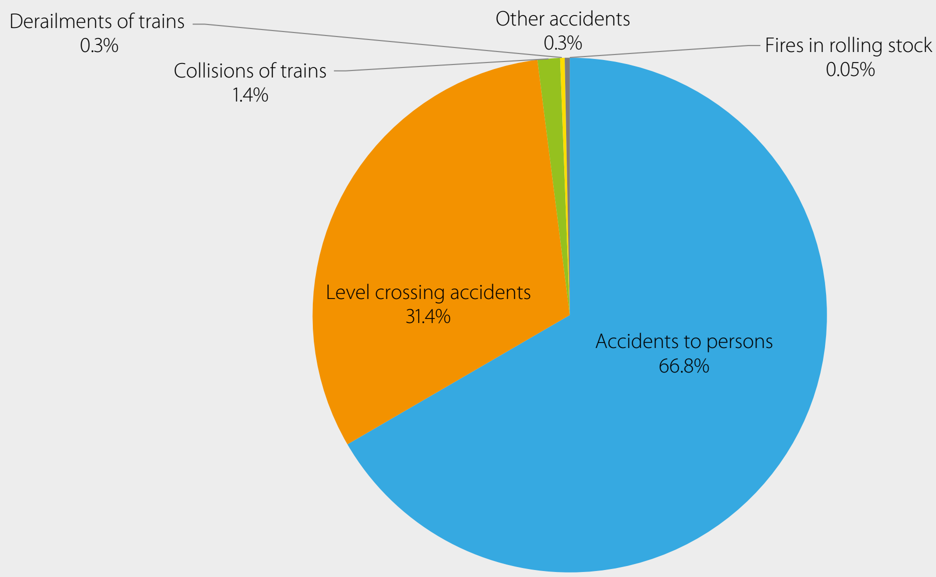
Data on seriously injured persons are slightly less reliable than statistics on deceased persons. This is because reporting practices and hospital procedures may vary in Member States and evolve over time. This has only a limited impact on the common safety target framework, in which the weight attributed to a seriously injured person is relatively low.

Figure A-19: Fatalities per victim category, excluding suicides (EU-27, 2018–2022)



Source: CSIs as reported by NSAs to the Agency.

Figure A-20: Fatalities per type of significant accident (EU-27, 2018–2022)



Source: CSIs as reported by NSAs to the Agency.

A-12 Suicides and trespasser fatalities

Purpose

'Death by railway' is a specific category of railway safety reporting, focusing on 'external' fatalities among those not intending to use or maintain the railway system. As these fatalities have serious consequences for the safety and quality of the railway system's operation, their monitoring is essential in proactive safety management.

Indicators

The indicators used are suicide (intentional) and trespasser (unintentional) fatalities on railway premises.

Findings

Suicides are reported separately from accident fatalities. They represent around 75 % of all fatalities on railways and, together with fatalities of unauthorised persons on railway premises, constitute an overwhelming 90 % of all fatalities occurring within the railway system. In 2022, on average, almost seven suicides were recorded every day on railways in the EU-27, totalling 2 399.

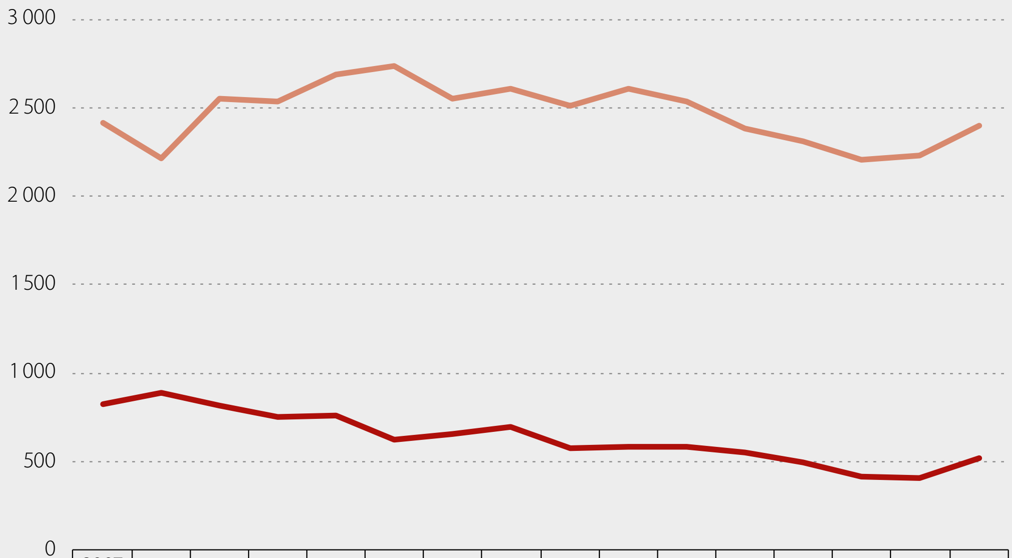
Trespasser fatalities have generally shown a decreasing trend since 2007, albeit with a recent increase in 2022. The number of suicides, however, rose following the financial crisis of 2008, peaked in 2012, then decreased before increasing again in 2021 and 2022.

Countries situated in the lower-right quadrant of Figure A-22 have relatively high third-party fatality rates, while their exposure to running trains is low (train frequency is relatively low). In many of those countries, trespassing is relatively common, and there is limited fencing around railway lines. However, other factors also play a role. Neither of the two indicators sufficiently takes into account the density of the population along the railway lines, which is another known risk factor.

Sources and limitations

Given the objective difficulties in classifying some third-party fatalities on railways and diverging national practices in their classification and reporting, suicides and trespasser fatalities are considered together when comparing countries. Two rates take into consideration potential exposure to running trains: third-party fatalities per train-km and third-party fatalities per line-km.

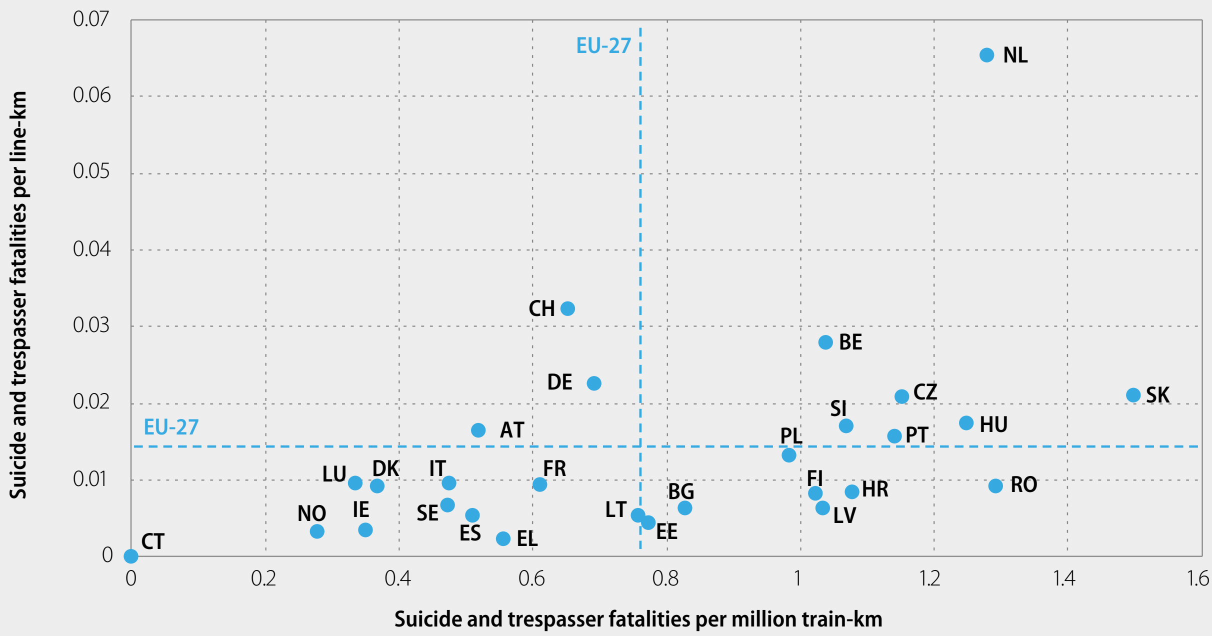
Figure A-21: Railway suicides and trespasser fatalities (EU-27, 2007–2022)



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Suicides	2 417	2 211	2 552	2 532	2 687	2 734	2 552	2 608	2 511	2 608	2 532	2 379	2 313	2 204	2 234	2 399
Trespasser fatalities	822	887	813	750	759	622	659	692	572	585	579	549	491	411	405	516

Source: CSIs as reported by NSAs to the Agency.

Figure A-22: Suicide and trespasser fatality rates (EU-27 + CH + NO, 2020–2022)



Source: CSIs as reported by NSAs to the Agency.

A-13 Railway suicides versus overall suicides

Purpose

Plotting the railway suicide rate against suicide mortality in individual countries provides an indication of whether those managing the railway system have succeeded in curbing suicides.

Indicators

The railway suicide rate (suicides per million train-km) and suicide mortality rate (suicides per 100 000 population) are used as indicators.

Findings

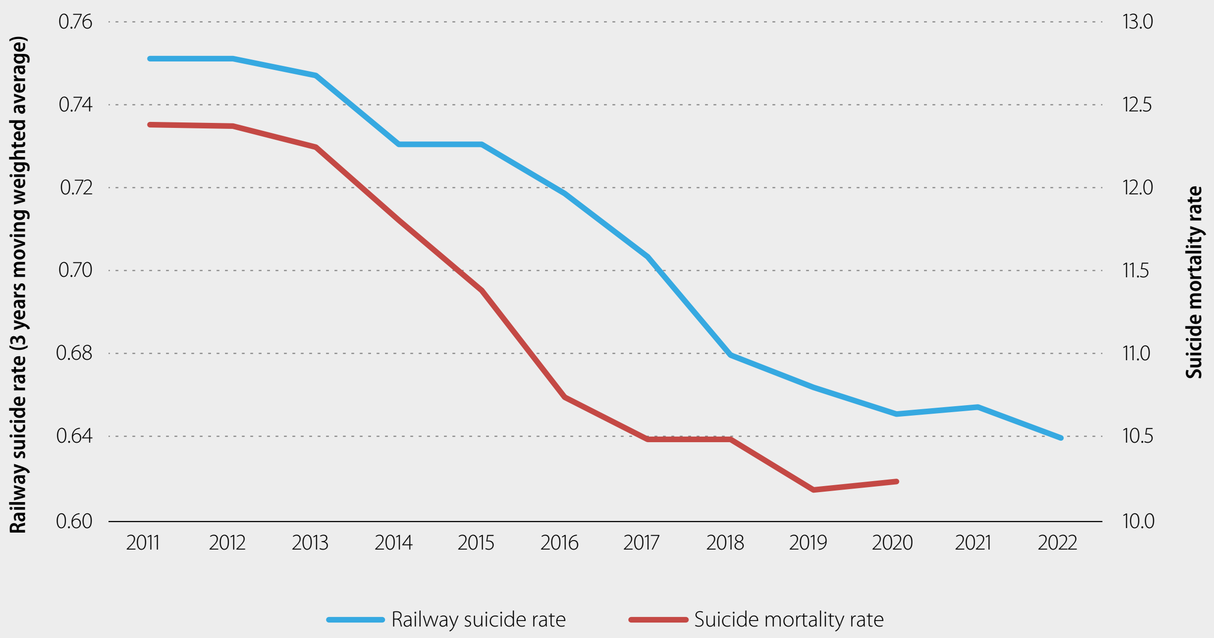
Suicides on railway premises have decreased in recent years. However, the total number of suicides in society has also decreased. Plotting trends in railway suicide rate (suicides per million train-km) alongside the suicide mortality rate (suicides per 100 000 population) reveals a strong correlation between the two indicators. This means that the decrease in railway suicides over recent years is unlikely to be associated only with measures taken within the railway system.

However, the countries with a high train frequency and a high population density along railway lines remain heavily disadvantaged in this comparison. In general, in countries below the trend line in Figure A-24, suicide fatalities occurring on railways account for a relatively high proportion of all suicides.

Sources and limitations

Railway suicide data are the result of the classification of fatalities on railways by coroners' courts, the police or other judicial bodies. This judicial classification, for example suicide or trespasser, is supplied by the NSAs to ERA. Data on suicide mortality are collected by the health authorities of Member States and provided by their statistical offices to Eurostat. There is a significant delay in data becoming available at the EU level, which means that data relating to more recent years are not yet included.

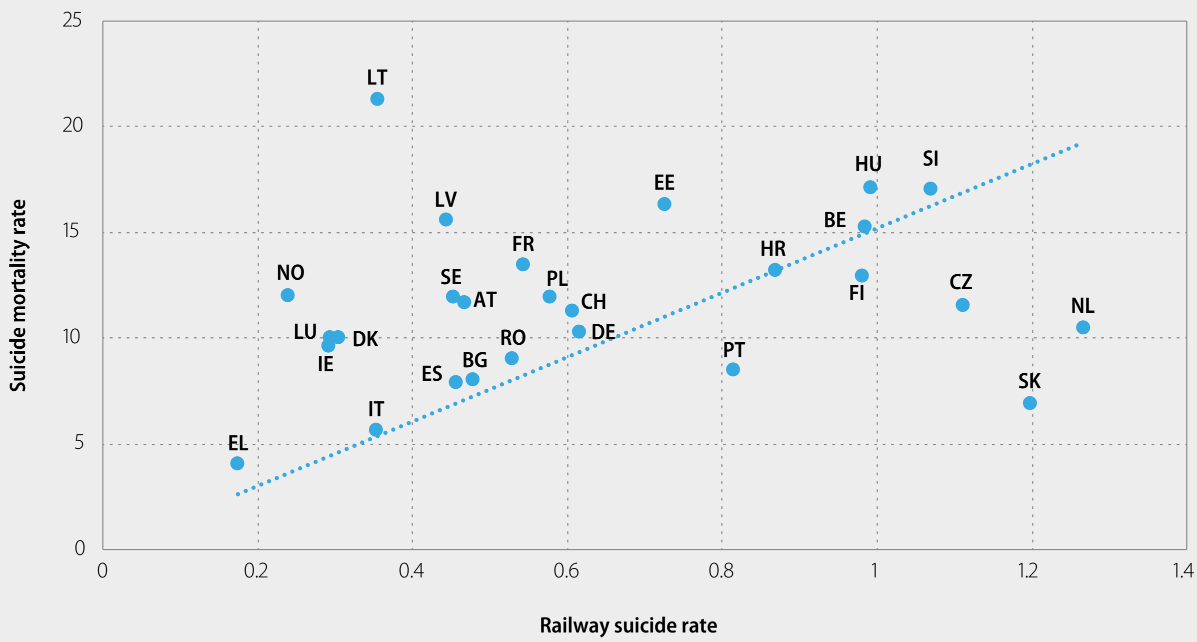
Figure A-23: Railway suicide rate (EU-27, 2011–2022) and suicide mortality rate (EU-27, 2011–2020)



Sources: Railway suicide rate – CSIs as reported by NSAs to ERA; suicide mortality rate – Eurostat (data set 'Death due to suicide, by sex' (TPS00122)).

Figure A-24: Suicide mortality rate compared with railway suicide rate (EU-27 + CH + NO)

Fatalities per 100 000 population in 2020, fatalities per million train-km 2020-2022



Source: Railway suicide rate – CSIs as reported by NSAs to ERA; suicide mortality rate – Eurostat (data set 'Death due to suicide, by sex' (TPS00122)).

A-14 Railway workers' safety

Purpose

A century ago, the majority of victims of railway accidents were railway employees. However, as a result of a continuous focus on staff safety, railway operators have succeeded in significantly reducing the number of staff casualties. Many operators have adopted a policy of zero tolerance of fatal injury in the workplace and to this end have implemented certain policies and measures. Statistics on workers' safety provide an indication of how successful railway operators are in limiting safety risks for their staff and contractors.

Indicators

The indicators used here are railway worker (employees and contractors) casualties and for comparison railway passenger and employee fatality rates (3-year moving averages).

Findings

No clear progress in reducing railway worker casualties in absolute terms has been observed in the last years. In 2022, 24 fatalities and 41 serious injuries were reported among railway workers in the EU-27.

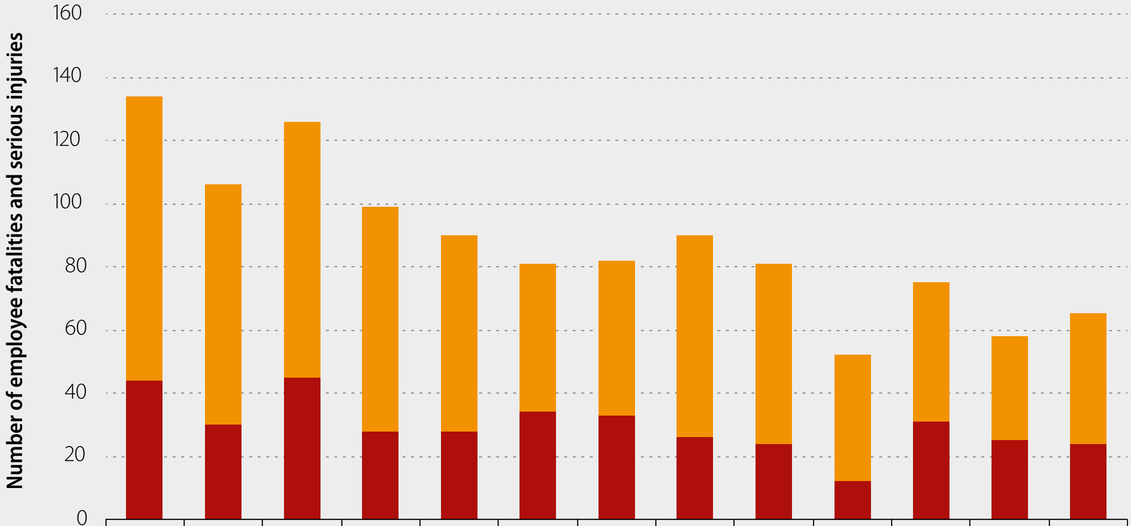
A significant decreasing trend in railway passenger fatality rate is observed until 2018; however, this has stagnated in recent years, while the employee fatality rate shows an increasing trend.

Sources and limitations

Data used to monitor progress in safety outcomes are included in the CSIs supplied by the NSAs to ERA. More than 15 years of continuous work on data quality in Member States and at the Agency provides assurance on the accuracy of the data.

Figure A-25: Railway employee casualties (EU-27, 2010–2022)

Fatalities, serious injuries

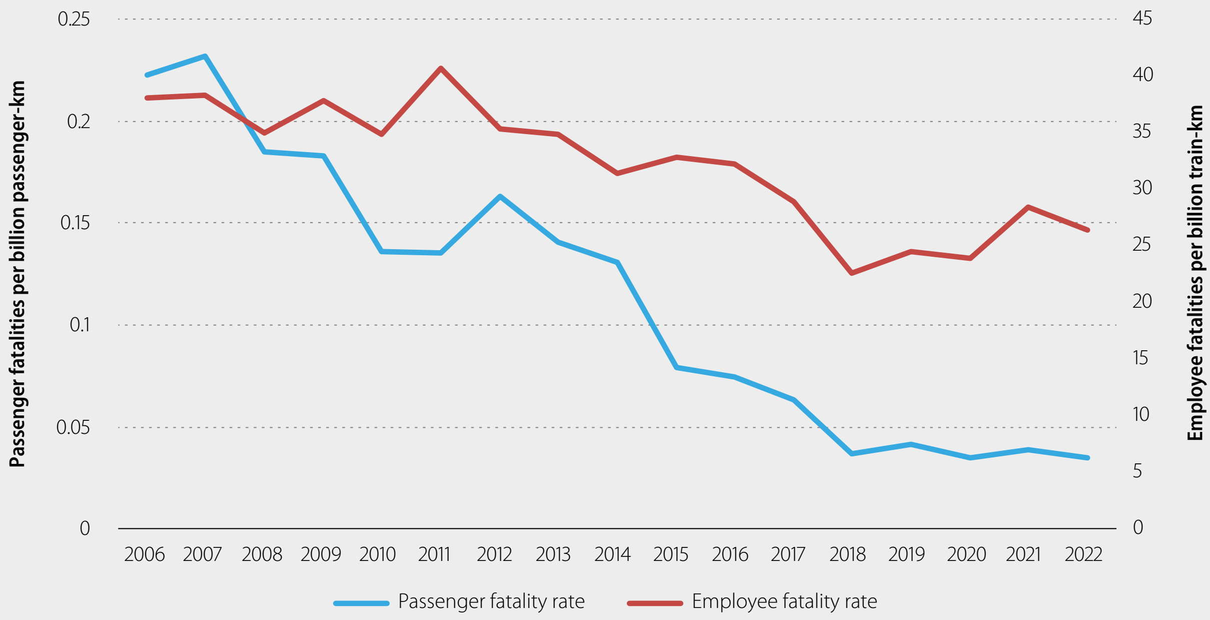


	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Seriously injured	90	76	81	71	62	47	49	64	57	40	44	33	41
Killed	44	30	45	28	28	34	33	26	24	12	31	25	24

Source: CSIs as reported by NSAs to the Agency.

Figure A-26: Railway passenger and employee fatality rates (EU-27, 2006–2022)

Passenger fatalities per billion passenger-km, employee fatalities per billion train-km, 3-year moving average



Source: CSIs as reported by NSAs to the Agency.

A-15 Level crossing safety

Purpose

Level crossing accidents represent more than one quarter of all significant accidents on EU railways. Level crossings represent not only the physical intersection of a railway track and a road but also an intersection of responsibilities and interests. The high-level monitoring of outcomes therefore provides objective evidence for efficient safety improvements.

Indicators

The indicators used are the absolute numbers of significant level crossing accidents, resulting fatalities and serious injuries, and the accident rate (significant accidents per train-km).

Findings

After an improvement in the number of level crossing accidents and related fatalities over 2010–2016, in the following years (2017–2022) a more stagnant trend was observed (despite a drop in 2020, probably linked to the COVID-19 pandemic).

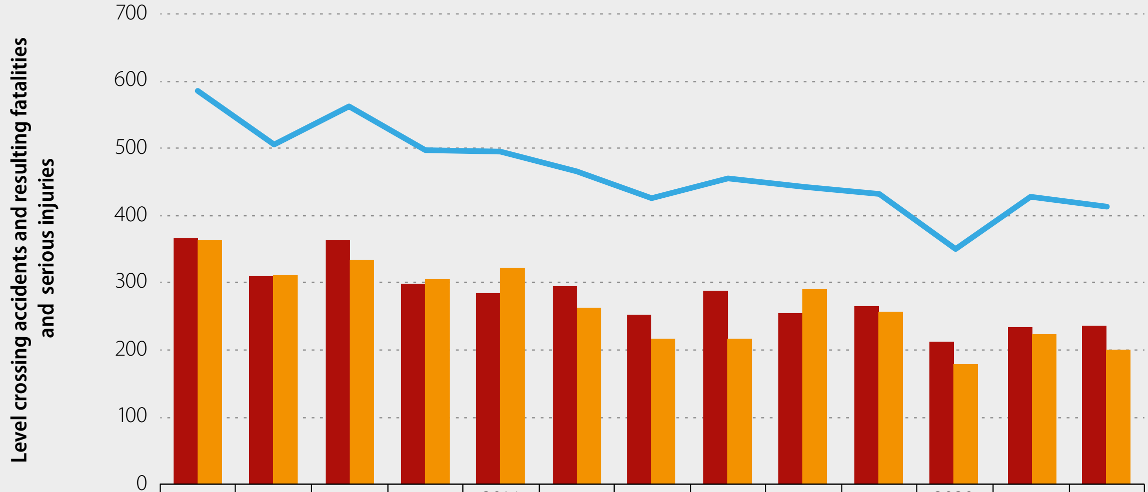
Level crossing accident rates vary considerably among Member States. The countries with the lowest accident rates have typically developed comprehensive strategies to improve the safety of level crossings, and this has translated into a small number of level crossings with poor or no protection. Common features of the countries with the highest accident rates are a low population density and low railway traffic volumes. These conditions perhaps provide less incentive for the comprehensive management of level crossing safety.

Sources and limitations

Data used to monitor progress with safety outcomes are part of CSIs supplied by the NSAs to ERA. More than 15 years of continuous work on data quality in Member States and at the Agency provides assurance on the accuracy of the data.

Figure A-27: Level crossing accidents and resulting casualties (EU-27, 2010–2022)

Significant accidents, fatalities and serious injuries

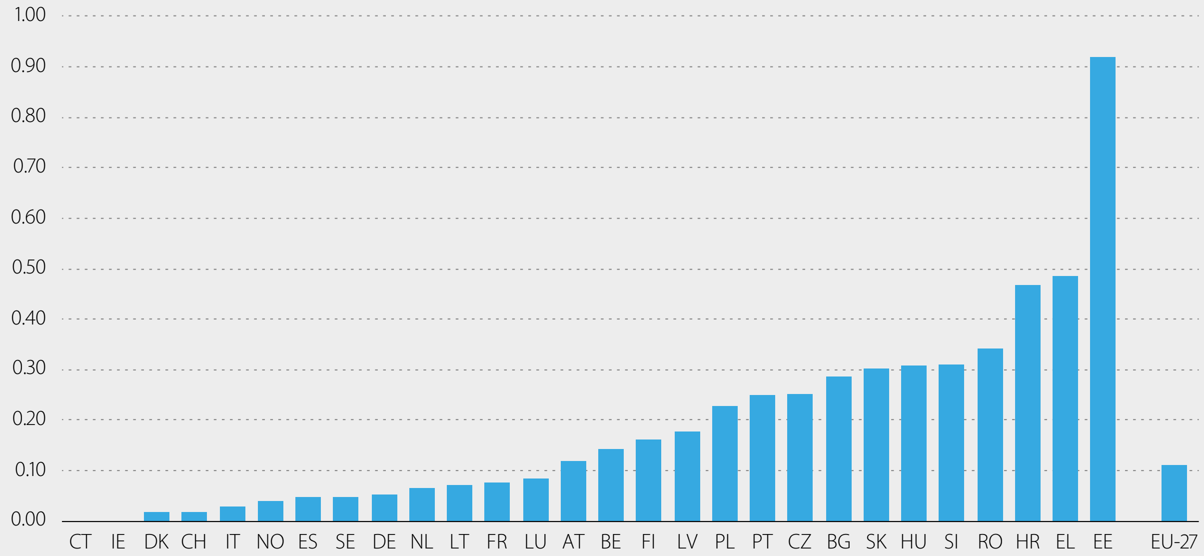


	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Fatalities	367	309	365	298	284	294	252	289	254	265	213	234	236
Serious injuries	363	311	335	305	321	263	217	217	290	257	179	224	201
Accidents	585	506	563	498	495	465	425	456	442	432	350	428	414

Source: CSIs as reported by NSAs to the Agency.

Figure A-28: Level crossing accident rates (EU-27 + CH + NO, 2020–2022)

Significant accidents at level crossings per million train-km



Source: CSIs as reported by NSAs to the Agency.

A-16 Precursors to accidents

Purpose

As accidents on railways are rare, an essential tool in a proactive safety management system is the monitoring of events that occur on railways even if they have no harmful consequences. Precursors to accidents are incidents that, under other circumstances, could have led to an accident.

Indicators

The indicators available at the EU level are broken rails, track buckles, signals passed at danger (SPADs), wrong-side signalling failures, broken wheels and broken axles. Their absolute numbers provide an initial indication of their relevance and trends.

Findings

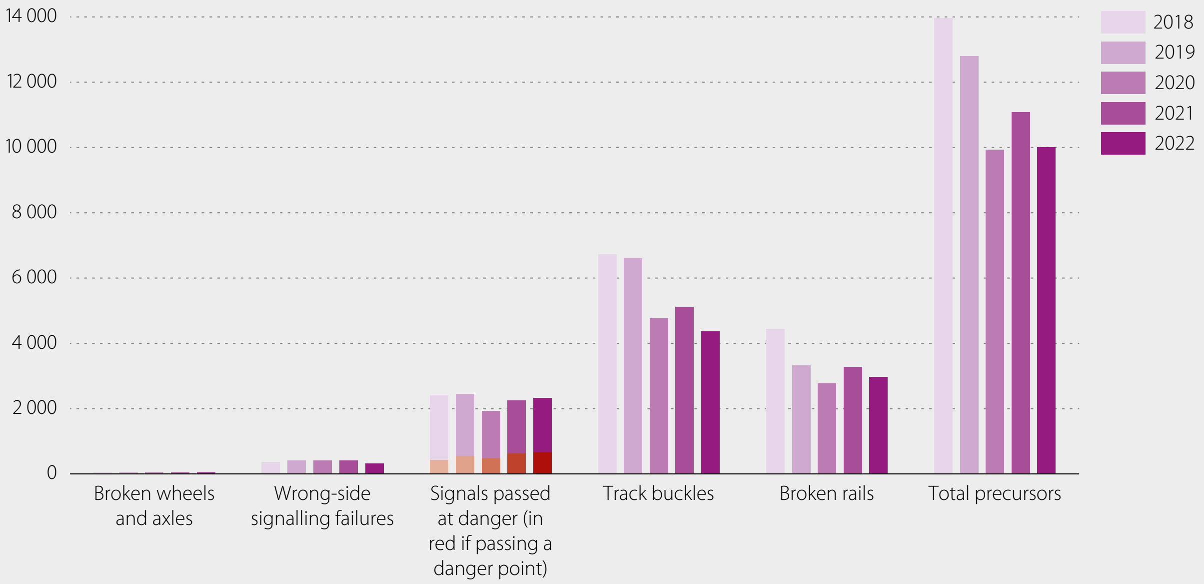
Between 2018 and 2022, Member States reported more than 11 500 precursors to accidents as defined under the CSIs on average each year. This works out as a ratio of precursors to significant accidents of almost 8:1. However, if we disregard accidents to persons caused by rolling stock in motion, the ratio of the precursors to accidents rises to 16:1. This highlights the learning potential of precursors to accidents. Among the SPAD incidents, those in which a danger point was passed represent a particularly high risk of collision. Of the 2 275 SPAD incidents on EU railways recorded on average each year during 2018–2022, fewer than one quarter were of this type. It would be interesting, in future editions of this report, to explore the possible relationship between the number of SPADs and the level of automatic train protection or ETCS implementation.

The variations in reported yearly occurrence of track buckles and broken rails do not provide a genuine picture of the situation because these are often influenced by different data collection practices and methods of reporting of these occurrences in Member States. This is further illustrated by plotting accident precursors to the accident ratio, per country. Since the availability of consistent and good-quality data is very important, further analysis and discussions are envisaged to identify possible differences and ways of harmonising the data collection and reporting among the different countries. A fast implementation of the CSM ASLP, with the associated systematic and comprehensive EU-wide safety incidents reporting scheme, would be beneficial to provide an additional angle for assessing and improving how safety is managed across Europe.

Sources and limitations

Despite gradual improvements in the quality of precursor data, they may not yet be fully comparable between Member States, and so a degree of caution should be exercised when interpreting the results. Under-reporting is not uncommon in the case of incidents in general and for certain accident precursors in particular.

Figure A-29: Precursors to accidents (EU-27, 2018–2022)



Source: CSIs as reported by NSAs to the Agency.

Figure A-30: Accident precursor to accident ratio per country (EU-27 + CH + NO, 2018–2022)

Ratios of CSI precursors to total number of CSI significant accidents

Source: CSIs as reported by NSAs to the Agency.

A-17 Accident investigations

Purpose

Independent investigations into the causes of accidents are invaluable to society. They ensure that lessons are drawn from past accidents and that action can be taken to prevent similar accidents from happening in the future. Independent accident investigation is the responsibility of each Member State, with the RSD requiring that serious accidents are investigated by an independent national investigation body (NIB).

Indicators

The indicators used are the number of accidents and incidents investigated by NIBs and their further subclassification according to mandatory requirements for investigation, accident type and availability of the final report.

Findings

Since 2006, the NIBs have opened investigations into, on average, 204 accidents and incidents per year, with final reports available in the European Railway Accident Information Links (ERAIL) database for some 93 % of these. Occurrences for which a mandatory independent investigation is legally required (by the RSD) represent 18 % of all investigated occurrences. As this proportion has been stable, it could indicate stability in NIBs' overall priorities and available budget.

NIBs have the discretion to investigate certain occurrences on top of those they must investigate. Regarding the distribution of accident types investigated and accompanied by a final report published since 2006, it appears that the NIBs are more inclined to investigate derailments and level crossing accidents (even when non-mandatory under EU legislation). Non-mandatory investigations (under the RSD) are carried out for all accident types and also for incidents (especially for SPADs). It should be noted that in some Member States, in accordance with national legislation, the investigation of derailments, SPADs and/or level crossing accidents is mandatory, regardless of the consequences of the accident.

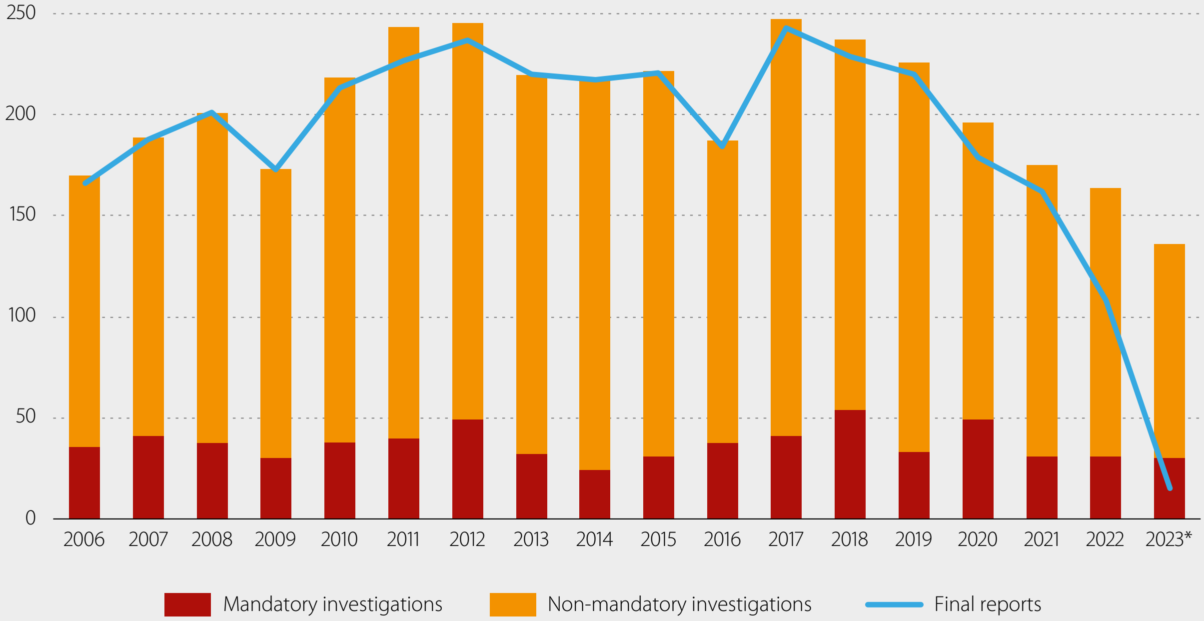
Sources and limitations

Investigations by NIBs were recorded in the ERAIL database until its disconnection at the end of 2020. Since then, an Excel database ([13]) (based on the information retrieved from ERAIL) has been updated with the information on the new investigations reported to ERA. The completeness of data depends on the inputs provided by the NIBs.

([13]) See European Union Agency for Railways, 'Accident investigation' (https://www.era.europa.eu/era-folder/accident-investigation).

Figure A-31: Accidents and incidents subject to independent investigation (EU-27 + CH + NO + UK, 2006–2023)

Mandatory and voluntary investigations by NIBs per year of occurrence

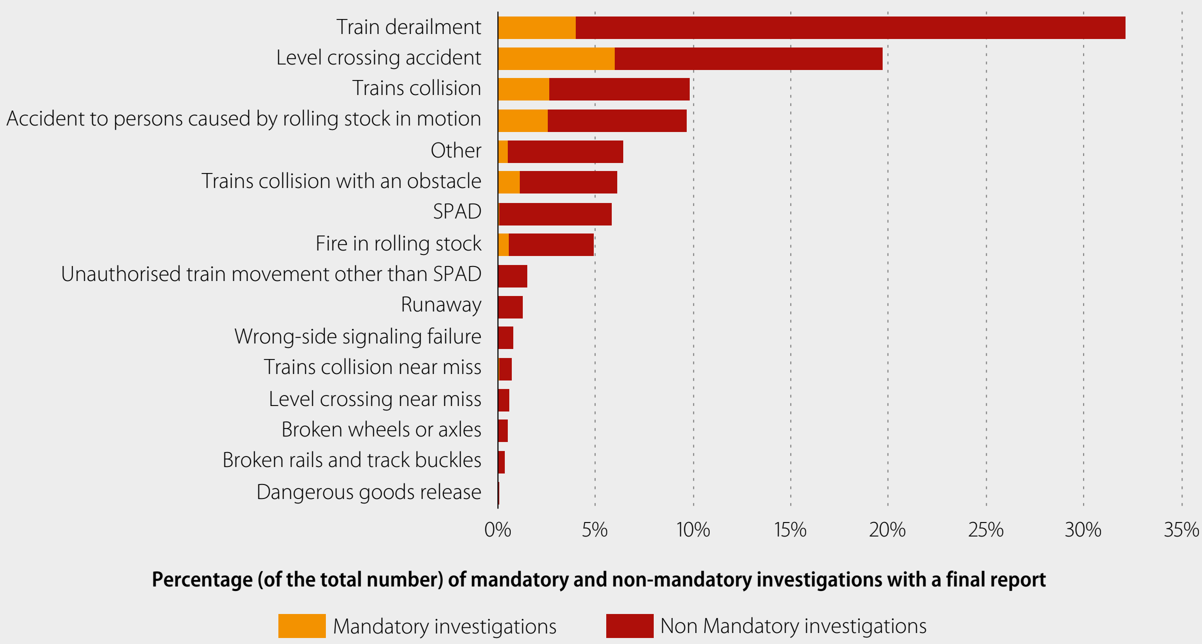


(*) Final reports are presented by year of the occurrence (not by year of publication); for example, for accidents occurring in 2023, final reports are expected to be issued within 1 year of the date of occurrence.

N.B.: Data for the United Kingdom are available until the end of 2020.

Source: Investigations by NIBs notified to ERA (ERAIL database), as of the end of 2023.

Figure A-32: Accident types of NIB-investigated accidents (EU-27 + CH + NO + UK, 2006–2023)



N.B.: Data for the United Kingdom are available until the end of 2020. 'Mandatory' refers to the obligations under the RSD, excluding national rules that can impose more restrictive investigation rules.

Source: ERAIL database; this includes data that have been provided by NIBs as of the end of 2023.

A-18 Weather-related occurrences investigated by NIBs

Purpose

Especially in recent years, there has been an increasing number of extreme weather-related events, with some having significant consequences on the railway system and the transport services. Natural disasters driven by climate change (e.g. extreme heatwaves and fires, heavy rainfall and flooding, heavy snowfall and thunderstorms) present safety hazards and test the transport system's resilience.

Indicators

Using information retrieved from final accident investigation reports sent to the Agency by the NIBs, it is possible to provide an overview of weather-related rail accidents/incidents investigated by the NIBs, classified by cause / contributing factor or by occurrence type.

Findings

In recent years, an increasing number of extreme weather-related events with significant consequences for the railway system has been recorded, and not only in Europe ([14]). Indeed, a recent survey jointly launched by the Swiss and the French NSAs, and concerning the impact of climate change on railway systems, showed that 87 % of respondents (i.e. seven EU NSAs) registered major railway-related occurrences caused by exceptional weather events in the past 5 years.

Since 2007, the Agency received 100 final accident investigation reports for occurrences caused, in whole or in part, by weather-related events (until 2023); weather conditions were indicated as direct causes in 27 cases, while they were considered as contributing factors for the other 73 occurrences.

The weather conditions most frequently directly causing the (investigated) rail occurrences are snow/ice (indicated in eight occurrences as the direct cause) and flood (indicated in five occurrences as the direct cause), followed by landslip, wind and storm. Snow/ice is also confirmed as one of the most frequent contributing factors in the weather-related occurrences investigated (14 occurrences), together with fog (14 occurrences), wind (13 occurrences) and rain (13 occurrences). From the accident investigations, train derailments and train collisions with obstacles appear to be the occurrences most frequently caused, in whole or in part, by severe weather conditions or weather-related events.

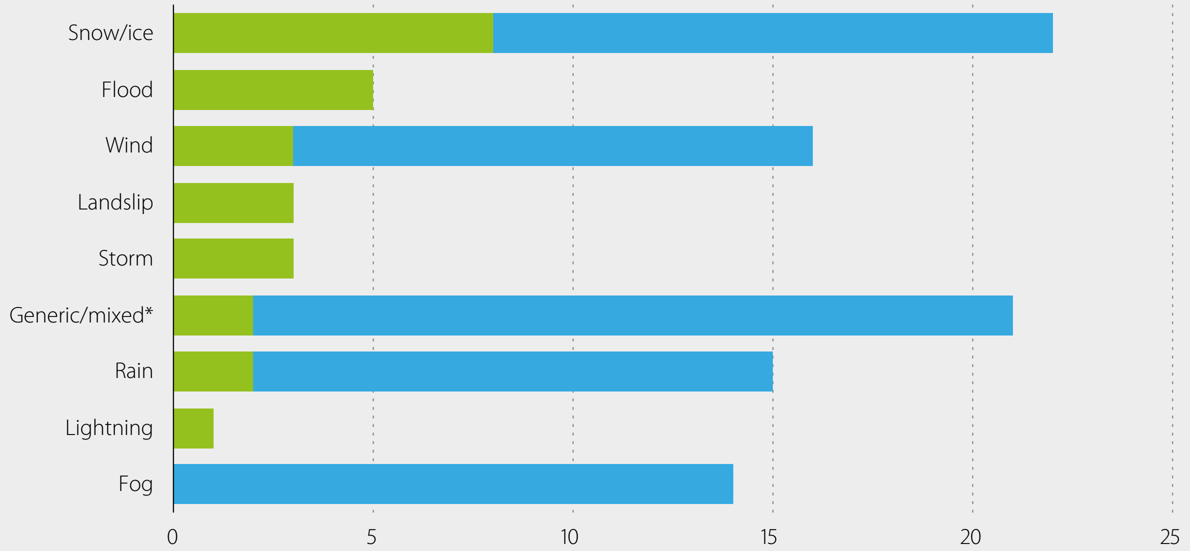
Sources and limitations

Investigations by NIBs were recorded in the ERAIL database until it was discontinued at the end of 2020; since then, an Excel database ([13]) (based on the information retrieved from ERAIL) has been updated with the information on the new investigations reported to ERA.

The analysis focuses only on weather-related accidents and incidents investigated by the NIBs, thus covering only a part of all accidents and incidents related to severe weather conditions. A fast implementation of the CSM ASLP, with the associated systematic and comprehensive EU-wide safety incidents reporting scheme, would be beneficial in further analysing possible patterns for weather-related accidents and incidents across Europe.

([14]) For example, in 2021-2023, 123 rail accidents/incidents were reported to the United States Federal Railway Administration as having been caused, in whole or in part, by severe weather conditions or weather-related events and over half of these were main-track derailments. See the related safety advisory (Federal Railroad Administration and Department of Transportation, 2023), *Safety Advisory 2023-07; Review and implement new predictive weather modeling and proactive safety processes across the national rail network to prevent weather-related accidents and incidents* (https://www.federalregister.gov/documents/2023/11/24/2023-25924/safety-advisory-2023-07-review-and-implement-new-predictive-weather-modeling-and-proactive-safety).

Figure A-33: Number of investigations on weather-related occurrences by cause / contributing factor (EU-27 + CH + NO + UK, 2007–2023)

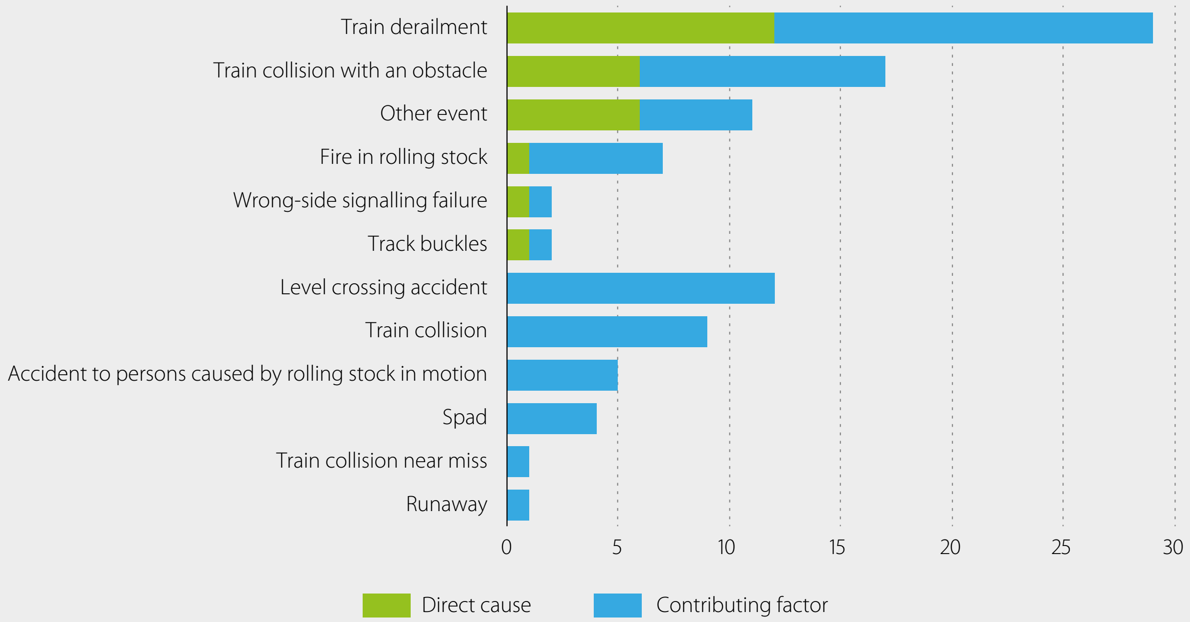


(*) 'Generic/mixed' indicates cases in which the weather event is not specified and/or there was more than one weather condition.

N.B.: Data for the United Kingdom are available until the end of 2020.

Source: Final accident investigation reports sent to the Agency by the NIBs.

Figure A-34: Number of investigations on weather-related occurrences by occurrence type (EU-27 + CH + NO + UK, 2007–2023)



N.B.: Data for the United Kingdom are available until the end of 2020.

Source: Final accident investigation reports sent to the Agency by the NIBs.

A-19 Deployment of train protection systems on railway lines

Purpose

The installation of Train Protection Systems (TPSs) is widely considered one of the most effective railway safety measures for reducing the risk of collisions between trains. The deployment of these systems on the national railway network and their use is monitored under the CSIs. Given the wide range of types and versions of TPSs in the EU, a classification focusing on three levels of assistance provided to the train driver is considered a solid basis for reporting comparable statistical data.

TPSs are non-interoperable legacy systems, also known as class B systems, with varying functions, reliability and accuracy, depending on when they were installed, while the European Rail Traffic Management System (ERTMS) is the most advanced class A system, and its installation across all core, extended core and comprehensive networks of the EU is mandated ([15]). The ERTMS is composed of train protection, radio communication and automated train operation ([16]). The ETCS is the standard European system for automatic train protection. It ensures a high level of safety, interoperability, reliability and performance. Some Member States have decided to deploy ETCS on their entire rail network, thus going beyond the EU legal requirements. In fact, several TPSs are obsolete and have low reliability, low safety levels and low performance.

Indicators

The shares of railway lines equipped with TPSs (per level of assistance) and with the ETCS are used as indicators.

Findings

Some Member States reported advanced TPS functional levels (including in some cases the ERTMS or other advanced class B systems), while a few other countries did not report the share of tracks equipped with TPSs (or reported that no tracks were equipped with TPSs). Among countries providing TPS data, Germany, Spain, Italy, Luxembourg, the Netherlands and Romania reported that more than 90 % of their networks are equipped with TPSs that provide the highest level of train protection, that is, warning, automatic stop and (discrete or continuous) supervision of train speed. However, a significant proportion of railway lines in other Member States are still not protected by TPSs.

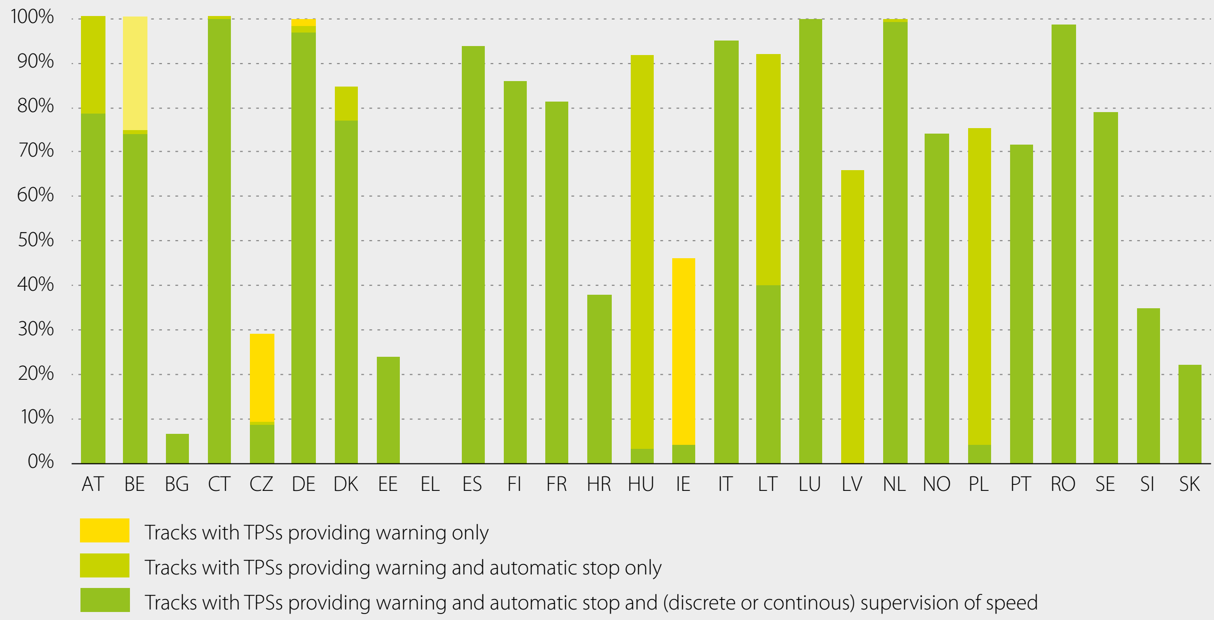
The deployment of ETCS has been limited so far; only a few countries have deployed the system on a significant share of their network. The percentage of the national network equipped with the ETCS is highest (i.e. more than 30 %) in Belgium, Luxembourg, Slovenia and Switzerland.

Sources and limitations

Although the three TPS levels have been part of CSI data collection for a long time, the levels have been redefined with a view to assuring harmonised reporting. However, not all IMs provide these data, and some may still be inaccurate. With regard to the Register of Railway Infrastructure (RINF), as these data are retrieved directly from the database, their reliability depends on the extent to which the information provided is up to date and complete. As specified in the terms of use of the RINF, ERA has no responsibility for or liability with regard to the information submitted and published in the database.

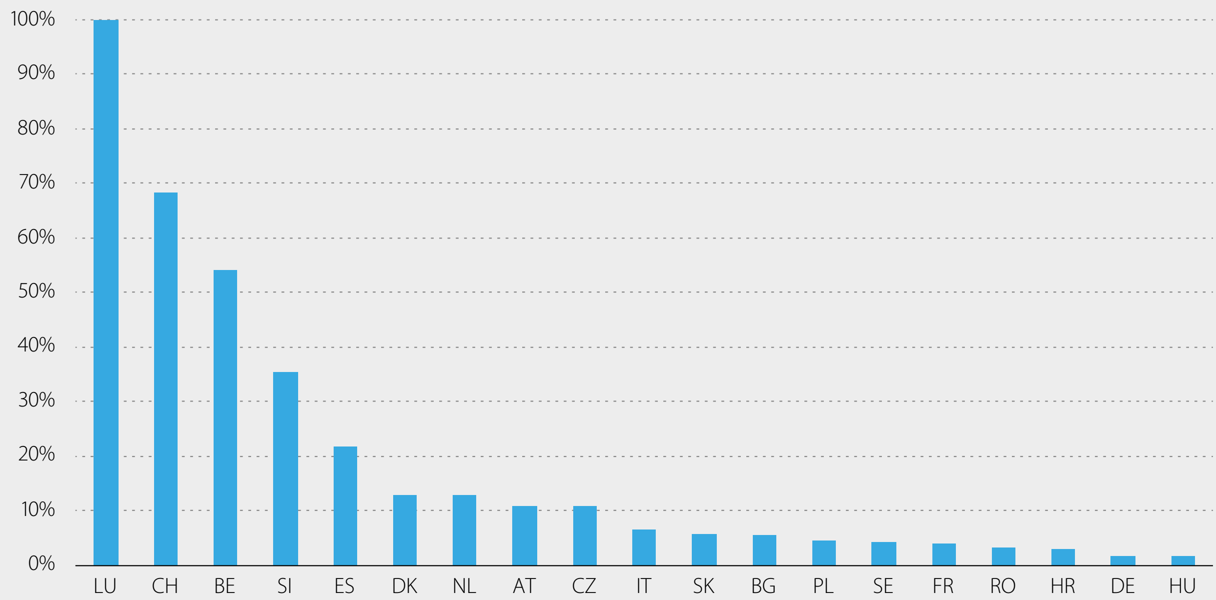
([15]) See Regulation (EU) No 1315/2013 (as amended). A revision of the trans-European transport network regulation was agreed in December 2023 and should be formally adopted and published in the first half of 2024.
([16]) See Section 2.2 of Annex I of the Control-Command Signalling Subsystem TSI 2023 (Commission Implementing Regulation (EU) 2023/1695 on the technical specification for interoperability relating to the control-command and signalling subsystems of the rail system in the European Union).

Figure A-35: Share of tracks equipped with a TPS, % (EU-27 + NO, end of 2022)



Source: CSIs as reported by NSAs to the Agency.

Figure A-36: Share of railway lines equipped with ETCS, % (EU-27 + CH, end of 2023)



Sources: ETCS data – RINF, ERTMS Deployment Management Team; total line data – RINF (end of 2023) and Eurostat (end of 2022).

A-20 Deployment of level crossing protection systems

Purpose

Level crossings are high-risk spots on the railway network, as they represent an inherent risk to the safety of both road and railway users. The installation of various protection systems has historically been a cheaper, yet less efficient, alternative to their replacement with overpasses, underpasses or bridges. However, they are still expensive to deploy across the whole railway network. Empirical data show that, although any type of protection is better than none, only manual and rail-side-protected level crossings reduce the risk of an accident towards zero.

Indicators

The indicators used are the absolute number of level crossings per type of protection, as defined in the RSD (Annex I), and the relationship between the number of accidents on passive level crossings and the number of passive level crossings per country.

Findings

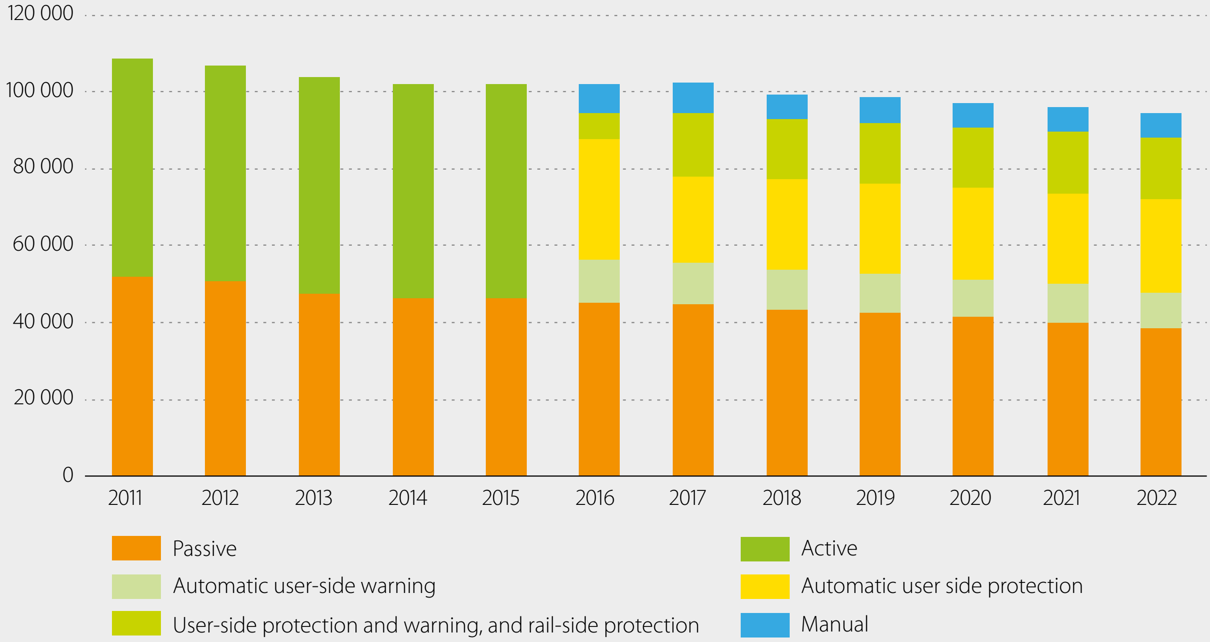
In 2022, the EU countries reported more than 94 000 level crossings. Passive level crossings account for more than 40 % of the total; these level crossings are usually equipped with a St Andrew's cross traffic sign but do not provide any active warning to road users. Level crossings with user-side protection (arm barriers and flashing lights) are the most common type of active level crossings (43 %). Level crossings that combine full road-side protection with rail protection represent around 17 % of all level crossings.

Passive level crossings and level crossings in general are being eliminated at quite a slow rate. There is a possible relationship between the average number of total and passive level crossings between 2020 and 2022 among European countries and the average number of accidents at these level crossings. In all but a few countries (e.g. France, Norway and Sweden), where further analysis is merited, a higher number of passive level crossings is associated with a higher number of accidents on these level crossings. 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. The higher level of granularity of the information in the CSM ASLP could help in further analysing possible patterns.

Sources and limitations

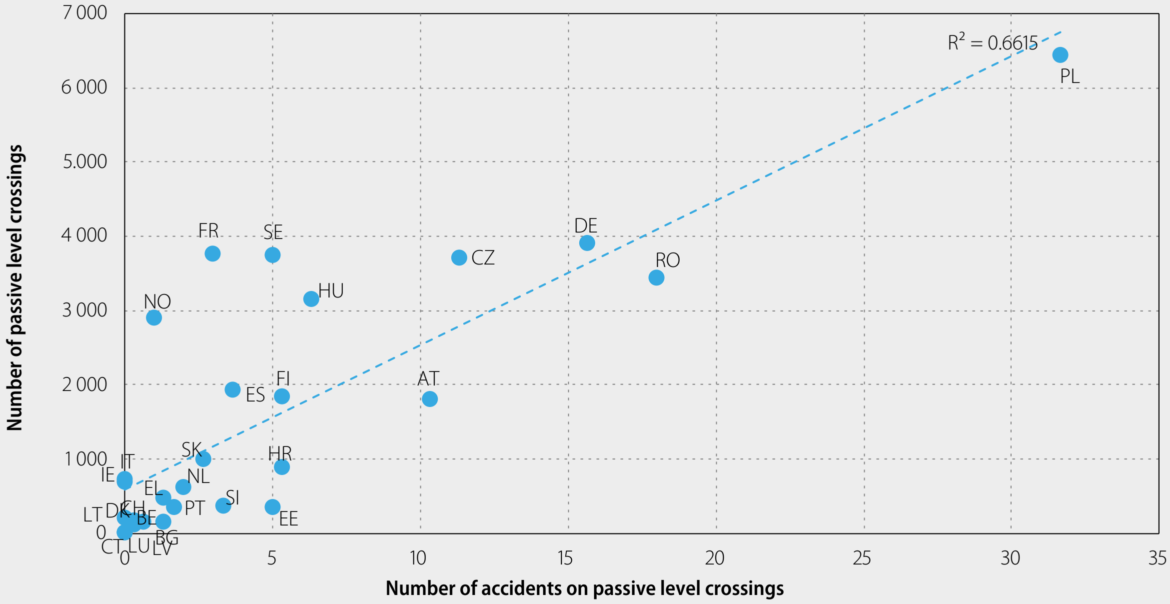
As there is no standard for level crossing protective equipment, dozens of types, with various combinations of features, exist in Europe. However, a basic classification has been agreed, featuring five main types, characterised by their main functional capacities and risk reduction potential; this classification can be seen in Figure A-37 starting in 2016.

Figure A-37: Level crossings per type of protection (EU-27, 2011–2022)



Source: CSIs as reported by NSAs to the Agency.

Figure A-38: Number of accidents on passive level crossings and number of passive level crossings per country (EU-27 + CH + NO, 2020–2022)



Source: CSIs as reported by NSAs to the Agency.

A-21 Safety certification

Purpose

Historically, until the entry into force of the fourth railway package, the safety certificate comprised a valid Part A safety certificate (certification confirming acceptance of the railway undertaking' s management system safety management system) and at least one Part B safety certificate (certification confirming acceptance of the provisions adopted by the RU to meet specific requirements necessary for the safe supply of its services on the relevant network). A single safety certificate (SSC) is now gradually replacing the old scheme, being the fourth railway package technical pillar fully applicable across the EU since the end of 2021 (excluding Norway).

Indicators

The indicators used are the number of valid Part A safety certificates and the number of SSCs per country (valid at the end of the last 4 years) and per type of service (valid at the end of 2023).

Findings

The trend over the last 4 years confirms the gradual transition from the old scheme (i.e. safety certificates, Parts A and B) to the new scheme (i.e. SSCs); since 2020, the number of Part A safety certificates decreased in all countries while the number of SSCs increased. Despite the quite significant scaling down, the number of Part A safety certificates still appears high, especially in some countries, which can be explained, in part, by the renewal of these safety certificates before the transposition of the fourth railway package into national law (which was extended in some cases, i.e. full transposition into national law in all EU countries, excluding Norway, occurred only since the end of 2021).

The figures for the EU-27, Norway and Switzerland at the end of 2023 indicate around 260 Part A safety certificates versus around 730 SSCs, with the majority of all certificates related to freight services.

Sources and limitations

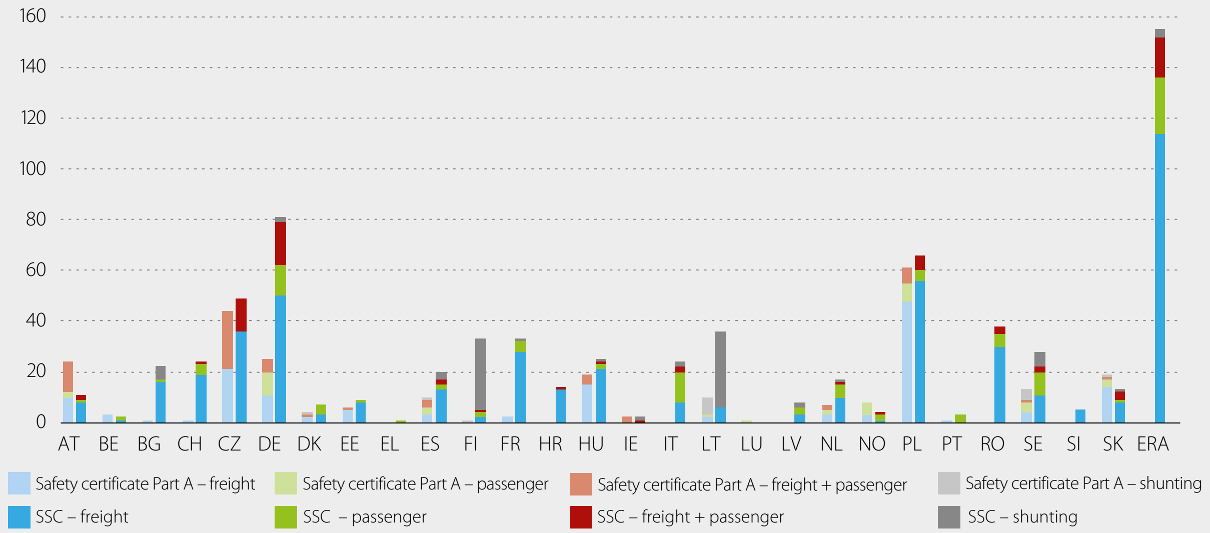
ERADIS contains data on Parts A and B safety certificates granted by NSAs and contains data on SSCs issued by NSAs or ERA. Data reliability depends on the extent to which the information provided is up to date and complete; as specified in the terms of use, ERA has no responsibility for or liability with regard to the data submitted by NSAs and published in ERADIS.

Figure A-39: Number of safety certificates (Part A) and SSCs valid at the end of 2020, 2021, 2022 and 2023 by issuing country / ERA (EU-27 + CH + NO)

N.B.: Full transposition into national law did not occur in all Member States in 2020 and 2021.

Source: ERADIS (ERA).

Figure A-40: Number of safety certificates and SSCs valid at the end of 2023 by type of service (EU-27 + CH + NO)



Source: ERADIS (ERA).

A-22 Entity in charge of maintenance certificates

Purpose

Commission Implementing Regulation (EU) 2019/779 (as amended by Commission Implementing Regulation (EU) 2020/780) lays down detailed provisions on a system of certification of entities in charge of maintenance (ECM) of vehicles pursuant to the RSD and in accordance with Annex A to the Uniform Rules concerning the Technical Admission of Railway Material used in International Traffic ([17]) (Appendix G to the Convention concerning International Carriage by Rail). Data on ECM certificates and maintenance functions certificates are reported in ERADIS.

Indicators

The indicators proposed here are the number of ECM certificates and maintenance functions certificates (including maintenance workshop certificates) per country of the certified entity and the number of ECM certificates for wagons or for vehicles other than freight wagons.

Findings

ERADIS reports 881 ECM certificates and 1 083 maintenance functions certificates (of which 619 were for maintenance workshops) valid at the end of 2023 in the EU-27, Norway and Switzerland. There is a significant variation across Member States, with the highest values reported in Germany.

All ECMs for vehicles should comply with Commission Implementing Regulation (EU) 2019/779. At the end of 2023, in ERADIS, 353 ECM certificates for vehicles other than freight wagons, 115 ECM certificates only for freight wagons and 413 ECM certificates for wagons and other vehicles were reported (for EU-27, Norway and Switzerland).

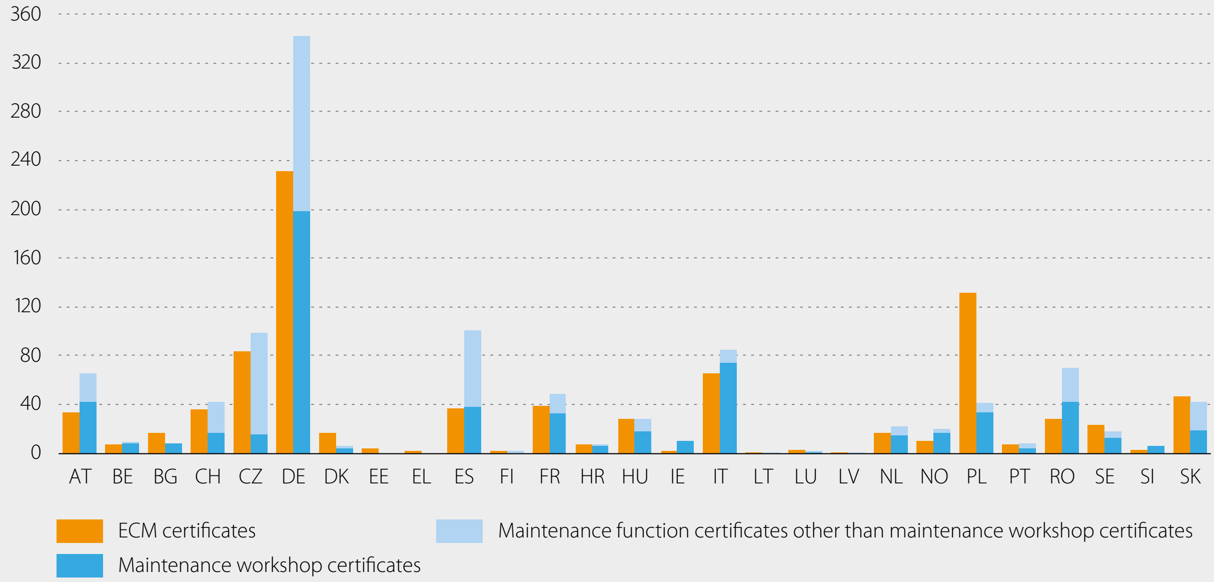
In addition, as of the end of 2023, ERADIS reported 17 NSAs acting as a certification body in their respective Member State, while 20 accredited or recognised certification bodies (in nine countries) could certify any ECM on the whole territory of the EU.

Sources and limitations

Data on ECM certificates and maintenance functions certificates are available in ERADIS, and their reliability depends on the extent to which the information provided is up to date and complete; as specified in the terms of use, ERA has no responsibility for or liability with regard to the data on ECM certificates and maintenance functions certificates submitted and published in ERADIS.

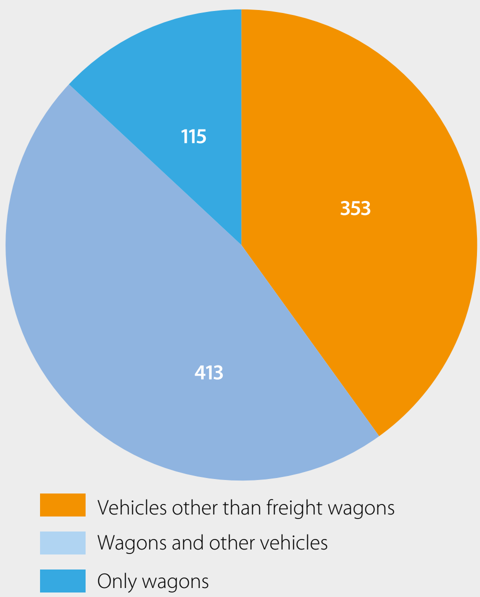
([17]) Uniform Rules concerning the Technical Admission of Railway Material used in International Traffic – ATMF (https://www.otif.org/fileadmin/user_upload/otif_verlinkte_files/06_tech_zulass/05_Reglementation_en_vigueur/ATMF-COTIF_1999_01_01_2011_e.pdf)

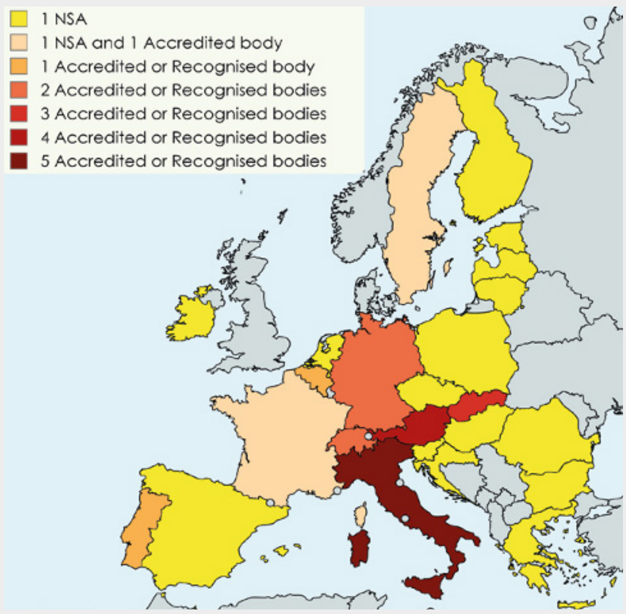
Figure A-41: Number of ECM certificates active at the end of 2023 by country of the certified entity (EU-27 + CH + NO)



Source: ERADIS.

Figure A-42: Number of ECM certificates for wagons and/or other vehicles valid at the end of 2023 in EU-27 + CH + NO (left), and number of certification bodies by type and EU country at the end of 2023 (right)





Source: ERADIS.

B. Progress with interoperability

Summary

Although the interoperability of the EU railway system is improving, progress has been slow so far, and it appears to be unequal/uneven across different areas. Solid progress has been achieved in aligning rules and procedures, whereas improvements have been slow in the area of rolling stock and infrastructure, partly owing to their long-life nature. Progress in the widespread adoption of technical standards supporting information availability and data exchange has also been delayed across the EU, often resulting in parallel developments, which in turn reduces the effectiveness of investments.

As a result of this uneven progress, EU railways have not increased their modal share in the past decade, despite being currently the most sustainable mode of transport. The relative share of people and goods transported by rail, compared with other modes of transport, appears to have stagnated at rather low levels (around 7 % and 12 %, respectively). European rail traffic has increased very little over the last decade. Rail passenger volumes increased slightly in recent years up to 2019, while freight volumes remained stable. In 2022, rail traffic recovered after the drop in 2020 due to the COVID-19 pandemic (and the related travel restrictions). International rail traffic is significant only for freight services (accounting for around 50 % of the total rail freight traffic) and appears to account for quite a small proportion of passenger services (around 6 %). These proportions are largely unchanged since 2006, suggesting that the EU is far from achieving its climate policy ambitions in this area.

The regular monitoring of rail traffic volumes, transfer times and punctuality at border sections may provide an indication of the development of rail interoperability across Europe year by year. In this report, for the second time, possible indicators are presented based on data provided by RailNetEurope (RNE), drawing on information from the RNE Train Information System (TIS). For the majority of the border sections analysed, traffic volumes remained relatively stable over 2021–2023, although there were significant increases or decreases in some operating points/areas. Rail traffic is quite significant for some cross-border sections but quite low in other areas. The average real transfer time for freight in 2021–2023 was lower or higher than the planned transfer time for most of the border sections analysed, indicating difficulty in precisely planning and in respecting timetables. Data for passenger trains show more expected/normal trends with differences between real and planned transfer times of a few minutes. Entry and exit delays at the selected border sections seem to confirm those trends. On average, transfer times were longer, and punctuality poorer, for freight trains than for passenger trains. The current data set does not cover all European cross-border points, and therefore the results cannot yet be considered representative of the overall situation in Europe; data coverage is expected to increase over time.

The degree of implementation by operators of single functions under the TSIs concerning the telematics applications for passenger services (TAP) and for freight services (TAF) varies considerably among functions, but in general implementation is progressing slowly.

The total number of national rules for vehicle authorisation (in addition to the latest TSIs in force) has decreased significantly since 2016, with some differences among countries. Although there has been an impressive decrease in the number of rules published in the past 8 years, this trend has flattened since the end of 2019. After cleaning up, a further reduction in the number of national rules is envisaged in the next revision of the TSIs.

The deployment of the ERTMS at the EU level has been slow so far and varies considerably among Member States. Progress has also been uneven among core network corridors (CNCs), with a substantially greater effort needed to meet the targets of the trans-European transport network (TEN-T) regulation.

Non-application of TSI requirements remains a common practice, as can be seen from the number of derogation requests addressed to the Commission. After a peak in 2017, the number has decreased; there is quite significant variation across Member States.

The number of train drivers licensed in line with the requirements set out in the train drivers directive (TDD) has been increasing steadily in recent years, with the implementation of the EU certification scheme complete in all Member States.

Records in ERADIS indicate a bit less than 250 Part B safety certificates compared with 635 SSCs valid at the end of 2023 with an area of operation in one Member State; the trend since 2021 confirms the gradual transition to the new scheme in all countries. In addition, the data on certificates for area of operation in multiple countries show the general decrease in RUs holding Part B safety certificates, gradually being replaced by the SSCs. It is important to highlight that these data may not be fully representative of international rail traffic because of the possible creation of subsidiaries in the different Member States where the RUs plan to operate. 15 % of the total share of safety certificates valid at the end of 2023 are managed by ERA, which could rise to at least 18 % after the end of the transition period of the fourth railway package. Around 12 % of the total safety certificates (recorded in ERADIS and valid at the end of 2023) concerned international operators (i.e. an area of operation in more than one Member State); more than 75 % of these certificates are SSCs issued by ERA, confirming the gradual transition to the new regulatory framework. Domestic operations represent most of the operations in the EU, with safety certificates that are mostly issued by NSAs and for which two thirds of companies have already migrated to an SSC. More freight services than rail passenger services are registered or operated internationally. International rail passenger services appear relatively limited.

Around 1 800 vehicle authorisations were submitted and handled by ERA in 2023, with more than 21 000 vehicles authorised; the data demonstrate an increasing trend over the past years. Around 17 % of all vehicle authorisations handled by ERA since 2019 concerned an area of use in one country and 83 % an area of use in multiple countries. The majority of authorisations in 2023 were related to wagons, followed by locomotives and train sets, while more than 1 550 authorisations (for more than 19 600 vehicles authorised) concerned an area of use in multiple countries.

The average time to obtain a vehicle authorisation in conformity to type has decreased significantly over time, fluctuating since August 2022 (and for the whole 2023) well below the target cap of 5 working days. Except for complex authorisation cases (e.g. locomotives running in several Member States, with control, command and signalling (CCS) involvement), the average duration of all vehicle authorisations has reduced.

The completeness and accuracy of data in the infrastructure register RINF represent a major challenge to the effective use of the register's data. As of the beginning of 2024, about 92 % of the Member States' railway networks has been described, while, for the technical parameters, 78 % of parameters for sections of lines (SoLs) and 83 % of parameters for operational points (OPs) were available in the RINF.

Overview of indicators and figures

Part B: Progress with interoperability

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Indicator	Figure	Indicator/Figure(s)	Category	Area
B-11		**Non-applications of technical specifications for interoperability related to rolling stock**	Outputs	Rolling stock
	B-20	Non-applications of rolling stock-related TSIs (EU-27 + UK, 2011–2023)		
	B-21	Non-applications of rolling stock-related TSIs per country (EU-27 + UK, end of 2023)		
B-12		**Applicable national technical rules for vehicles**		
	B-22	National rules for vehicle authorisation in addition to the latest TSIs (EU-27 + CH + NO, December 2023)		
	B-23	National rules for vehicle authorisation (EU-27 + CH + NO + UK, 2016–2023)		
B-13		**European Rail Traffic Managment System on-board deployment**		
	B-24	Vehicles in operation equipped with ERTMS OBUs (EU-27 + CH, end of 2022)		
	B-25	Contracted ERTMS vehicles (EU-27 + CH + NO + UK, 2010–2022)		
B-14		**Safety certificates or single safety certificates for railway undertakings with an international area of operation (part 1)**		Area of operations in more than one Member State
	B-26	Member States concerned with Part B safety certificates and SSCs for RUs operating in one Member State (EU-27 + CH + NO, end of 2021, 2022 and 2023)		
	B-27	Member States concerned with Part B safety certificates and SSCs for RUs operating in more than one Member State (EU-27 + CH + NO, end of 2021, 2022 and 2023)		
B-15		**Safety certificates or single safety certificates for railway undertakings with an international area of operation (part 2)**		
	B-28	Safety certificates and single safety certificates issued by NSAs and ERA per area of operation (EU-27 + CH + NO, end of 2023)		
	B-29	Single safety certificates issued by ERA, per type and area of operation (EU-27 + NO, end of 2021, 2022 and 2023)		
B-16		**Vehicle authorisations handled by the European Union Agency for Railways per area of use and type of vehicle**		Area of use in more than one Member State
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B-18		**Register of Railway Infrastructure completeness**	Inputs	Enablers
	B-33	RINF network description completeness (EU-27, 10 January 2024)		
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B-19		**European Train Control System trackside costs**		
	B-35	Average capital expenditure per ETCS level 1-equipped line-km (EU-27, 2014–2018)		
	B-36	Average capital expenditure per ETCS level 2-equipped line-km (EU-27, 2014–2018)		
B-20		**European Train Control System on-board costs**		
	B-37	Average capital expenditure per ETCS level 1-equipped vehicle (EU-27, 2014–2017)		
	B-38	Average capital expenditure per ETCS level 2-equipped vehicle (EU-27, 2014–2017)		
B-21		**Time to obtain vehicle authorisation**		
	B-39	Time frame to obtain a vehicle authorisation in conformity to type (2019–2023)		
B-22		**European Rail Traffic Management System trackside approvals**		

B-1 Rail transport figures

Purpose

Rail transport is increasingly considered one of the key elements of a more sustainable European mobility strategy owing to its strategic value, high level of safety, high transport volumes and relatively low externalities. EU policy contains explicit goals to increase the share of rail transport and provide public support to reach these goals; this justifies the close monitoring of developments in rail transport.

The relative share of people and goods transported by railways, compared with all other modes of transport, reflects the competitive position of rail transport in terms of its efficiency and performance. Seamless, timely operation is one of the inherent advantages of rail transport and one of the key performance parameters and is further enhanced by an interoperable railway system, which aims to facilitate cross-border and international traffic. Therefore, the modal share of transport and the percentage of international rail traffic across Europe are considered indirect measures of the impact of railway interoperability on actual transport performance.

Indicators

The modal split is calculated on the basis of the transport performance, measured in passenger-km and tonne-km, of five transport modes: road, rail, inland waterways, air and maritime. It is presented alongside the absolute rail transport volumes (both domestic and international), providing background information on the underlying trends.

Findings

European rail traffic has increased very little over the last decade. Rail passenger volumes increased slightly in recent years up to 2019, while freight volumes remained stable. In 2022, rail traffic recovered after the drop in 2020 due to the COVID-19 pandemic (and the related travel restrictions).

The passenger-km in EU-27 increased by around 50 % in 2022 compared with 2021 (although remaining below the pre-COVID-19 levels), while the freight tonne-km transported remained relatively stable.

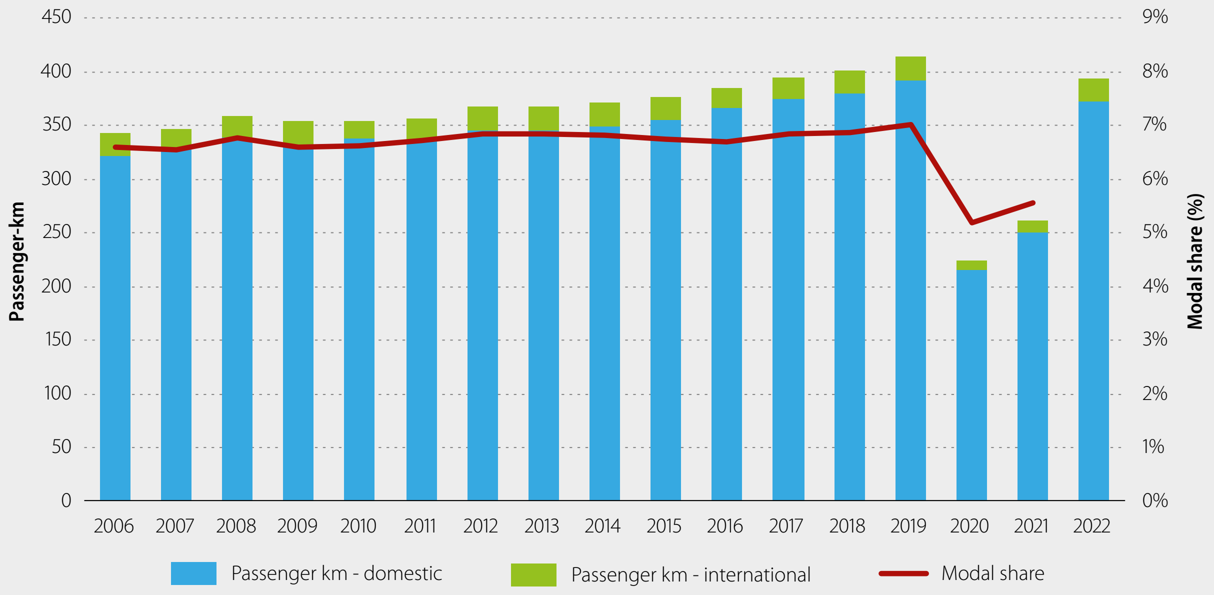
The relative share of people and goods transported by railways, compared with other modes of transport, appears to have stagnated at rather low levels (i.e. around 7 % and 12 %, respectively). International rail traffic is significant only for freight services (accounting for around 50 % of total rail freight traffic) and appears to account for quite a small proportion of passenger services (around 6 %). These figures have been largely stable since 2006.

Sources and limitations

The data on rail traffic have traditionally been compiled by Eurostat, relying on inputs from national statistical offices. Eurostat has notably developed and applied methodologies allowing the territorialisation of the transport flows at the Member State level and to avoid double counting transport flows on single territories (e.g. in the case of road transport). The quality of these administrative data could be considered high, as the data collection and data production practices are well established. Figures on the modal share are retrieved from the *Statistical Pocketbook 2023* (published by the Directorate-General for Mobility and Transport).

Figure B-1: Rail transport figures (passengers, EU-27, 2006–2022)

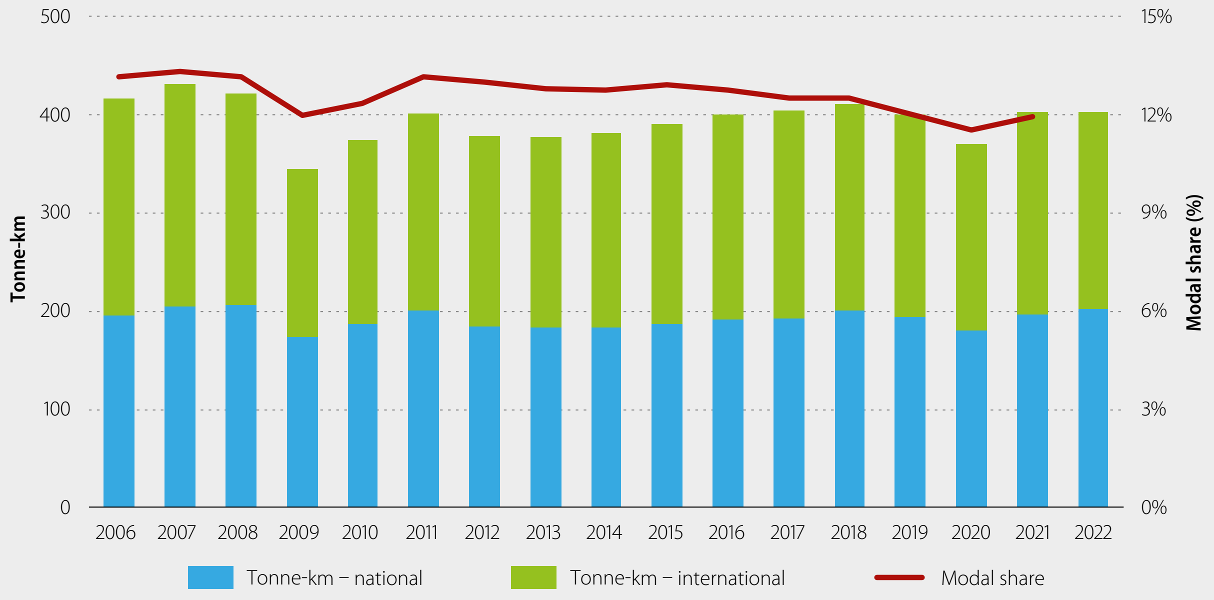
Passenger-km (billions) for domestic and international traffic and modal share (%)



Source: Estimations based on Eurostat tables 'rail_pa_total', 'rail_pa_quartal' and 'rail_pa_typepas', *Statistical Pocketbook 2023* (Directorate-General for Mobility and Transport).

Figure B-2: Rail transport figures (freight, EU-27, 2006–2022)

Tonne-km (billions) for domestic and international traffic and modal share (%)



Sources: Estimations based on Eurostat tables 'rail_go_total', 'rail_go_quartal' and 'rail_go_typepas', *Statistical Pocketbook 2023* (Directorate-General for Mobility and Transport).

B-2 Number of international passenger/freight trains at selected border stations

Purpose

As mentioned in the previous section on transport figures, the volume of international rail traffic across Europe can be considered an indirect measure of the impact of railway interoperability on actual transport performance. Therefore, the purpose of this indicator is to monitor traffic volumes in terms of international passenger/freight trains at selected border stations, as an outcome of the interoperability of the European railway system.

Indicators

The metric used is the number of passenger and freight trains crossing selected sections of borders, collected by RNE automatically from the Train Information System (TIS), based on the results of the RNE border section project. These data refer to the total annual number of trains over 2021–2023. For some borders, only freight data or only passenger data are provided; this does not necessarily mean that the related line is dedicated to one type of traffic (i.e. data for the other types of traffic could be incomplete owing to operational restrictions or data quality problems).

Findings

As shown in Figure B-3, the border sections considered in the analysis are not geographically distributed along all national borders of the Member States. For this reason, the results presented in this section and in the following sections should not be considered representative of the overall picture in Europe.

Traffic across the selected border sections in 2021–2023 varied from less than 1 to more than 70 freight trains per day and from 1 to more than 180 passenger trains per day; crossing volumes are significant for some sections but quite limited in other areas. As shown in Figure B-4, the volumes of traffic for the majority of cross-border sections remained relatively stable over the 3 years, albeit with significant increases or decreases in some points/areas. The total number of freight trains for all the sections analysed decreased by around 6 % from 2021 and 2023, while the number of passenger trains increased by around 17 % in the same period (mainly for a significant increase in some cross-border points).

The variance in traffic volumes across the selected border sections may reflect not only possible limitations to interoperability but also different demand levels, capacity and/or operational planning.

Sources and limitations

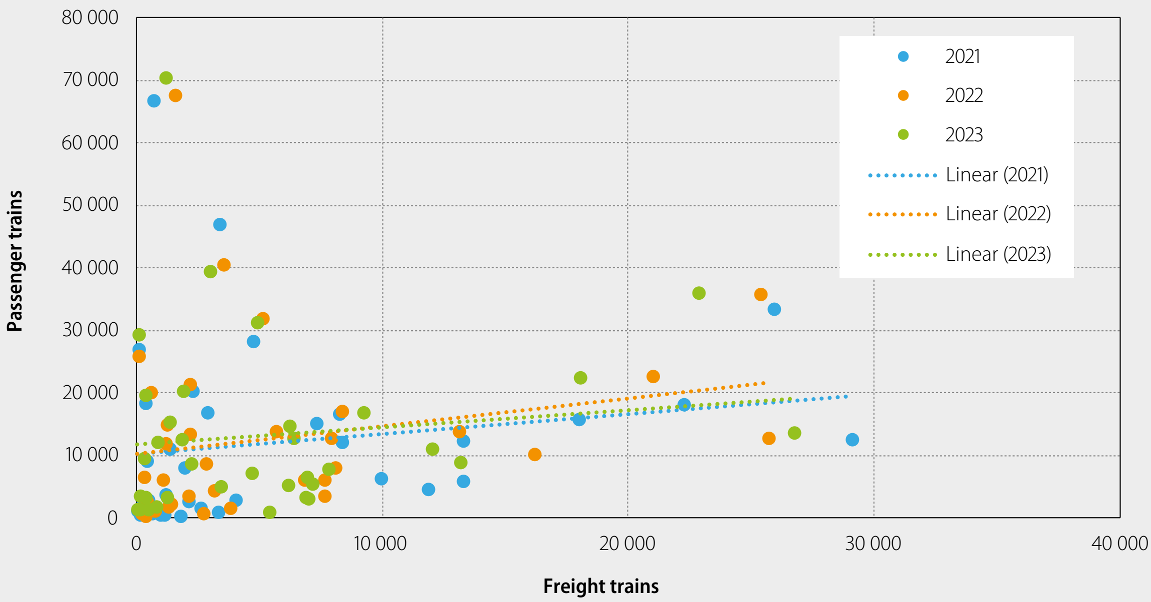
Data are collected by RNE automatically from the TIS, following the results of the RNE border section project. The border sections vary in length from 10 to 30 km, covering both sides of the geographical border between two Member States and all major points where procedures related to border crossing normally occur. A sample of the 250 border crossing points analysed for the SERA network (i.e. around 50 border crossing points with the best data quality) was used to obtain the figures provided. Detailed reliability checks were carried out by RNE with experts from its member IMs to provide the best sample of data. The number of borders considered is expected to increase in the coming years (thanks to ongoing initiatives by RNE to improve data quality). The current data set does not cover all European border crossing points, and therefore the results should not be considered a picture of the overall situation in Europe; however, data coverage is expected to increase in the coming years.

International trains may have two unlinked train numbers (i.e. an international train may have a different national train number on each IM network section). If the two numbers are unlinked, both are counted in this indicator (i.e. there is potential error due to double counting). In the future, improvements in linking train numbers (e.g. through the full implementation of the TAF TSIs train ID concept and/or based on the train composition message) could lead to a decrease in the number of international passenger/freight trains at selected border stations (such a reduction in traffic volumes may be driven by improved data quality and eliminating double counting, and not by an actual decrease in rail traffic).

Figure B-3: Border crossing points included in the analysed data set (location and border ID)

Source: RNE TIS.

Figure B-4: Number of (freight and passenger) trains crossing the selected border sections (2021–2023)



N.B.: For some borders, incorrect or missing data may influence the figures; only a limited sample of trains (compared with all trains crossing the border) was considered for the calculations.

Source: RNE TIS.

B-3 Transfer time of international trains at selected border sections

Purpose

Seamless train operation across national borders is one of the main goals of an interoperable railway system. The regular monitoring of transfer time at border sections may provide an indication of the development of rail interoperability across Europe year on year. Border section transfer time is considered a suitable (dwell time-related) indicator for policy advice. However, long transfer/dwell times are possible for several reasons, including change of locomotive, change of crew, operational choices of RUs, lack of availability of immediate train paths on following infrastructure, capacity constraints, engineering works and the administrative burden of train handover or checks at borders (breaking tests, national rules, customs, etc.).

Indicators

The metrics proposed focus on the variance in planned and real transfer times (including running and dwell times) at selected border sections (measured in minutes), calculated using data from the RNE TIS, following the results of the RNE border section project. The data presented are calculated as averages weighted on the yearly number of trains at each location. The section transfer time represents a compatible measurement for all borders with a focus on the total time that a train spends in the border section area. The main focus of the analysis is on the difference between planned transfer time and real transfer time in order to identify the operational obstacles causing transfer times that are longer than planned.

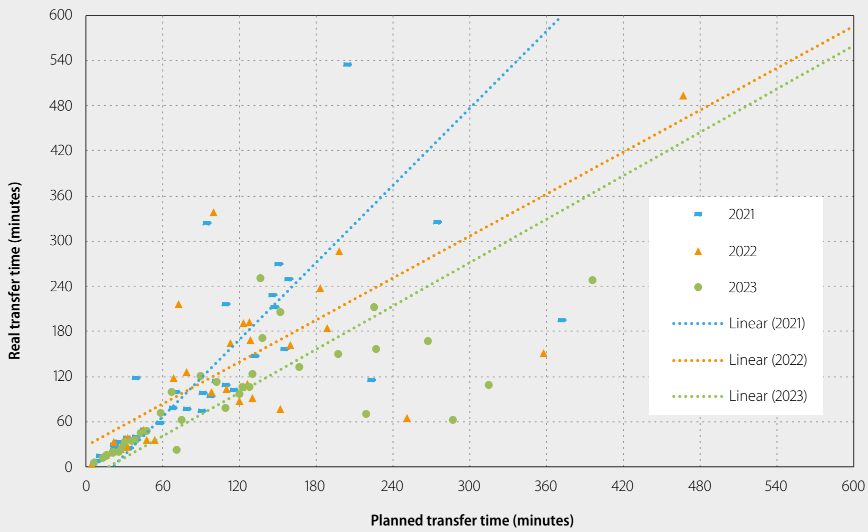
Findings

As indicated in Figure B-5, for the majority of the border sections analysed the average real transfer time for freight in 2021–2023 was lower or higher than the planned transfer time, indicating somehow a difficulty in precisely planning and in respecting the timetable. In many border areas the planned transfer time (on average in 2023) was more than 30 minutes (and up to more than 200 minutes) longer than the real transfer time, while, in other cross-border sections, delays of more than 30 minutes were registered on an annual average. Data for passenger trains show more expected/normal trends; the differences between real and planned transfer times (on average over 2023) is within the range ± 6 minutes. For almost the totality of border sections crossed by both freight and passenger trains, the transfer time for freight is (significantly) higher than the transfer time for passengers. Benchmarking the difference in transfer time across the border points should not be the focus of the analysis, as the underlying causes of extended running and dwell times are not directly available and may not reflect the limitations on interoperability stemming from the physical or regulatory constraints. Anyway, it should be noted that for freight trains the average transfer time for more than half of the cross-border sections analysed in 2023 was longer than 1 hour, while for passenger trains there are various sections with transfer times between 30 minutes and more than 1 hour. The different border sections may have high or low transfer times depending on the sections' length, type of traffic, geography and infrastructure design, among other things, as well as, for example, possible necessary changes to technical systems (e.g. locomotive and/or crew). In addition to technical conditions, commercial aspects can influence transfer time. In some instances, the constraints would reflect operations planning and notably capacity restrictions. For these reasons, the indicator can be only a proxy measure of interoperability.

Sources and limitations

Data are calculated by RNE based on data from the RNE TIS and following the results of the RNE border section project. The border sections vary in length from 10 to 30 km, covering both sides of the geographical border and all major points where procedures related to border crossing normally occur. A sample of the 250 border crossing points analysed for the SERA network (i.e. around 50 border crossing points with the best data quality) was used to obtain the figures provided. Detailed reliability checks were carried out by RNE with experts from its member IMs to provide the best sample of data for as many borders as possible. The current data set does not cover all European border crossing points and therefore the results should not be considered a picture of the overall situation in Europe; data coverage is expected to increase over time. To evaluate the planned and real times, only cross-border trains with the same train number on both sides of the border or trains with linked numbers were considered; given the possible cases of unlinked trains, the actual traffic volumes at the borders may be slightly higher than the volumes considered.

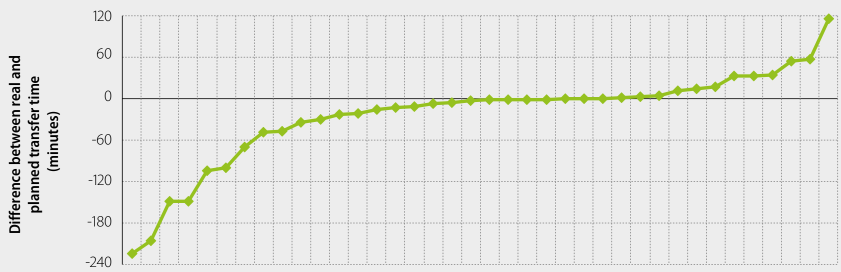
Figure B-5: Planned and real transfer times at selected border sections (international freight trains, 2021–2023)



N.B.: For some borders, incorrect or missing data may influence the figures; only a limited sample of trains (compared with all trains crossing the border) was considered for the calculations.

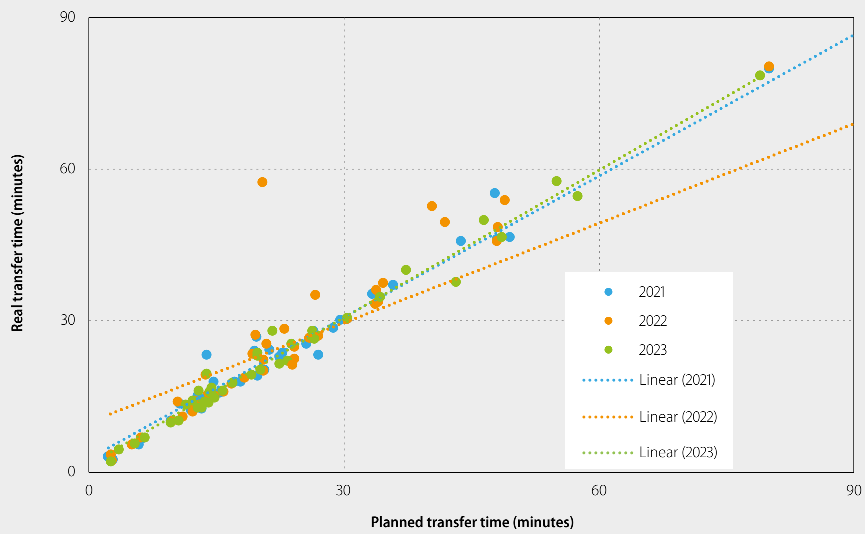
Source: RNE TIS.

Figure B-6: Difference between real and planned transfer times at selected border sections (international freight trains, 2021–2023)



Source: RNE TIS.

Figure B-7: Planned and real transfer times at selected border sections (international passenger trains, 2021–2023)



N.B.: For some borders, incorrect or missing data may influence the figures; only a limited sample of trains (compared with all trains crossing the border) was considered for the calculations.

Source: RNE TIS.

B-4 Punctuality of international trains at selected border crossing points

Purpose

Monitoring the performance of cross-border trains in terms of punctuality may provide a further indication of the quality/constraints of train operations across national borders. The difference between entry and exit delay at the selected border sections may help to identify possible delays accumulated during rail operations in the section areas considered.

Indicators

The metrics proposed focus on the difference between the entry and exit delay at selected border sections, as defined for policy advice within the RNE border section project. The figures are calculated as averages (over 2021–2023) weighted on the yearly number of trains considered at each location. Given that in some cases trains may change number once they cross borders and therefore may not be captured in the available data set (i.e. unlinked numbers), the real traffic volumes at the borders could be higher than the figures considered.

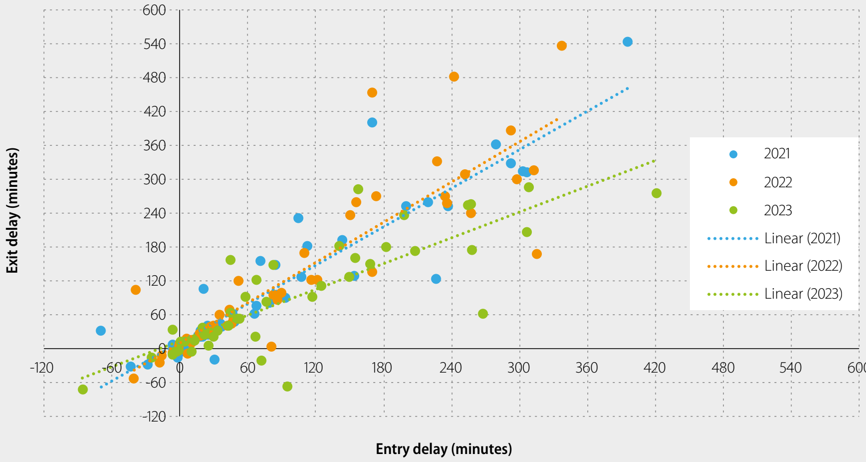
Findings

Data for freight seem to confirm that, when crossing some border sections, on average trains may face either an additional delay or a recovery of the initial entry delay. The difference between exit and entry delay can vary from quite low to quite high values; in various border areas (on average over 2023) a recovery of more than 60 minutes (and up to more than 200 minutes) was registered, while in other cross-border sections delays of more than 30 minutes (up to 2 hours) were registered on an annual average. In more than half of the sections analysed the average exit delay for freight trains (over 2023) appears to be quite significant (> 30 minutes) and in general longer than the delays for passengers. Indeed, the differences between exit and entry delay (on average over 2023) for passenger trains is around ± 6/7 minutes, even if there are many border sections with final exit delays of more than 10 minutes.

Sources and limitations

Data are calculated by RNE based on data in the RNE TIS and following the results of the RNE Border section project. The border sections areas vary in length from 10 to 30 km, covering both sides of the border and all major points where procedures related to border crossing normally occur. Only a sample of the 250 border crossing points analysed for the SERA network (i.e. around 50 border crossing points with the best data quality) was used to obtain the figures provided. Detailed reliability checks were carried out by RNE with experts from its member IMs to provide the best sample of data for as many borders as possible. The current data set does not cover all European border crossing points and therefore the results should not be considered a picture of the overall situation in Europe. The number of borders considered and the data coverage are expected to increase over time (because of ongoing initiatives by RNE to improve data quality).

Figure B-8: Entry and exit delays at selected border sections (international freight trains, 2021–2023)



N.B.: For some borders, incorrect or missing data may influence the figures; only a limited sample of trains (compared with all trains crossing the border) was considered for the calculation.

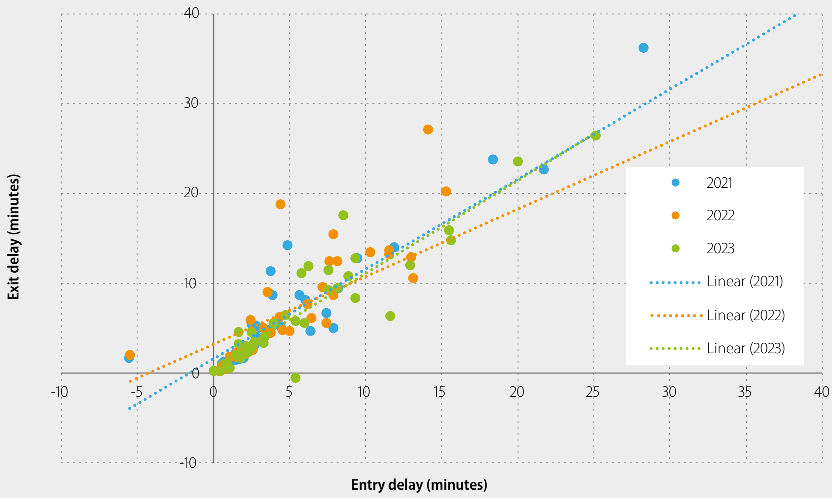
Source: RNE TIS.

Figure B-9: Difference between exit and entry delay at selected border sections (international freight trains, 2021–2023)

N.B.: For some borders, incorrect or missing data may influence the figures; only a limited sample of trains (compared with all trains crossing the border) was considered for the calculation.

Source: RNE TIS.

Figure B-10: Entry and exit delays at selected border sections (international passenger trains, 2021–2023)



N.B.: For some borders, incorrect or missing data may influence the figures; only a limited sample of trains (compared with all trains crossing the border) was considered for the calculation.

Source: RNE TIS.

B-5 Implementation of technical specifications for interoperability concerning telematics applications for passenger services

Purpose

Telematics applications for passenger services (TAP) TSIs were introduced to allow the harmonisation/standardisation of procedures, data and messages to be exchanged between the computer systems of multiple railway companies and of independent ticket vendors in order to provide reliable information to passengers and to issue tickets for journeys across the EU railway network. Furthermore, the data exchange between the RUs and IMs is standardised to make information to passengers on connections, delays, transport of passengers with reduced mobility, disruptions, etc., more accurate, supporting the requirements on passenger information in the rail passengers' rights regulation (Regulation (EU) 2021/782).

The implementation of TAP by RUs and IMs has been under way in the EU. The railway operators have been gradually integrating TAP standards into their IT systems. In a first step, the governance functions were set up by a European entity, the TAP TSI Services Governance Association (TSGA), and have been available since 2019. This entity provides central services for the European RUs. The RUs have implemented specific functions for retail and for communication between them and the IMs.

Indicators

The indicator used to monitor the progress on the implementation of TAP TSI-specific functions by the railway sector is the market share of IMs (weighted by line-km on a European scale) and RUs (weighted by the estimated passenger-km on a European scale) that have implemented a certain TAP function in their IT systems. For each 2-year period the most recent response of an operator is used if two responses were given. The figure gives insights into the degree of implementation and the market share that the responses represent, and thus the knowledge gap that remains. The target for the indicator is to have 100 % of the individual functions implemented (including existing, updated or new IT systems, as this TSI is a functional one), as communicated in the European TAP TSI master plan. A revision of the TAP TSI is now under way.

Findings

The degree of implementation of single functions by operators varies considerably among functions and it is progressing slowly, however it is starting to take off. In 2022–2023, the majority of the functions (i.e. all except one) had been implemented (with different degrees) by IMs representing around or more than 80 % of the European rail network. The figures for RUs, however, are less positive, with only two functions implemented to a high degree by operators representing more than 50 % of the market share (in terms of passenger-km). Regarding the retail functions for RUs, considering the varying response rate and that not all RUs are subject to implementing all of them, the majority of the functions shows a quite high degree of implementation but for a few of them (e.g. exchange of special tariffs/fares) the implementation is much lower.

Overall, it has to be considered that the implementation of TAP TSI functions is mainly in place for the incumbent RUs, whereas for new entrant RUs less progress has been achieved so far.

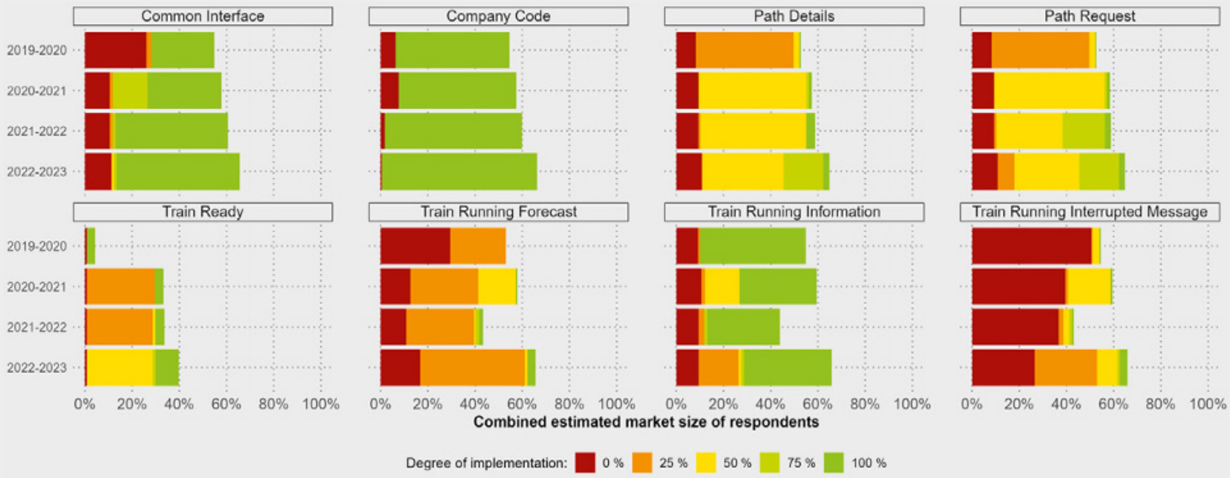
Sources and limitations

A specific Implementation Cooperation Group led by the Agency and involving the sector and the national contact points was set up for the purpose of collecting data on the TAP TSI implementation. The group set up a dedicated survey that allows RUs, IMs and ticket vendors to report once a year on the degree of implementation of specific TAP TSI functions. Data provided by RUs and IMs have a good degree of reliability, but, being a survey, the quality of statistical estimates depends on the response rate. When analysing the trends in the deployment of the functions, attention should be paid to the fact that the population of respondents may not be identical across various reporting periods. Therefore, Figure B-11 refers to several reporting years. The estimated market share is based on SCI Verkehr publications and desk research.

Figure B-11: Degree of implementation of TAP functions (% of European market share, 2019–2023)

TAP implementation status for IMs

TAP implementation status for RUs



Degree of implementation for the retail functions for RUs

Sources: TAP surveys of RUs and IMs, TAP retail function surveys, SCI Verkehr data and ERA analysis.

B-6 Implementation of technical specifications for interoperability concerning telematics applications for freight services

Purpose

Telematics applications for freight services (TAF) TSI sets the functional and technical standards for exchanging harmonised information between IMs, RUs, terminal operators, wagon keepers and other identifiable stakeholders involved in the freight service. After years of design and development, implementation of TAF functions by the RUs and IMs is now under way in the EU. Railway operators have been gradually integrating TAF standards into their IT systems in line with the European TAF master plan.

Indicators

The indicator used to monitor progress with the implementation of TAF TSI-specific functions by the railway sector is the market share of IMs (weighted by line-km on a European scale) and RUs (weighted by the estimated tonne-km on a European scale) that have implemented the TAF functions, as per regular survey carried out by the Implementation Cooperation Group. For each 2-year period the most recent response of an operator is used if two responses were given. The figure gives insights into the degree of implementation and the market share that the responses represent, and thus the knowledge gap that remains. The target for the indicator is to have 100 % of the individual functions implemented (including existing, updated or new IT systems, as this TSI is a functional one), as communicated in the TAF TSI master plan. A revision of the TAF TSI is now under way.

Findings

The degree of implementation of single functions by operators varies considerably among functions and it is progressing slowly, however it is starting to take off. In 2022–2023, a large majority of the functions (i.e. all except two) had been implemented (to different degrees) by IMs representing around 80 % of the European railway network. The figures for RUs, however, are less positive, with only two functions implemented to a high degree by operators representing more than 50 % of the market share (in terms of tonne-km). Although not reported in Figure B-12, wagon keepers, representing more than 60 % of the European freight wagon fleet, have achieved a high degree of implementation for the relevant mandatory TAF TSI functions (including the Rolling Stock Reference Database).

Sources and limitations

A specific Implementation Cooperation Group led by the Agency and involving the sector and the national contact points was set up for the purpose of collecting data on the TAF TSI implementation. The group set up a dedicated survey that allows RUs, IMs and wagon keepers to report once a year on the degree of implementation of specific TAF TSI functions. While not all organisations respond, the number doing so grows steadily each year, and the degree of representativeness of the data sample is relatively high, as the responding organisations represent major players on the railway market. When analysing the trends in the deployment of the functions, attention should be paid to the fact that the population of respondents may not be identical across various reporting periods. Therefore, Figure B-12 refers to several reporting years. The estimated market share is based on SCI Verkehr publications and desk research.

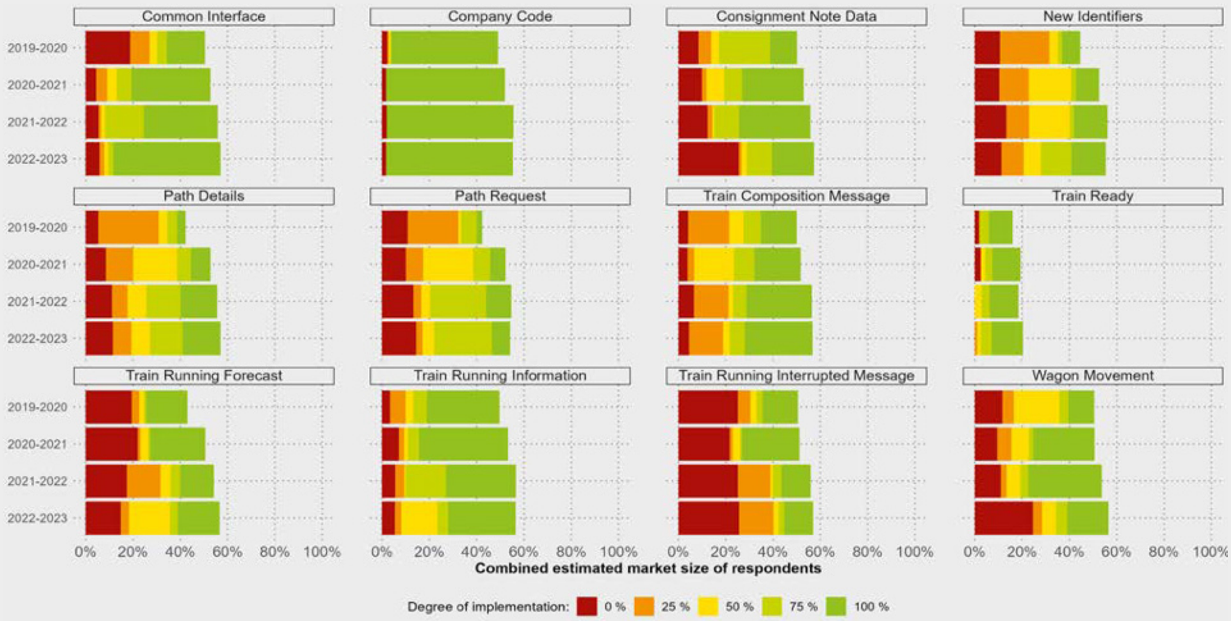
Recently, ERA has started exploring the replacement of the traditional "degree of implementation" reporting based on company feedback with new "KPI" reporting based on data coming from TAF/ TAP TSIs compliant sector tools ([18]). Even acknowledging the challenge posed by the collection of the KPI data, this will provide a broader overview of the real implementation and focus on the usage and the quality of the implemented functions.

([18]) See the first working document report on Key Performance Indicators (*2022 TAF TSI implementation key performance indicator (KPI) working document report of the European Union Agency for Railways*, https://www.era.europa.eu/system/files/2023-06/Agency_s%202022%20Report%20ERA-REP-114-IMPL-2022%20on%20TAF%20TSI%20Implementation%20-%20KPI.pdf)).

Figure B-12: Degree of implementation of TAF functions (% of European market share, 2019–2023)

TAF implementation status for IMs

TAF implementation status for RUs



Sources: TAF surveys of RUs , SCI Verkehr data and ERA analysis.

B-7 Train drivers with a European Union licence

Purpose

The EU train driver licence is a means of facilitating cross-border operations and labour mobility. It is obtained and maintained based on the common requirements valid in all Member States for all train drivers involved in train operation covered by the RSD. It was introduced by the TDD ([19]), which anticipates a gradual implementation in the Member States. Since October 2018, all train drivers in the EU have been required to hold a licence, in accordance with the TDD. They also need to be certified by the RU for the rolling stock and infrastructure that they can operate on. This is part of the RUs' safety management system.

Indicators

The indicator used to measure the implementation of the EU train driver licence scheme is the number of train drivers with a valid EU licence.

Findings

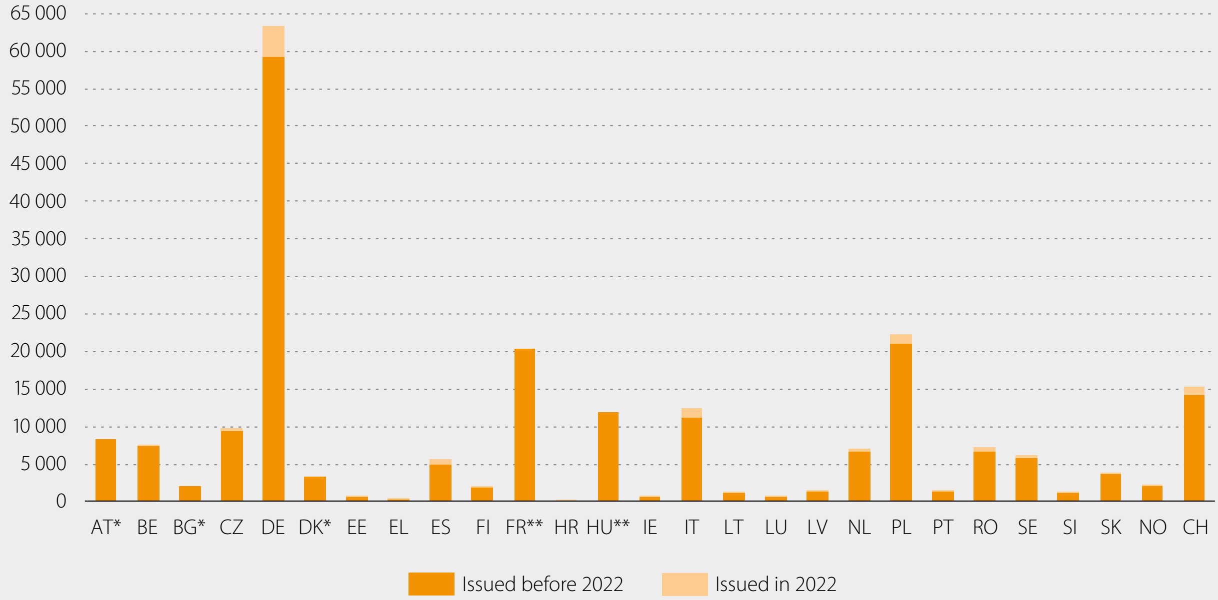
The number of train drivers licensed in line with the TDD requirements has been increasing steadily in recent years; at the end of 2022, the implementation of the EU certification scheme appeared to be complete in all Member States. According to the data provided by the NSAs, there were almost 220 000 train drivers with a valid EU licence in the EU-27, Norway and Switzerland by the end of 2022; this number varies significantly among countries because of the difference in the sizes of their railway sectors.

Sources and limitations

Data on the total number of train drivers licensed in accordance with the TDD are provided by the NSAs in each Member State, who are the licensing authority. Although the quality of these data can be considered satisfactory, inconsistencies are possible (e.g. as the underlying data were not available for five Member States, values from previous NSA surveys (2019 or 2021) were used).

([19]) Directive 2007/59/EC on the certification of train drivers operating locomotives and trains on the railway system in the Community, as amended.

Figure B-13: Train drivers with an EU licence per country (EU-27 + CH + NO, end of 2022)



(*) Data as of end of 2021 (from the survey of NSAs in 2022).

(**) Data as of end of 2019 (no updates available).

Source: Survey of NSAs in late 2023.

B-8 Railway stations accessible to persons with reduced mobility

Purpose

There are over 100 million persons with disabilities living in the EU ([20]). An additional 50 million Europeans have reduced mobility due to temporary disability, age or pregnancy ([21]). They often avoid taking the train because of physical barriers that are present at railway stations. The persons with reduced mobility (PRM) TSI specifies that all Member States should work towards improving the accessibility of their rail systems for persons with disabilities and reduced mobility. More specifically, all Member States are required to develop and put into practice a national implementation plan setting out how they will progressively eliminate all identified barriers to accessibility across the rail network ([22]).

Indicators

Stations may have various degrees of accessibility to PRMs. The indicators used to measure the degree of accessibility are the share of railway stations compliant with the PRM TSI requirements and the share of accessible stations. Full TSI compliance means full conformity with the PRM TSI requirements, as demonstrated by a notified body (NoBo) certificate. Partial TSI compliance means conformity with some (but not all) PRM TSI requirements, as demonstrated by the NoBo certificate. An accessible station is a station considered accessible under national legislation (i.e. no NoBo certificate is available).

Findings

According to the data supplied by the NSAs, by the end of 2022, there were at least 472 stations with full TSI compliance and 168 stations with partial TSI compliance. At the EU level, around 4 % of all reported stations are fully TSI compliant and around 1 % are estimated to be partially TSI compliant. An additional 56 % of all stations offer step-free access to platforms.

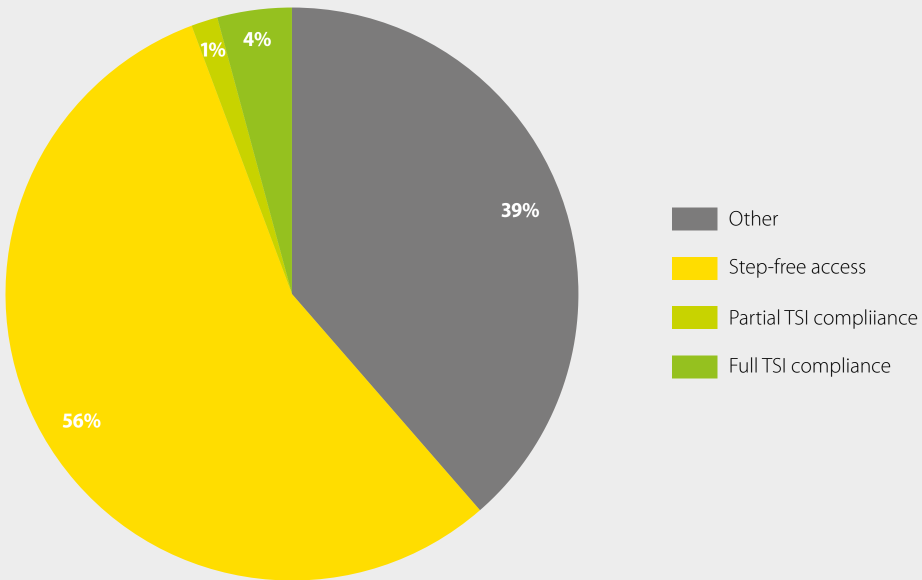
Sources and limitations

The quality of the data used to produce these estimates is currently limited: there are sometimes inconsistencies in the data on railway stations available from various sources, and their classification per the categories above is a relatively new concept and not yet properly implemented in all national data.

Substantial differences exist among Member States. The most progressive countries seem to be the smaller ones, often located in eastern Europe. The available data further demonstrate the need for an ever closer monitoring of progress towards the goal of mobility for all. For this report, data were available for 17 Member States.

([20]) European Disability Forum (http://www.edf-feph.org) (accessed 14 February 2022).
([21]) Study: Railway costs and benefits data collection (ERA 2017 38 RS) by INECO-Ecorys.
([22]) These plans are accessible via European Commission, 'Persons with reduced mobility –PRM TSI NIP' (https://transport.ec.europa.eu/transport-modes/rail/interoperability-safety/interoperability/persons-reduced-mobility-prm-tsi-nip_en).

Figure B-14: Railway stations per type of PRM accessibility (17 Member States, end of 2022)

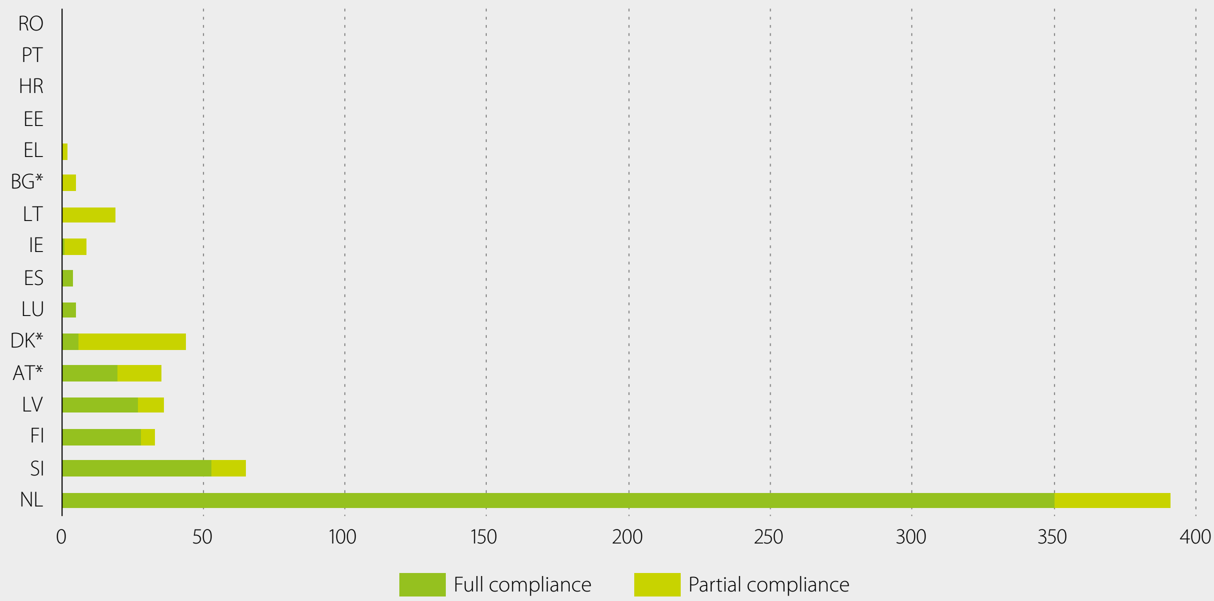


N.B.: ERA estimates based on sample data from 17 Member States.

Source: Survey among NSAs carried out by ERA at the end of 2023.

Figure B-15: Railway stations accessible to PRMs by Member State (end of 2022)

PRM – TSI-compliant stations



(*) Data as of end of 2021 (from the survey of NSAs in 2022).

Source: Survey among NSAs carried out by ERA at the end of 2023.

B-9 Non-applications of fixed installation-related technical specifications for interoperability

Purpose

A number of legal grounds specified in Article 7(1) of the railway interoperability directive (Directive (EU) 2016/797) allow the non-application of TSI requirements, if a particular subsystem cannot fulfil all TSI requirements. This is often applicable to projects at an advanced stage when a new TSI comes into force. As each category of TSI specifies transition rules (the CCS TSIs introduced transitions after their amendment in 2019), most ongoing projects can apply previous requirements during a certain period without requesting a non-application.

Article 7(1)(a) gives Member States the possibility to grant a non-application that will need to be verified by the European Commission. However, certain justifications require a positive assessment by the European Commission (e.g. Article 7(1)(e) on isolated networks) and ratification by the Committee on the interoperability and safety of the European rail system (e.g. Article 7(1)(c) on economic viability).

Non-applications of fixed installation-related TSIs may represent technical barriers. In general, the lower the number of non-application requests, the higher the level of interoperability of the EU railway system. Nevertheless, the procedure set out in Article 7 of the railway interoperability directive aims to achieve a balance between exceptional but justified non-applications to guarantee the feasibility of the projects while ensuring the highest possible level of interoperability.

Indicators

The indicator used here is the number of non-application requests (infrastructure, energy, safety in railway tunnels, PRM and CCS trackside) submitted by Member States under the previous railway interoperability directive (Directive 2008/57/EC) and the current railway interoperability directive. All requests for non-applications received by the European Commission are counted (except those that were rejected). They concern general infrastructure projects and apply to either a single railway line or an area of a network, depending on the geographical scope of the request.

Findings

The non-applications of fixed installation-related TSIs most frequently concern the CCS TSIs and refer to the requirements of the 2008 interoperability directive. From July 2020, all non-applications are based on the 2016 interoperability directive. Several non-applications of the CCS TSIs since 2017 may concern on-board units (OBUs) of rolling stock and not fixed installations.

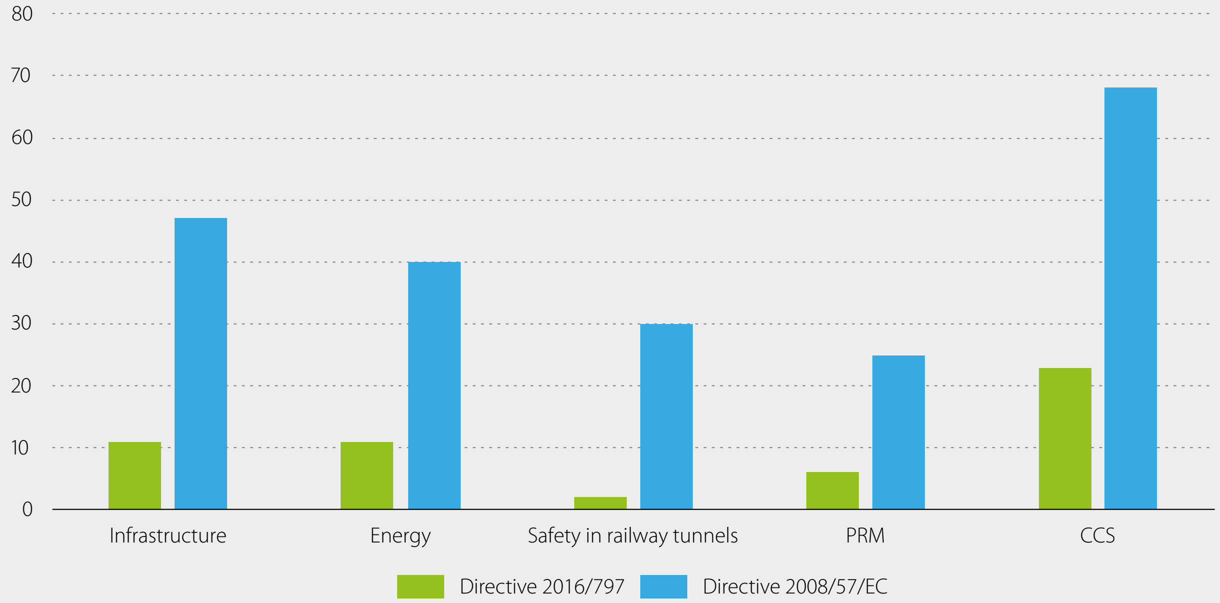
On average, 17 non-application requests have been received each year since 2008. There was a substantial increase in requests in 2017, most likely linked to the recast of the relevant TSIs; the annual number of requests has decreased since then.

Sources and limitations

While an analysis per Member State is not shown in this report, the data show that non-applications are submitted by many Member States. Interestingly, in a few cases, some countries, but not others, have made non-application requests in relation to the same project, despite the fact that the railway interoperability directive (Article 7) requires applications to be made on an individual national basis. The data are directly retrieved from an internal database of the European Commission (Directorate-General for Mobility and Transport), where all submitted non-application requests are recorded. Their quality is considered satisfactory for the given purpose.

Figure B-16: Non-applications of fixed installation-related TSIs (EU-27 + UK, end of 2023)

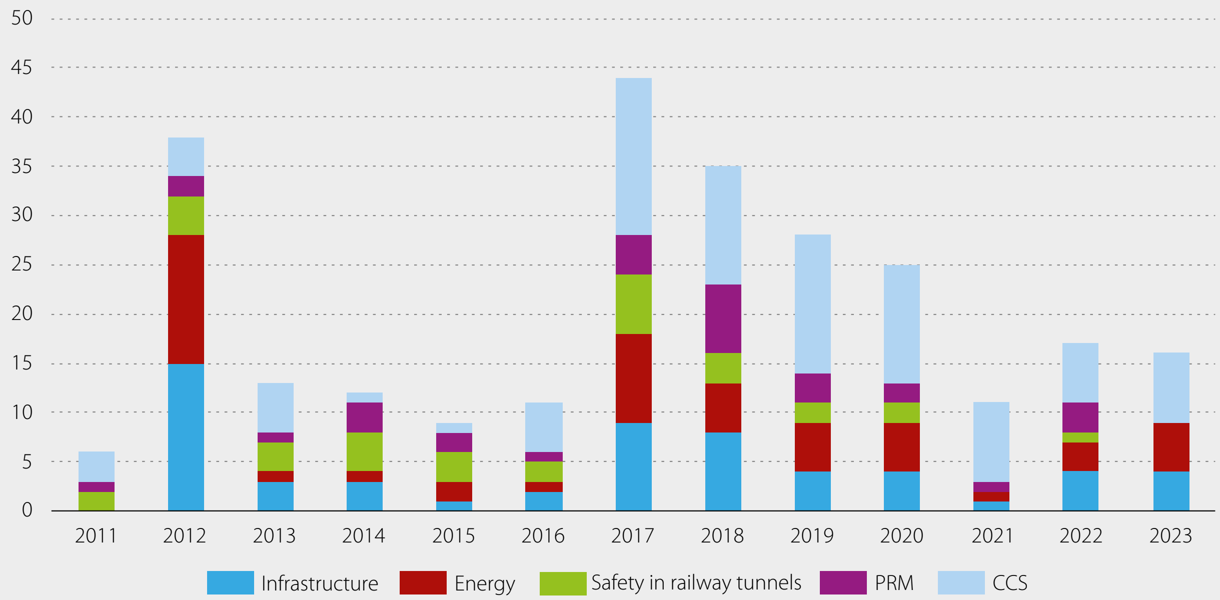
TSIs Iinfrastructure, energy, safety in railway tunnels, PRM and CCS



N.B.: From July 2020, all non-applications are based on Directive (EU) 2016/797; data for the United Kingdom are available until the end of 2020.
Source: Directorate-General for Mobility and Transport internal database.

Figure B-17: Non-applications of fixed installation-related TSIs per year (EU-27 + UK, 2011–2023)

TSIs Iinfrastructure, energy, safety in railway tunnels, PRM and CCS



N.B.: Data for the United Kingdom are available until the end of 2020.
Source: Directorate-General for Mobility and Transport internal database.

B-10 European Rail Traffic Management System trackside deployment

The ERTMS is intended to replace legacy TPSs and is designed to replace the many incompatible safety systems currently used by European railways. It will allow an interoperable railway network in Europe, while providing additional benefits in terms of increased operational efficiency, capacity and safety. Although ideally all core/comprehensive networks ([23]) in the EU would be equipped with the system, emphasis has been put on nine CNCs, with a view to maximising the return on investment. The long-term target adopted by the European Commission is to have the whole core TEN-T equipped with the ERTMS by 2030, the extended core network by 2040 and the whole comprehensive network by 2050 ([24]).

Indicators

The indicators used are the length of lines equipped with the ETCS per Member State (and per level) and the share of lines equipped with the ETCS and the Global System for Mobile Communications – Railway on the CNCs.

Findings

The deployment of the ETCS on the EU railway network has been slow so far; it currently stands at about 13 700 km of railway lines in the EU-27 (on the whole network). Deployment varies considerably among Member States, reflecting national rail transport policy and investment priorities. Section A-19 of this report presents the percentages of national networks equipped with ETCS (Figure A-36), while the total length of railway lines equipped, by country, is reported below. According to records in the RINF, Switzerland, Spain and Belgium have the most kilometres of lines equipped with ETCS. In the case of the Member States not represented, either ETCS has not been deployed at all or data are missing.

ERTMS deployment on the CNC network had reached 15 % (ETCS) and 61 % (Global System for Mobile Communications – Railway) at the end of 2023. However, the length of lines with ETCS deployment increases significantly when the projects currently under construction are also considered (i.e. 39 % of the CNCs are equipped with ETCS or are under construction). Nevertheless, with 9 000 km of CNC lines equipped with the ETCS (at the end of 2023), a substantially greater effort is needed to meet the target of the TEN-T regulation of 57 000 km on CNCs by 2030. Progress has been uneven among individual corridors; it has been notable in the case of the Rhine–Alpine and the Baltic–Adriatic corridors, with around 32 % and 29 % of lines (by length) equipped with the ETCS, compared with 11–20 % in other corridors.

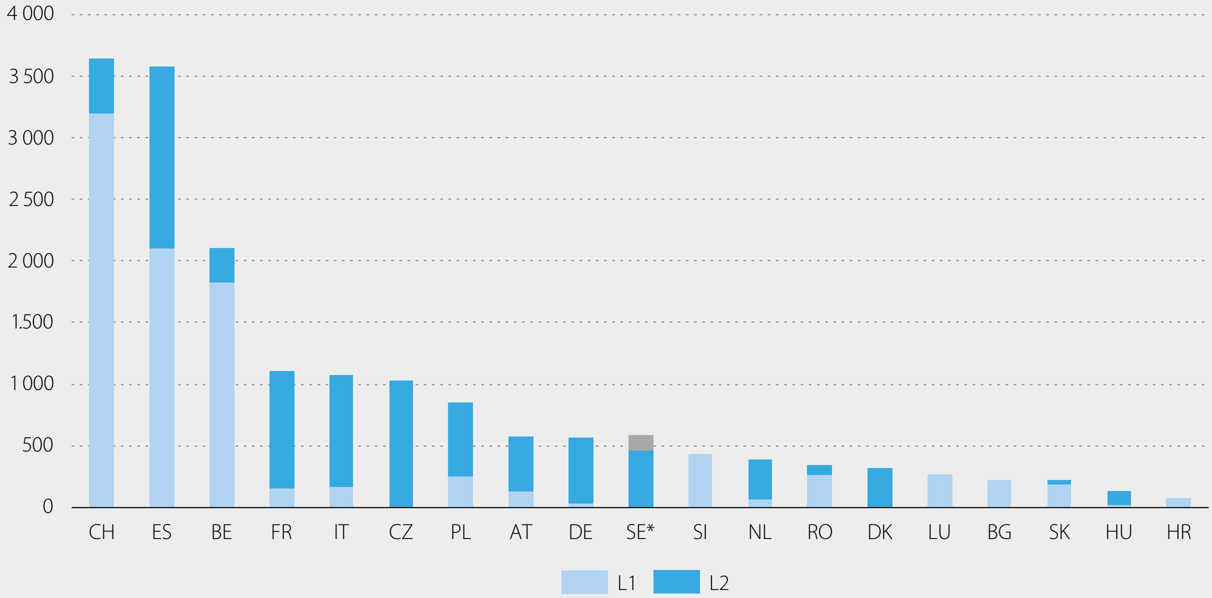
Sources and limitations

The data relating to the entire national rail network are reported by IMs to the RINF, maintained by ERA, while data relating to the CNCs are provided by the ERTMS Deployment Management Team contracted by the European Commission to coordinate and support the TEN-T policy database under the European deployment plan ([25]). The quality of the available CNC data is deemed satisfactory. In the case of the RINF, data reliability depends on the extent to which the information provided is up to date and complete; as specified in the terms of use, ERA has no responsibility for or liability with regard to the information submitted and published in the RINF.

([23]) The revised TEN-T regulation, to be adopted and published in the first half of 2024, introduces, as an additional intermediary layer, the 'extended core network', which should be equipped with ERTMS by 2040. In addition, it also enlarges the nine CNCs to improve the transport links with neighbouring third countries, by integrating Moldova and Ukraine, as well as the six western Balkan partners in the newly established nine European transport corridors.
([24]) See Regulation (EU) No 1315/2013 and the upcoming revision to be adopted and published in the first half of 2024.
([25]) Commission Implementing Regulation (EU) 2017/6 on the European Rail Traffic Management System European deployment plan.

Figure B-18: Length of railway lines equipped with the ETCS (EU-27 + CH, end of 2023)

Length in km per ETCS level

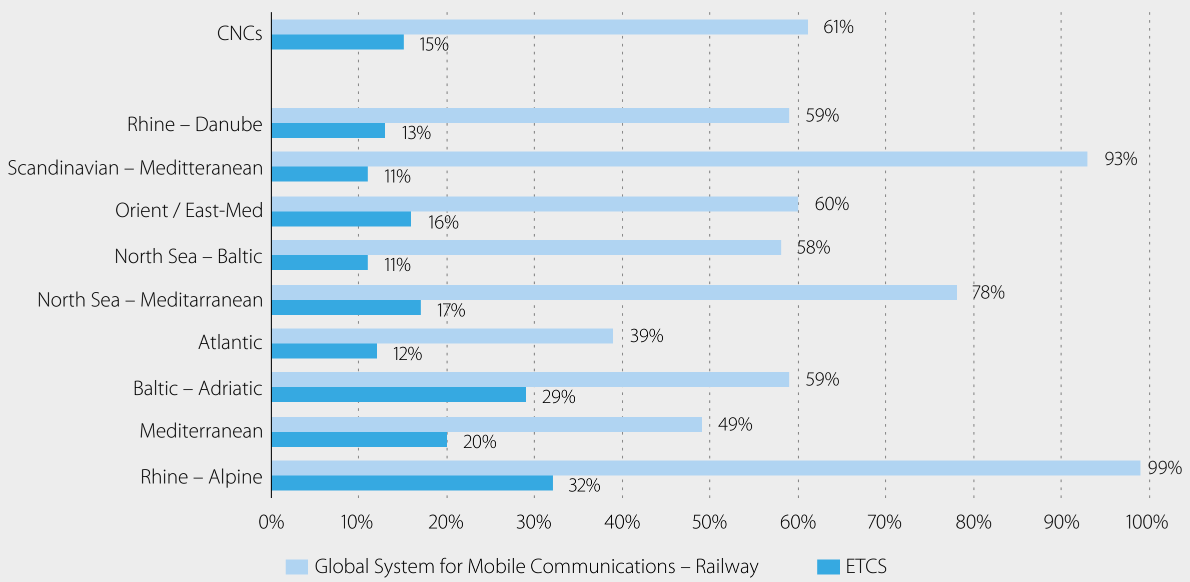


(*) The grey bar refers to an ERTMS regional solution without a train integrity function implemented on low traffic lines (https://www.ertms.net/wp-content/uploads/2021/06/19.ERTMS-in-Sweden.pdf).

Source: RINF, data extracted on 10 January 2024.

Figure B-19: Deployment of the ERTMS on CNCs (end of 2023)

ETCS- and Global System for Mobile Communications – Railway-equipped lines among CNC lines



Source: ERTMS Deployment Management Team / TENtec Information System (Directorate-General for Mobility and Transport).

B-11 Non-applications of technical specifications for interoperability related to rolling stock

Purpose

Requests for non-applications of current TSIs for vehicles may reflect technical barriers that hinder migration towards an interoperable target system. They may be triggered by a non-interoperable trackside infrastructure within the area of use of these vehicles.

In general, the lower the number of non-application requests, the higher the level of interoperability of the EU railway system.

Indicators

The indicator used here is the number of requests for non-applications of rolling stock-related TSIs (locomotive and passenger rolling stock, wagon, PRM, safety in railway tunnels, noise and on-board CCS) submitted by Member States. All requests for the non-application of TSIs received by the European Commission are counted, except those that were rejected.

The indicators represent the non-application of TSIs under Directive 2008/57/EC and Directive (EU) 2016/796.

Findings

On average, there have been 10 non-application requests per year since 2008; altogether, 161 requests for non-applications of TSIs were submitted to the European Commission under Directive 2008/57/EC and Directive (EU) 2016/796. The number of requests varies from year to year, with peaks in 2017–2020; there is also quite significant variation across Member States.

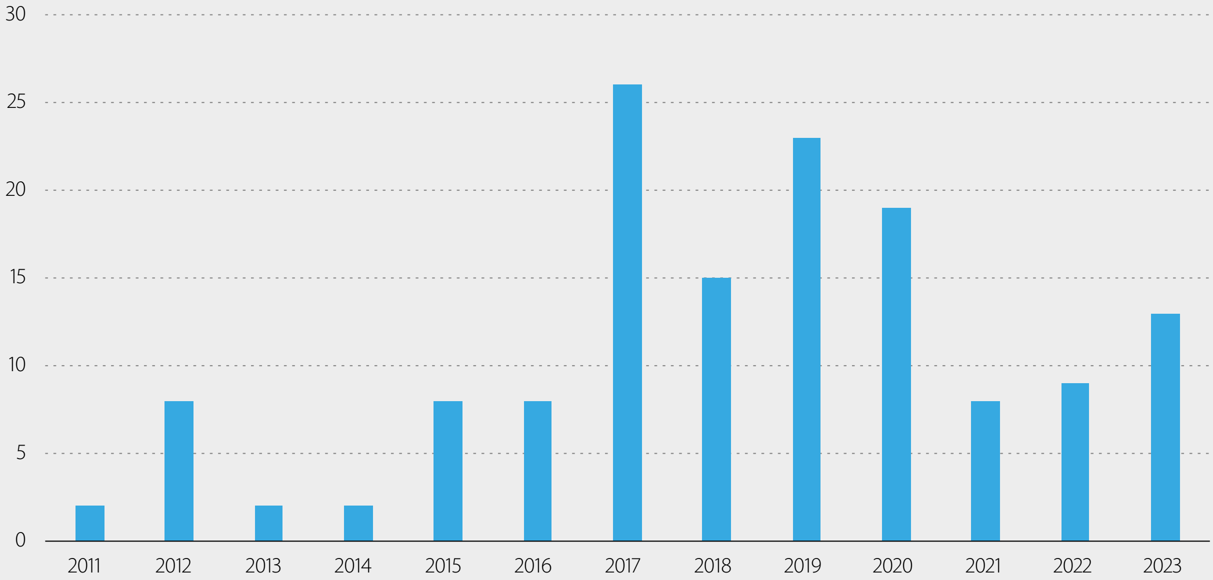
A recent task force organised by ERA has focused on creating a harmonised transition and migration framework for all the rolling stock-related TSIs (including on-board CCS), with the aim of reducing the complexity of adopting new TSI requirements for existing projects, which should lead to fewer non-application requests.

Sources and limitations

Non-application requests are received and processed by the European Commission (Directorate-General for Mobility and Transport), which also keeps track of them through an internal database.

Figure B-20: Non-applications of rolling stock-related TSIs (EU-27 + UK, 2011–2023)

TSIs locomotive and passenger rolling stock, wagon, PRM, safety in railway tunnels, noise and on-board CCS

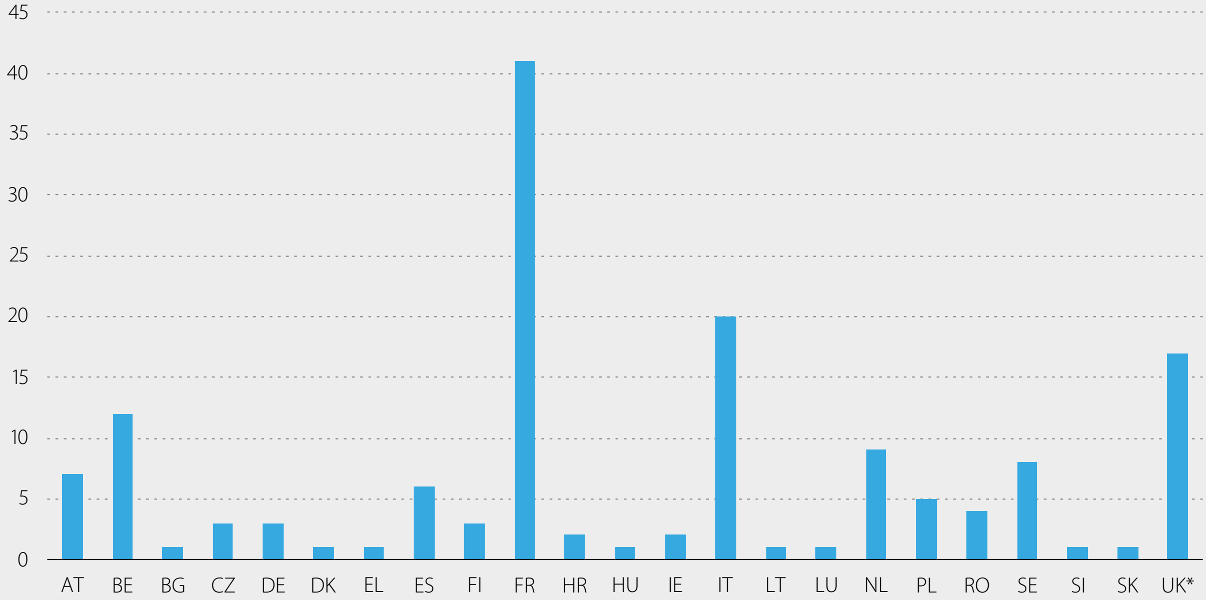


N.B.: Data for the United Kingdom are available until the end of 2020.

Source: Directorate-General for Mobility and Transport internal database.

Figure B-21: Non-applications of rolling stock-related TSIs per country (EU-27 + UK, end of 2023)

TSIs locomotive and passenger rolling stock, wagon, PRM, safety in railway tunnels, noise and on-board CCS



(*) Data for the United Kingdom are available until the end of 2020.

Source: Directorate-General for Mobility and Transport internal database.

B-12 Applicable national technical rules for vehicles

Purpose

National technical rules for vehicle authorisation can represent technical barriers in the framework of the vehicle authorisation process because vehicles need to be compliant with these rules to be authorised. This is especially the case when the national rules are negatively assessed against the harmonised TSIs and other applicable EU legal frameworks and are not repealed by the Member States or in case the national rules are not notified at all.

Member States must notify their national rules in accordance with Directive (EU) 2016/797. On the same legal basis, the Agency examines the notified national rules. The enforcing of national rules that are not notified conflicts with Directive (EU) 2016/797 and leads to unnecessary uncertainty, costs and can affect interoperability. A process of 'cleaning up' of the national rules is ongoing. The remaining national technical rules should cover only open points in TSIs, specific cases in TSIs, aspects of vehicle compatibility with the network (e.g. class B signalling systems) and other limited cases as set out in Directive (EU) 2016/797. The cleaning-up process ensures that the rules are notified/published along with ERA assessment results in the publicly accessible Reference Document Database and transferred to the future Single Rules Database.

Indicators

The indicator used is the number of national rules for vehicle authorisation published/notified in the EU-27, Norway and Switzerland since January 2016.

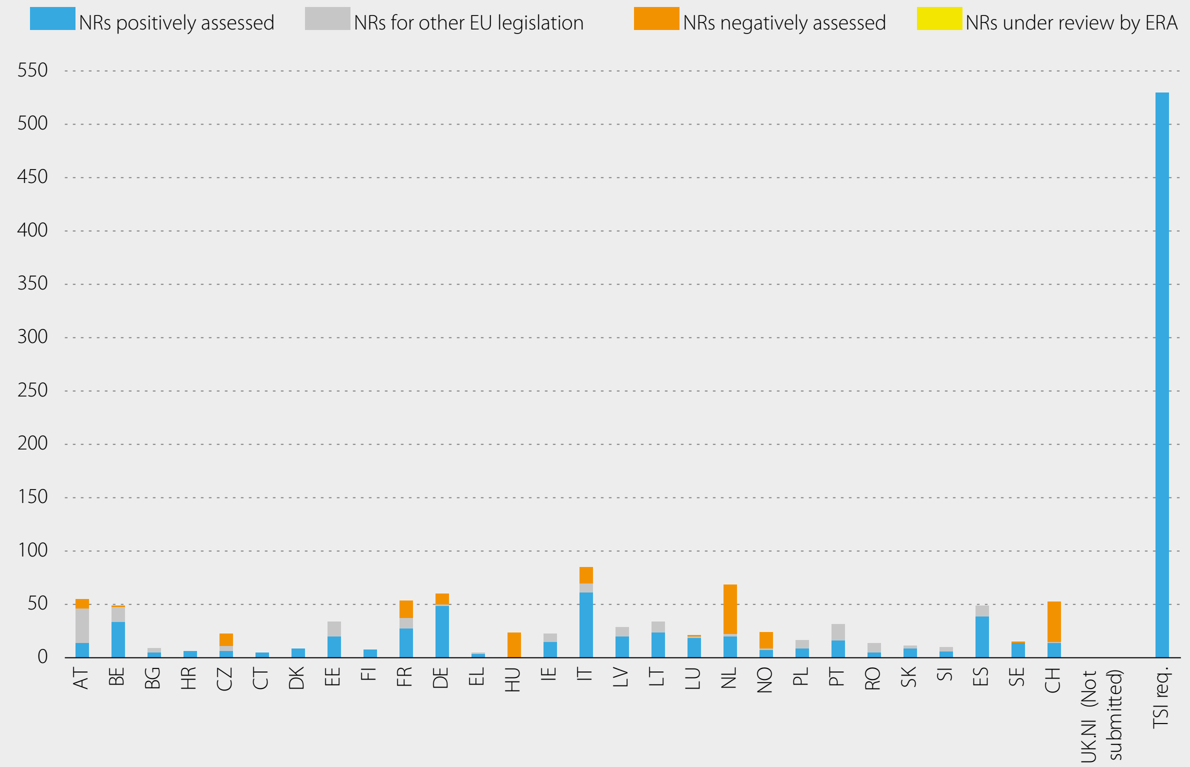
Findings

At the level of the EU-27, Norway and Switzerland, the total number of national rules for vehicle authorisation (in addition to the latest TSIs in force) dropped from over 14 000 in January 2016 to 821 in December 2023, with some differences among the countries. Although there has been an impressive decrease in the number of published rules in the past 8 years, this trend has flattened since the end of 2019. After cleaning up, a further reduction in the number of national rules is envisaged in the next revision of the TSIs.

Sources and limitations

As the data are retrieved directly from ERA's Reference Document Database after being published by the Member States, the reliability of the data depends on the extent to which the information from the Member States is up to date and complete.

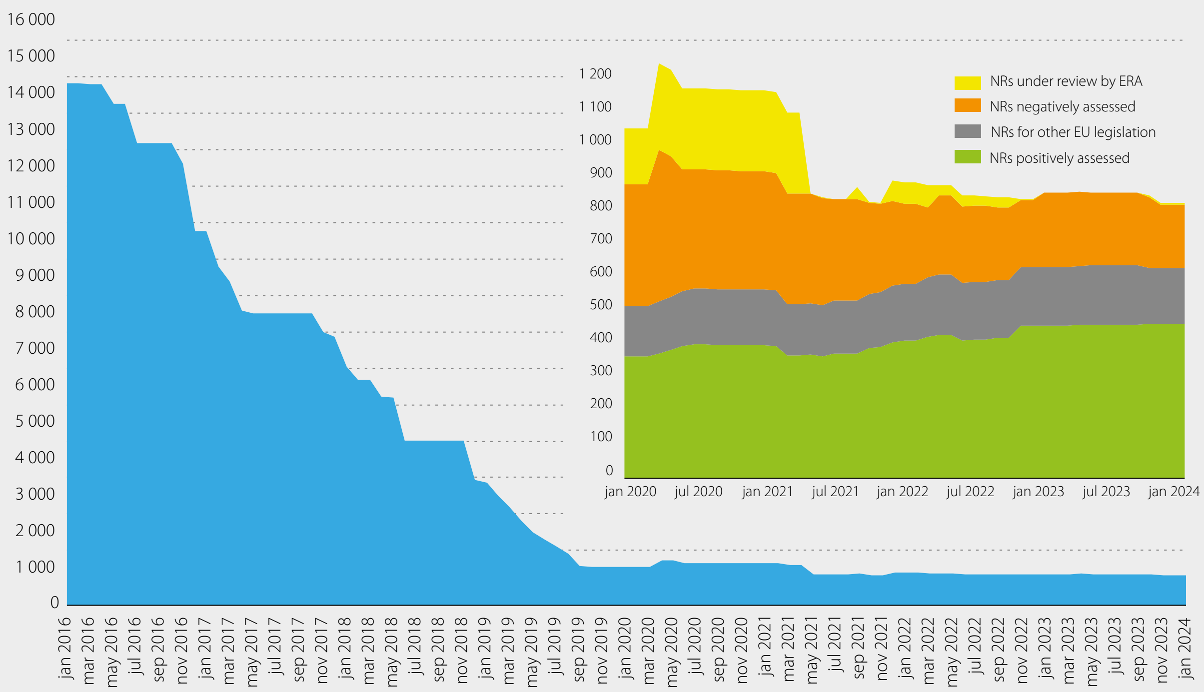
Figure B-22: National rules for vehicle authorisation in addition to the latest TSIs (EU-27 + CH + NO, December 2023)



N.B.: NR, national rule.

Source: Reference Document Database maintained by ERA.

Figure B-23: National rules for vehicle authorisation (EU-27 + CH + NO + UK, 2016–2023)



N.B.: National rules from the United Kingdom are considered until 2021.

Source: Reference Document Database maintained by ERA.

B-13 European Rail Traffic Management System on-board deployment

Purpose

The deployment of ERTMS equipment on board tractive vehicles is a prerequisite for ERTMS-compatible train operation. It is achieved either by purchasing new vehicles or by retrofitting the existing fleet.

Indicators

The indicators used to measure the extent of on-board deployment of the ERTMS are the total number of tractive rolling stock vehicles in operation equipped with the ERTMS authorised for operations on the EU railway network and the number of ERTMS-equipped vehicles contracted (delivered or to be delivered) in the EU-27, Norway, Switzerland and the United Kingdom.

Findings

The number of contracted vehicles with the ERTMS has increased steadily since 2010, with over 9 850 vehicles contracted in Member States (over 13 700 in the EU-27, Norway, Switzerland and the United Kingdom) at the end of 2022. However, the time lag between contracting vehicles with the ERTMS and their operation should be taken into account.

The countries reporting the highest number of vehicles equipped with the ERTMS in operation in 2022 were Switzerland, Germany and Belgium. The survey of NSAs indicated that (on average among the countries that provided data) around 18 % of the operating tractive vehicles (including train sets) were equipped with the ERTMS at the end of 2022.

To achieve successful implementation of the ERTMS in the core network by the target date of 2030, greater effort is needed to accelerate the on-board deployment of the ERTMS.

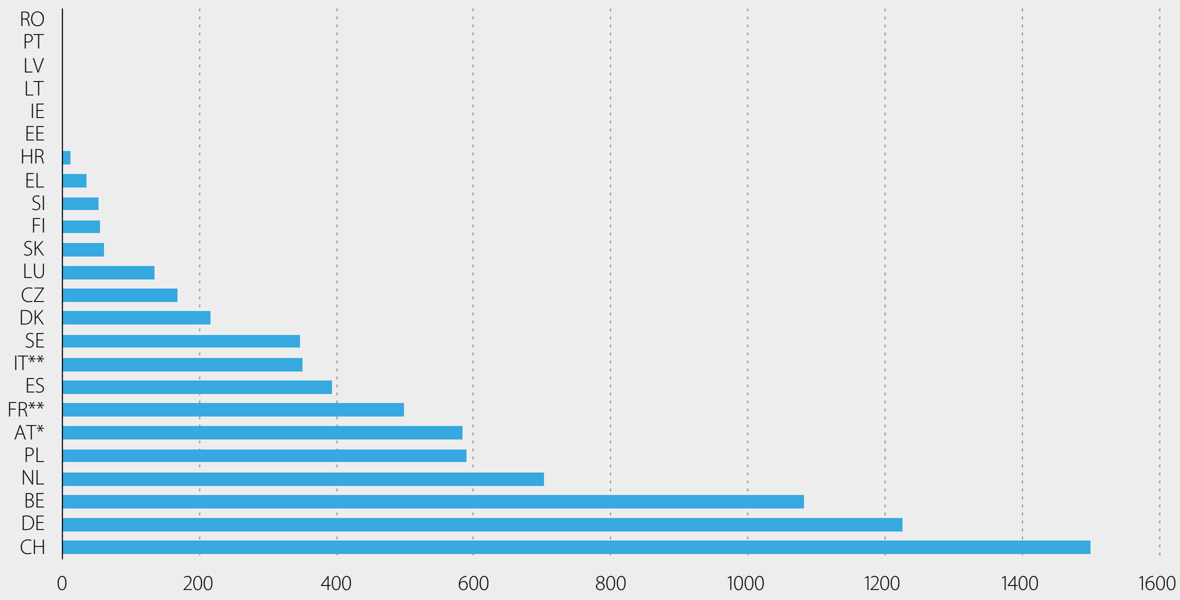
Sources and limitations

The underlying data are not readily available and have to be compiled from various sources. One source is a survey on vehicles in service, conducted among NSAs by ERA. A second source is a survey of the rolling stock manufacturers' association, the European Rail Supply Industry Association (UNIFE), among their members on vehicles contracted. In the case of national data supplied by NSAs, the data are not available for five countries (i.e. Austria, Bulgaria, France, Hungary and Norway). In the case of UNIFE, the data are deemed accurate enough.

NSA survey data are provided by the NSAs, and some discrepancies between these data and data from other sources are possible. The number of tractive vehicles operated comprises the number of owned, leased and rented vehicles minus the number of rented-out vehicles equipped with the ETCS. Vehicles without power units are excluded. Multiple units and train sets are counted as one equipped vehicle. Data include vehicles that are operated to transport freight or passengers. Vehicles under pilot yellow fleet operations, vehicles for track maintenance and other IM vehicles are not included. Data refer only to vehicles that are registered in the country in which the RUs conduct their main business activities.

Figure B-24: Vehicles in operation equipped with ERTMS OBUs (EU-27 + CH, end of 2022)

New and retrofitted vehicles

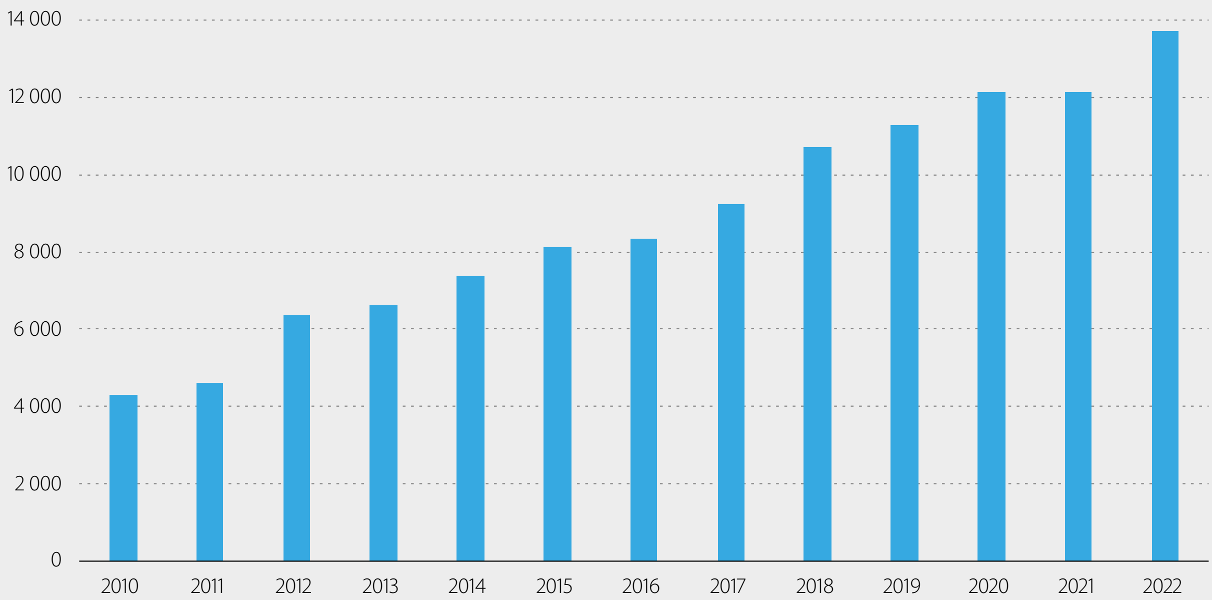


(*) Data as of end of 2021 (from the survey of NSAs in 2022).

(**) Data from the ERTMS Deployment Management Team for 2023.

Sources: Survey among NSAs carried out by ERA at the end of 2023 and ERTMS Deployment Management Team data.

Figure B-25: Contracted ERTMS vehicles (EU-27 + CH + NO + UK, 2010–2022)



Source: UNIFE.

B-14 Safety certificates or single safety certificates for railway undertakings with an international area of operation (part 1)

Purpose

The number of RUs with Part B safety certificates in more than one Member State and the number of SSCs with multi-country area of operation may provide an indication of the international rail services across Europe.

Indicators

Member States concerned with national or international operation of RUs (i.e. area of operation in one or more Member States) holding Part B safety certificates and/or SSCs.

Findings

Records in ERADIS indicate a bit less than 250 Part B safety certificates compared with 635 SSCs valid at the end of 2023 with area of operation in one Member State; the trend since 2021 confirms the gradual transition to the new scheme in all countries.

Also the data on certificates for area of operation in multiple countries show the general decrease in RUs holding Part B safety certificates, with these gradually being replaced by the SSCs. It is important to highlight that these data may not be fully representative of the international rail traffic because of the possible creation of subsidiaries in the different Member States where the RUs plan to operate (with different names and national certificates).

Despite the quite significant decrease, the number of Part B safety certificates appears still quite high in some countries (e.g. Czechia, Germany and Poland), which may be explained, in part, by the renewal of these safety certificates before the transposition date of the fourth railway package (which was in some cases extended, i.e. full transposition into national law in all EU countries, excluding Norway, has occurred only since the end of 2021).

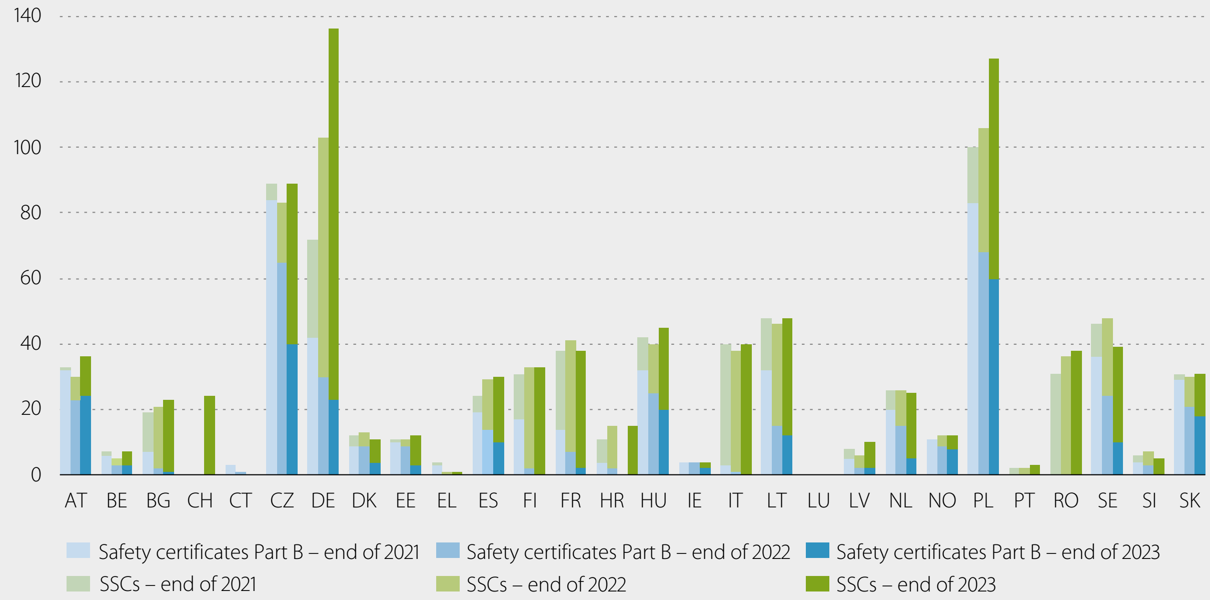
Sources and limitations

In ERADIS, safety certificates (Part B) are submitted by NSAs and data reliability depends on the extent to which the information provided is up to date and complete. As specified in the terms of use, ERA has no responsibility for or liability with regard to the data submitted by NSAs and published in ERADIS. Data for SSCs issued by ERA, instead, are available in ERADIS and were retrieved from the One-Stop Shop (OSS).

Subsidiaries of an RU are not detected and counted if registered nationally (in each country of operation).

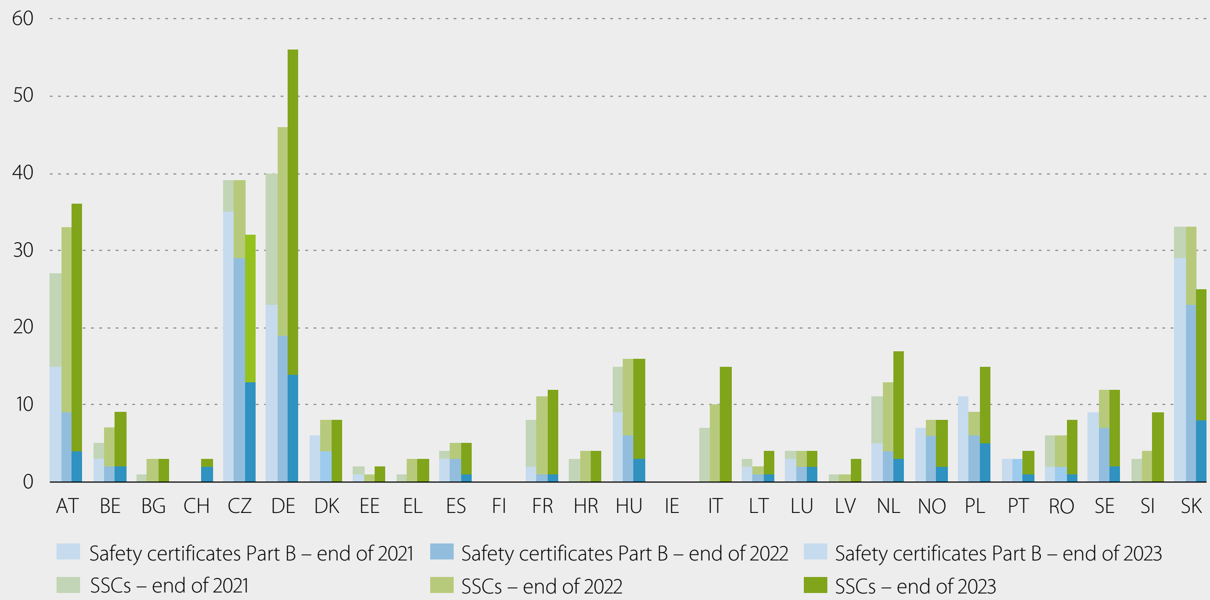
It should be noted that, granting a (single) safety certificate for an area of operation composed of one Member State does not mean that the RU exclusively operates at the national level. Many sister companies with their own (single) safety certificates still exist and manage their operations through partnership agreements or contractual relationships with other RUs either when crossing the state border or when operating to border stations. In addition, operations to border stations in neighbouring Member States are not counted as international operations.

Figure B-26: Member States concerned with Part B safety certificates and SSCs for RUs operating in one Member State (EU-27 + CH + NO, end of 2021, 2022 and 2023)



Source: ERADIS (ERA).

Figure B-27: Member States concerned with Part B safety certificates and SSCs for RUs operating in more than one Member State (EU-27 + CH + NO, end of 2021, 2022 and 2023)



Source: ERADIS (ERA).

B-15 Safety certificates or single safety certificates for railway undertakings with an international area of operation (part 2)

Purpose

The Part B safety certificates for RUs operating in more than one Member State are being gradually replaced by SSCs with multi-country area of operation issued by ERA, which may provide an indication of the international rail services across Europe.

Indicators

Percentages (on the total) of safety certificates and SSCs issues by NSAs and ERA per area of operation, and number of SSCs issued by ERA per type and area of operation.

Findings

Records in ERADIS indicate that 15 % of the total share of safety certificates valid at the end of 2023 were managed by ERA, which could rise to 18 % after the end of the transition period of the fourth railway package (i.e. when all Part B safety certificates will be replaced by SSCs). In 2019–2023, ERA delivered 211 SSCs, of which around 155 were valid at the end of 2023. Indeed, each RU can apply several times for an SSC (e.g. renewals, amendments) but can have only one valid SSC at a time.

Around 12 % of the total safety certificates (recorded in ERADIS and valid at the end of 2023) concerned international operators (i.e. an area of operation in more than one Member State). More than 75 % of these certificates were SSCs issued by ERA, confirming the gradual transition to the new regulatory framework.

Domestic operations represent most operations in the EU, with safety certificates mostly issued by NSAs and for which two-third of companies have already migrated to an SSC. As it is also evident from the number of SSCs issued by ERA per type and area of operations, more freight services are registered or operated internationally, while the international rail passenger services appear relatively limited. This can be partially justified also by the fact that, for passenger transport, RUs rely on partnership agreements among them (i.e. they can operate under the safety certificate of the partner RU without applying for an SSC to ERA).

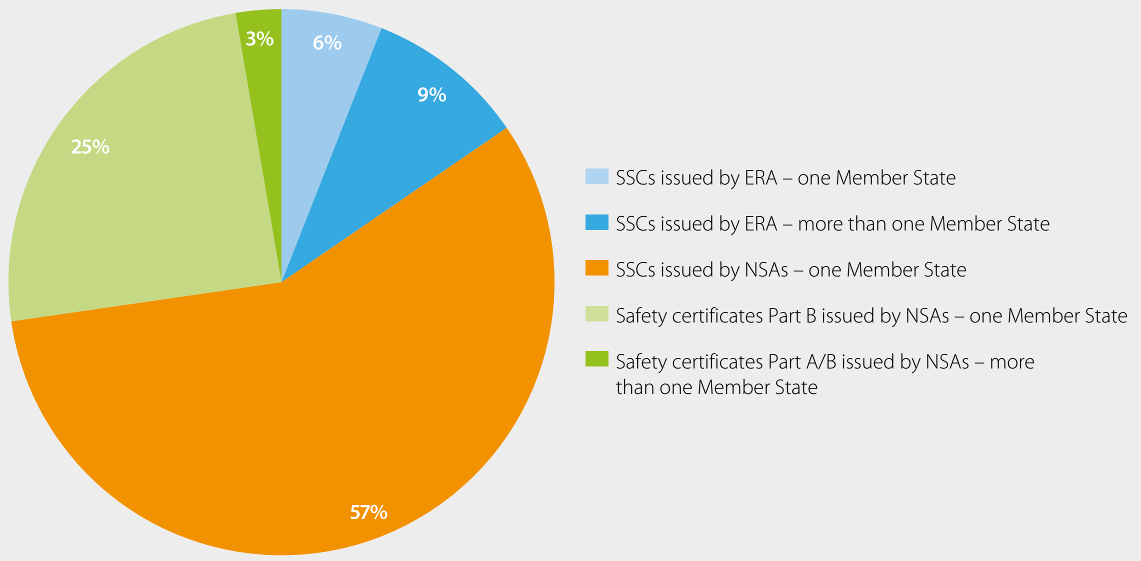
Sources and limitations

Part B safety certificates are submitted by NSAs in ERADIS. Data reliability depends on the extent to which information provided is up to date and complete; as specified in the terms of use, ERA has no responsibility for or liability with regard to the data submitted by NSAs and published in ERADIS. Data for SSCs issued by ERA, instead, are available in ERADIS and were retrieved from the OSS.

Subsidiaries of an RU are not detected and counted if registered nationally (in each country of operation).

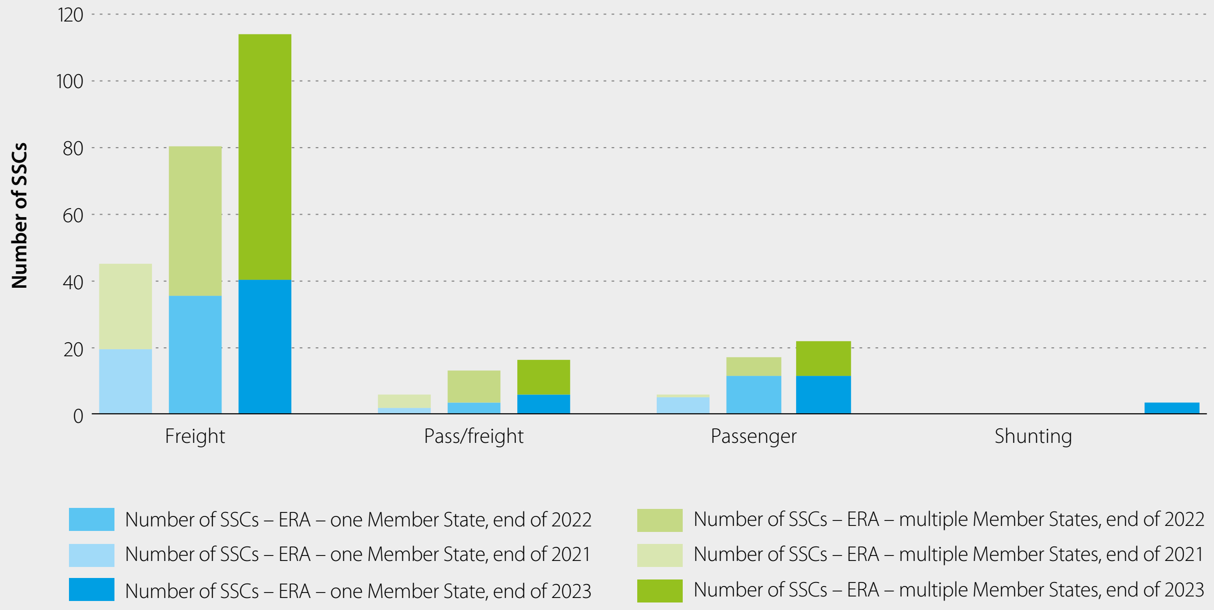
It should be noted that granting a (single) safety certificate for an area of operation composed of one Member State does not mean that the RU exclusively operates at the national level. Many sister companies with their own (single) safety certificates still exist and manage their operations through partnership agreements or contractual relationships with other RUs either when crossing the state border or when operating to border stations. In addition, operations to border stations in neighbouring Member States are not counted as international operations.

Figure B-28: Safety certificates and SSCs issued by NSAs and ERA per area of operation (EU-27 + CH + NO, end of 2023)



Sources: ERADIS and OSS (ERA).

Figure B-29: Single safety certificates issued by ERA, per type and area of operation (EU-27 + NO, end of 2021, 2022 and 2023)



Sources: ERADIS and OSS (ERA).

B-16 Vehicle authorisations handled by the European Union Agency for Railways per area of use and type of vehicle

Purpose

Before a new or modified railway vehicle is permitted to operate on the EU railway network it must be authorised. A vehicle and/or vehicle type authorisation is valid for a defined area of use (i.e. a network or networks within one or more Member States where the vehicle may be used). A further authorisation is required if changes are made to the area of use (extension of the area of use). According to Directive (EU) 2016/797 (Interoperability Directive), when the area of use is limited to a network or networks within one Member State, the applicant would be able to choose whether it submits its application for vehicle authorisation to the NSA of that Member State or to the Agency. In the case of vehicles having an area of use in more than one Member State, the Agency will issue the authorisation. The number of vehicle authorisations handled by the Agency with area of use in multiple countries may provide an indication of the vehicles authorised for international use across Europe.

Indicators

Number of vehicle authorisations and vehicles authorised by ERA, per area of use and category of vehicle.

Findings

Around 1 800 vehicle authorisations were submitted and handled by ERA in 2023, with more than 21 000 vehicles authorised. The figures show an increasing trend over the past years (also as a result of progress with the transposition of the fourth railway package into national law) and they refer to all types of authorisations (e.g. conformity to type, first authorisation, renewal, extension of area of use). Around 17 % of all vehicle authorisations handled by ERA since 2019 concerned an area of use in one Member State, and 83 % concerned an area of use in multiple countries.

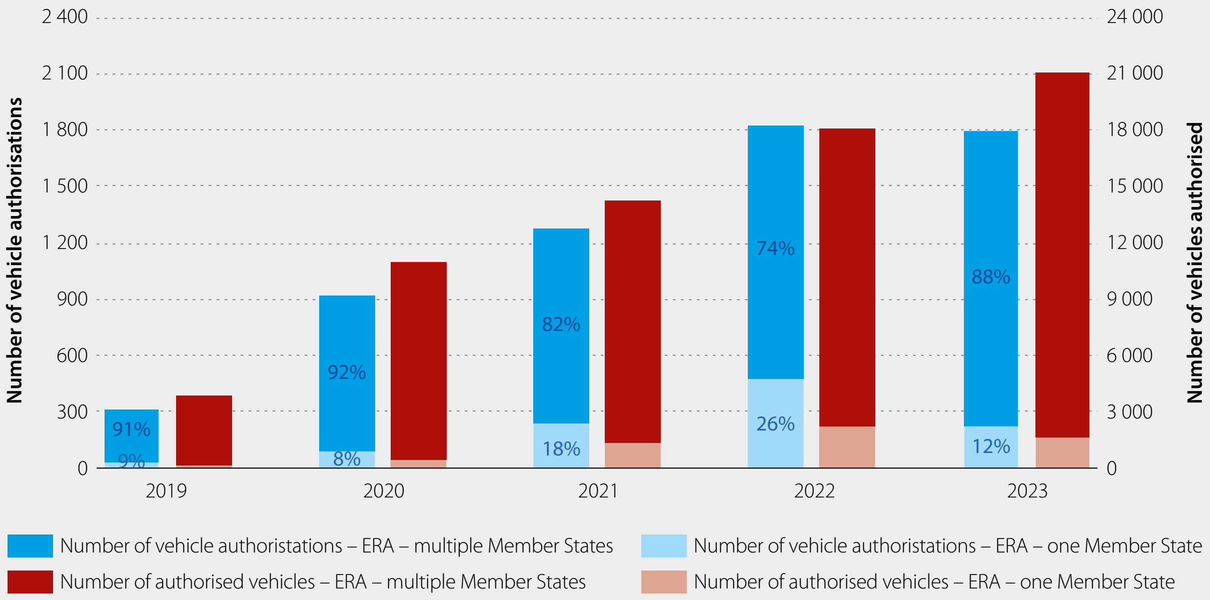
The majority of authorisations in 2023 were related to wagons, followed by locomotives and train sets while more than 1 550 authorisations (for more than 19 600 vehicles authorised) concerned an area of use in multiple countries.

Sources and limitations

Data on vehicle authorisations and vehicles authorised by ERA are retrieved from the OSS and can be considered fully reliable. The figures presented refer to all types of authorisations. Data for 2019 refer to vehicle authorisations since July; moreover, in 2019 and 2020, there was not full transposition into national law of the new rules in all Member States.

Figure B-30: Number of vehicle authorisations and vehicles authorised by ERA, per area of use (2019–2023)

Area of use in one or more Member States

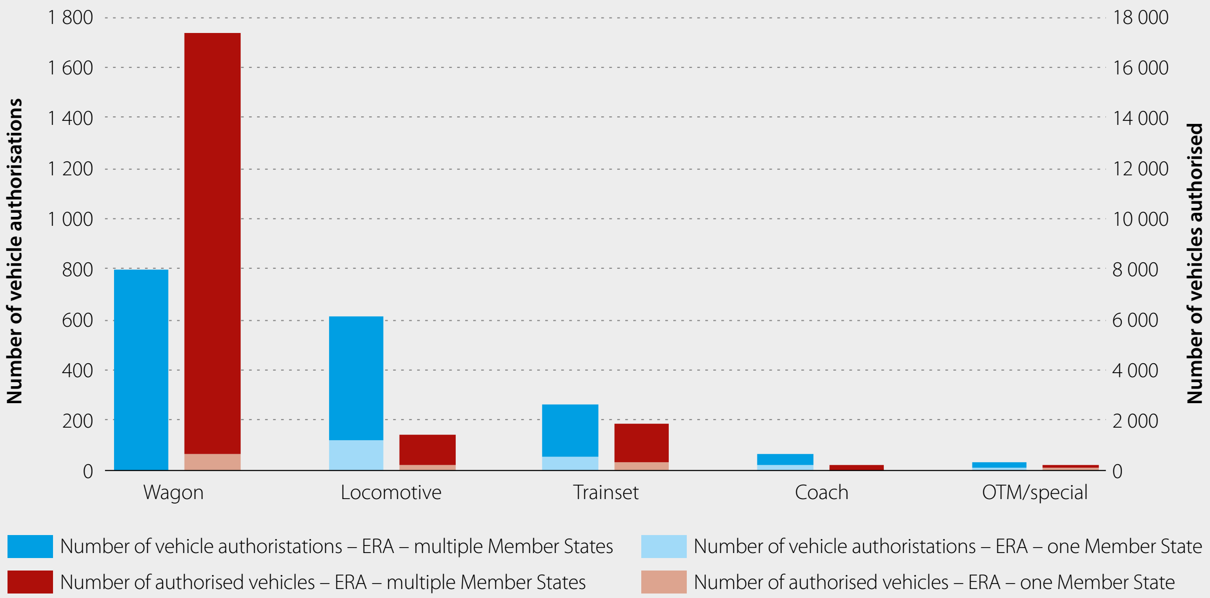


N.B.: Data for 2019 since July. In 2019 and 2020, full transposition into national law did not occur in all Member States.

Source: OSS.

Figure B-31: Number of vehicle authorisations and vehicles authorised by ERA, per area of use and category of vehicle (2023)

Area of use in one or more Member States



N.B.: Each train set is counted as single unit/vehicle.

Source: OSS.

B-17 Licence documents

Purpose

Directive 2012/34/EU as amended lays down the criteria applicable to the issuing, renewal or amendment of licences by a Member State intended for RUs that are or will be established in the EU. Data on licences for the performance of rail transport services within the EU and the European Economic Area are submitted by the national licensing authorities, monitored by the Commission and available in ERADIS ([26]).

Indicators

The number of valid licence documents valid at the end of 2023, per country and type of service.

Findings

The ERADIS reports around 1 200 licence documents ([27]) valid on 31 December 2023 (in EU-27, Norway and Switzerland) for freight, passenger and freight/passenger services. The majority of licences are related to freight services, and there is a significant difference in the number of licence documents across Member States, with the largest values reported in Germany, Poland and Czechia.

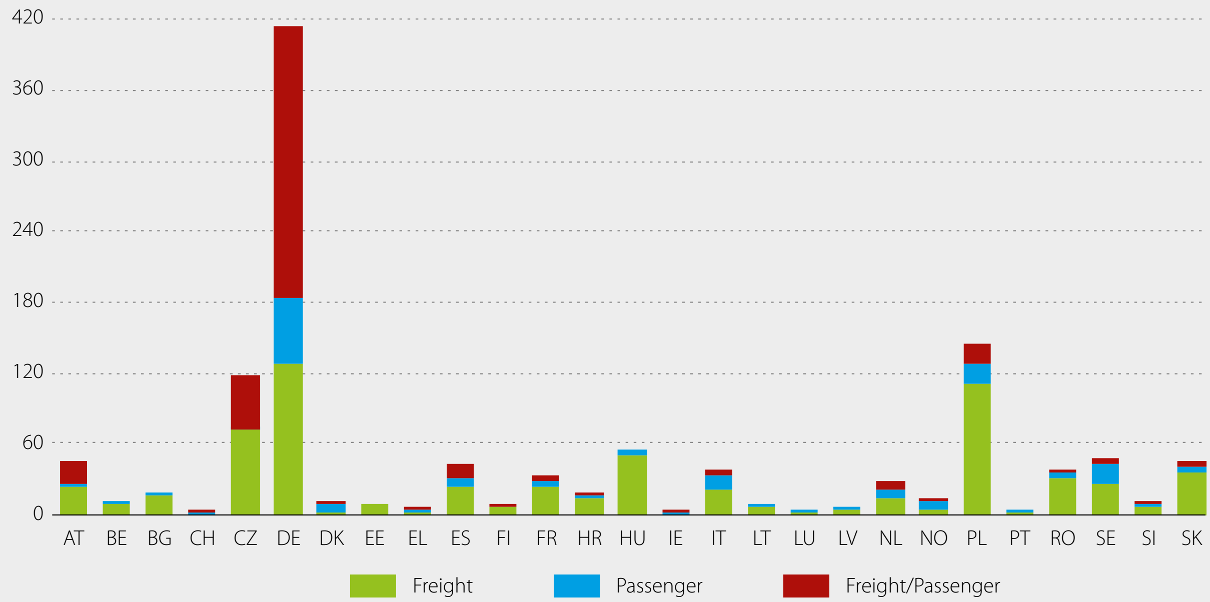
Sources and limitations

Data on the licence documents are submitted by the national licensing authorities, monitored by the Commission and published in ERADIS. Data reliability depends on the extent to which the information provided is up to date and complete; as specified in the terms of use, ERA has no responsibility for or liability regarding the information submitted and published in ERADIS.

([26]) European Union Agency for Railways, 'ERADIS– European Railway Agency Database of Interoperability and Safety' (https://eradis.era.europa.eu/).
([27]) Note that an RU with a licence may not necessarily be operational.

Figure B-32: Number of valid licence documents active at the end of 2023, by country (EU-27 + CH + NO)

Documents valid on 31 December 2023, for passenger, freight and freight/passenger services



N.B.: An RU with a licence may not necessarily be operational.

Source: ERADIS.

B-18 RINF completeness

Purpose

The RINF is a common European register hosted by ERA and intended to contain and provide specified technical data about rail infrastructure. It has been implemented in the context of technical specifications that support interoperability on the railway networks within the European Community. The register should, in particular, provide seamless access to static infrastructure data to RUs for planning and preparing railway services within the EU. The main benefits are expected to come from the possibility to carry out vehicle–route technical compatibility checks before service planning.

Data availability is a key success factor for the register. As with other databases, its usefulness is based on the accuracy and completeness of the data it contains.

Indicators

Two indicators are presented: network description completeness and technical parameter completeness. The former refers to the percentage of the national railway network for which a geometrical description is available. The latter refers to the technical parameters provided for the railway network described in the register. The indicators focus on the availability of data for the related parameters and not on the accuracy of the information provided.

Findings

As of the beginning of 2024, about 92 % of the Member States' railway network had been described in the RINF through sections of lines (SoLs) and operational points (OPs). One national network is not described, and the availability of values for mandatory technical parameters for those SoLs/OPs varies greatly between Member States. In respect of the parameters mandatory since 1 January 2021, 78 % of parameters for SoLs and 83 % of parameters for OPs are currently available in the RINF. These figures focus on the availability of data and not on their accuracy (which is another key factor for vehicle–route compatibility checking). The completeness and accuracy of the data in the RINF are major hurdles to the effective use of the register and the lack of data completeness and accuracy may reduce the return on investments. The latest RINF regulation anticipates further development of the RINF, including the integration of new functions. This brings a challenge in managing this evolution in a way that benefits both the original functions as well as new ones.

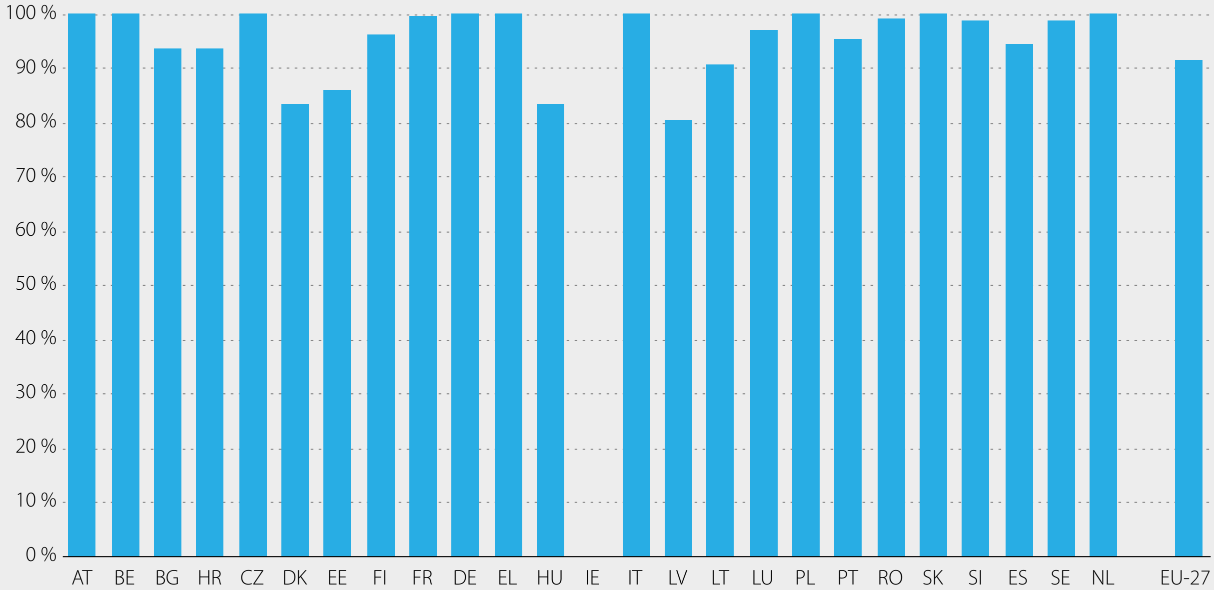
Sources and limitations

The statistics are produced at the level of railway lines; the length of lines in the RINF is evaluated from data available as of the beginning of January 2024, which are analysed in combination with information from Eurostat (2022 data) for establishing the reference length of the national network. In the case of the technical parameters, estimates are produced for all SoLs/OPs in the RINF, across single parameters, mandatory as of 1 January 2021. The indicators focus on the availability of data for the related parameters and not on the accuracy of the information provided.

As the data are retrieved directly from RINF, their reliability depends on the extent to which the information provided is up to date and complete. As specified in the terms of use, ERA has no responsibility for or liability with regard to the information submitted and published in the RINF.

Figure B-33: RINF network description completeness (EU-27, 10 January 2024)

Estimated share of railway line decribed in RINF

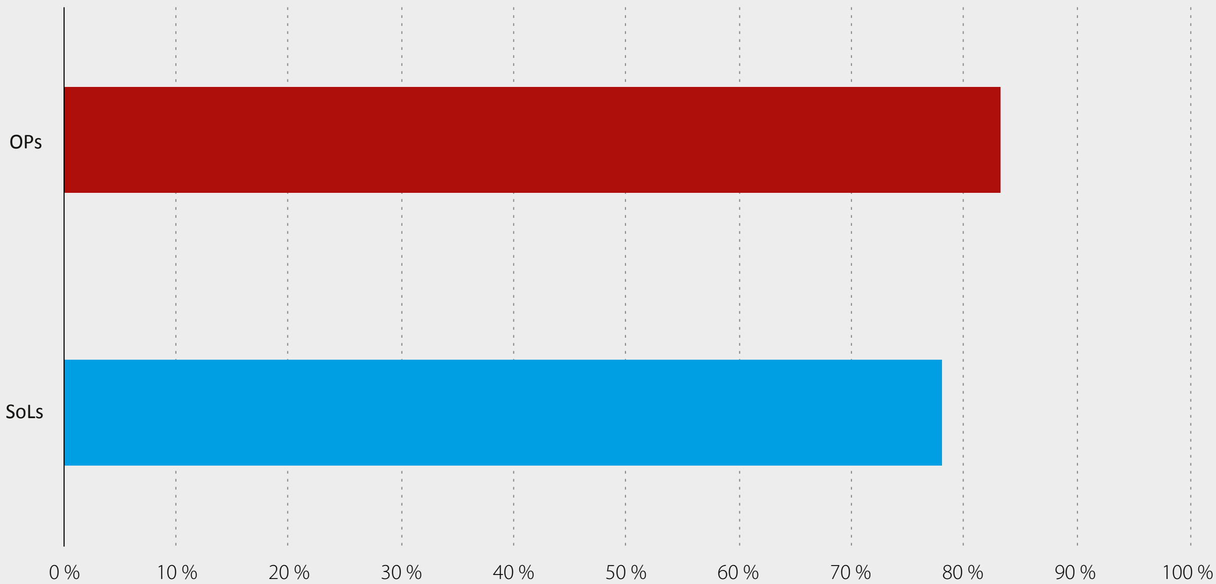


N.B.: The physical descriptions of the tracks of the line, not attributes, are counted.

Sources: RINF and Eurostat, retrieved on 10 January 2024.

Figure B-34: RINF technical parameters completeness (EU-27, 10 January 2024)

Share of SoLs/OPs in RINF with encoded technical parameters across Member States



N.B.: Average of data completeness across 152 parameters for SoLs and 60 parameters for OPs, mandatory as of 1 January 2021.

Sources: RINF and Eurostat, retrieved on 10 January 2024.

B-19 European Train Control System trackside costs

Purpose

ETCS deployment is a means of achieving technical interoperability in train control and signalling in Europe. However, its progress has been limited, mainly because of high costs. A mature set of technical specifications, greater experience of the sector, increased competition and economies of scale can be expected to drive down unit costs over time.

Indicators

The indicator used to monitor the ETCS trackside costs is the weighted average cost for ETCS trackside installation on 1 km of a double-track line equivalent (standard two-track line) expressed as average capital expenditure, based on the Connecting Europe Facility (CEF-1) calls. Reference is also made to the unit costs identified in the European Commission decision authorising the use of unit contributions and applied for CEF ERTMS calls at the end of CEF-1 and since the beginning of CEF-2.

Findings

Within the CEF-1 calls ('actual cost' actions), there have been no new ETCS level 1 trackside projects since 2016; the majority of such projects were related to 2014 and 2015 calls with a unit cost of around EUR 200 000 per line-km (double-track line equivalent). In addition, ETCS level 2 trackside installation costs from CEF-1 calls are available only for 2014–2018, with a weighted average of around EUR 145 000 per line-km. Even if related to 2014–2018, many of these CEF-1 projects (based on actual costs grant) were finalised only recently or will be finalised in 2024, and therefore information on actual costs will be available in the future.

With regard to CEF-2 ERTMS projects, EU support is granted by means of unit contributions and is not based on actual costs (i.e. a dedicated fixed amount is granted per defined unit(s) covered by a project, regardless of the actual incurred costs); this also applies to a number of CEF-1 calls as of 2019. The unit contributions per track-km are defined in a European Commission decision ([28]), which (in table 4) indicates the unit cost identified (e.g. for standard ETCS and associated upgrade costs, the identified unit cost for 1 km of double track equipped is EUR 200 000); there is still work ongoing to update these values.

An increase in competition among ERTMS trackside suppliers as well as their production capacity may help to drive down unit costs.

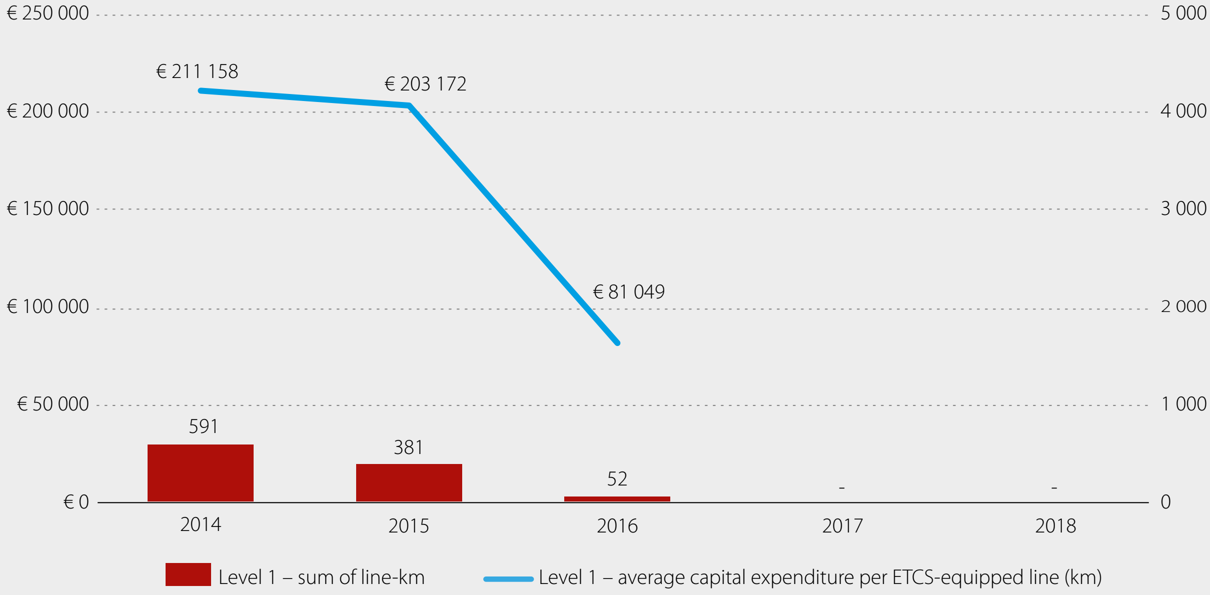
Sources and limitations

Although the quality of the data is estimated to be high, the accuracy of the indicator is compromised by a small number of projects for which comparable data are available; no projects related to ERTMS trackside deployment were supported with CEF based on 'actual cost' as of 2019. Data are sourced from grant agreements of ongoing and closed ERTMS projects submitted to and retained under CEF-1 transport calls for proposals organised by the European Climate, Infrastructure and Environment Executive Agency (CINEA). Therefore, other ERTMS trackside projects not supported by the CEF budget are not captured by the indicator.

([28]) See table 4 in European Commission (2021), Decision authorising the use of unit contributions to support the deployment of ERTMS, electric vehicles recharging infrastructure and the retrofitting of noisy wagons under CEF transport (https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/cef/guidance/unit-cost-decision-cef-ertms-afif-evri-rfn_en.pdf).

Figure B-35: Average capital expenditure per ETCS level 1-equipped line-km (EU-27, 2014–2018)

Unit costs per km of double track line

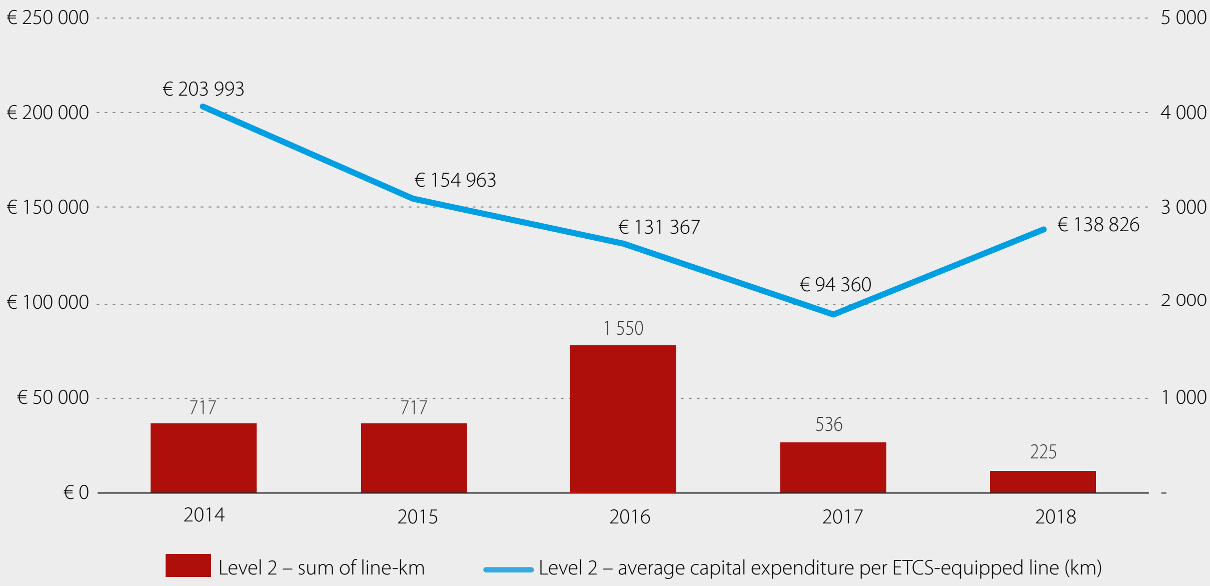


N.B.: Unit costs derived as weighted averages.

Source: CINEA data from CEF-1 actions (grant agreements).

Figure B-36: Average capital expenditure per ETCS level 2-equipped line-km (EU-27, 2014–2018)

Unit costs per km of double track line



N.B.: Unit costs derived as weighted averages.

Source: CINEA data from CEF-1 actions (grant agreements).

B-20 European Train Control System on-board costs

Purpose

The on-board deployment of the ETCS follows the trackside deployment in assuring technical interoperability in train control and signalling in Europe. Like trackside deployment, progress in equipping the vehicles providing traction has been limited, mostly because of high costs. A mature set of technical specifications, greater experience of the sector, increased competition and economies of scale can be expected to drive down unit costs over time.

Indicators

The indicator used to measure the costs for the on-board deployment of the ETCS is the weighted average investment cost needed for fitting, retrofitting or upgrading on-board units (OBUs) on an existing vehicle, based on CEF-1 calls. Reference is made also to the unit costs identified in the European Commission decision authorising the use of unit contributions and applied for CEF ERTMS calls at the end of CEF-1 and since the beginning of CEF-2.

Findings

The data on ETCS on-board costs (based on CEF-1 actions) show an average unit cost of approximately EUR 171 000 per OBU for projects granted between 2014 and 2017, while the costs per ETCS level 1 OBU derived from projects in 2014 and 2015 were much higher. Even if related to 2014–2017, many of these CEF-1 actions (based on actual costs grant) were finalised only recently or will be finalised this year, with updated information on the actual costs.

With regard to CEF-2 ERTMS projects, EU support is granted by means of unit contributions and is not based on actual costs (i.e. a dedicated fixed amount is granted per defined unit(s) covered by a project, regardless of the actual costs incurred); this also applies to a number of CEF-1 calls as of 2019. The unit contributions per on-board ERTMS B3 equipped vehicle are defined in a European Commission decision ([29]), which (in table 4) indicates the unit cost identified (e.g. for the upgrade of software and hardware, the identified unit cost for one equipped (serial) vehicle is EUR 139 000 (national scenario)).

The future deployment of 'ETCS-only' vehicles rather than vehicles with both the ETCS and other class B systems on board is also expected to reduce the costs of ETCS OBUs.

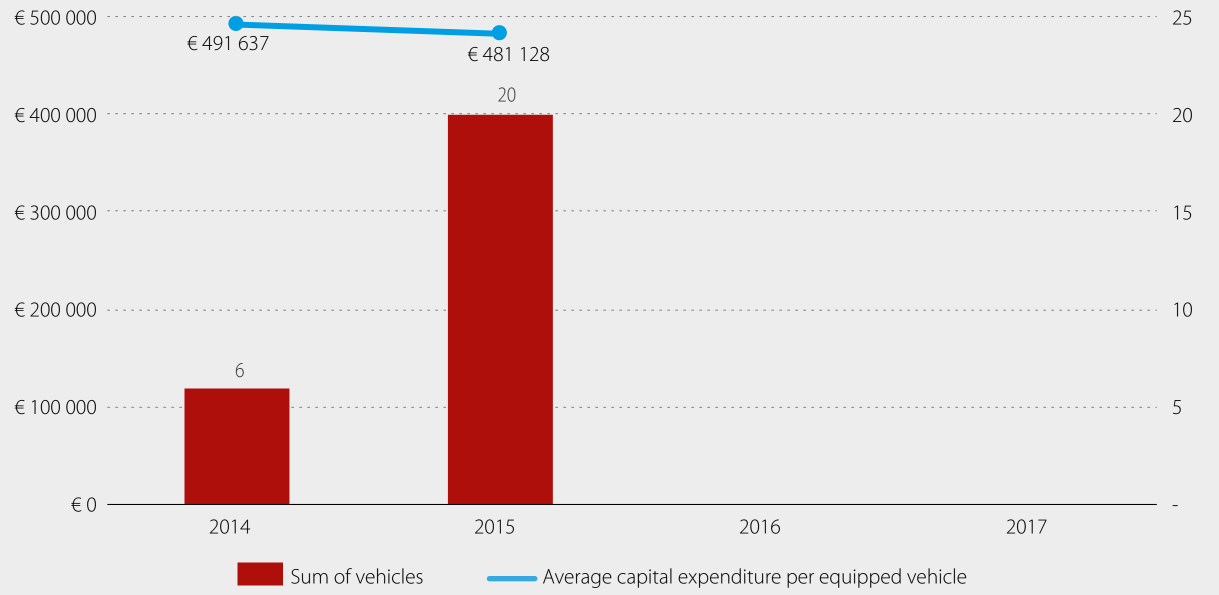
Sources and limitations

The data are retrieved from grant agreements of ongoing and closed ERTMS actions submitted to and retained under CEF-1 transport calls for proposals organised by CINEA. The metric focuses only on capital expenditure for fitting, retrofitting and upgrading existing vehicles, excluding prototyping. Although the quality of the data is estimated to be high, the accuracy of the metric is compromised by a small number of projects for which comparable data are available; no projects related to the on-board deployment of the ETCS were supported by CEF grant based on 'actual costs' as of 2018. Other ETCS OBU projects not supported by the CEF-1 budget are not captured by the indicator.

([29]) See table 4 in European Commission (2021), Decision authorising the use of unit contributions to support the deployment of ERTMS, electric vehicles recharging infrastructure and the retrofitting of noisy wagons under CEF transport (https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/cef/guidance/unit-cost-decision-cef-ertms-afif-evri-rfn_en.pdf).

Figure B-37: Average capital expenditure per ETCS level 1-equipped vehicle (EU-27, 2014–2017)

Unit costs per vehicle

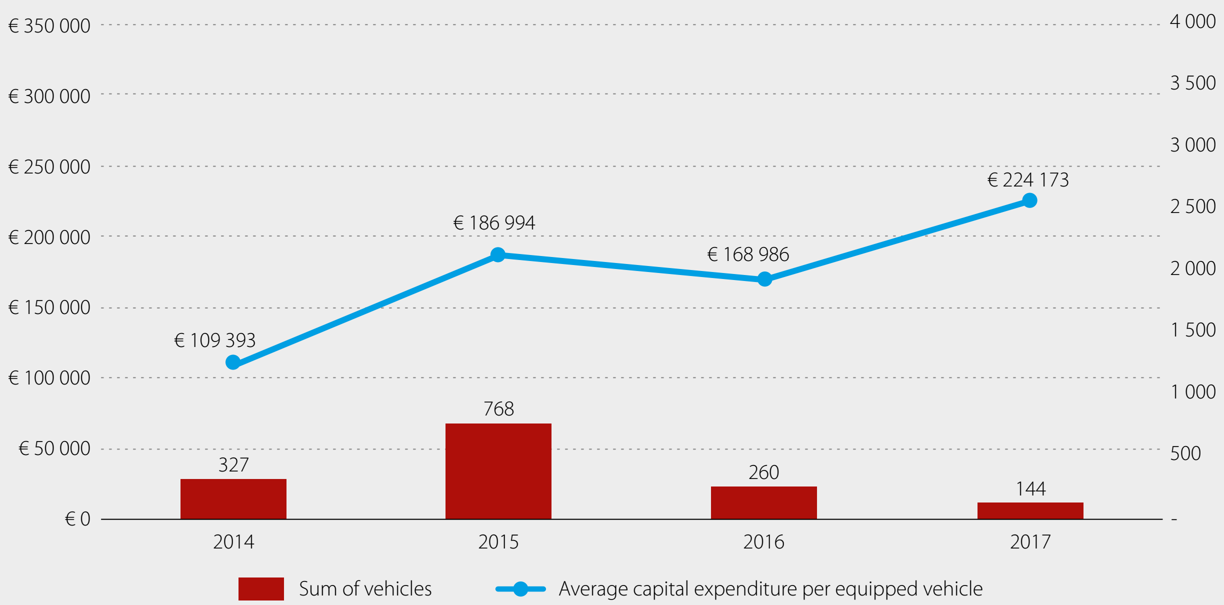


N.B.: Unit costs derived as weighted averages.

Source: CINEA data from CEF-1 actions (grant agreements).

Figure B-38: Average capital expenditure per ETCS level 2-equipped vehicle (EU-27, 2014–2017)

Unit costs per vehicle



N.B.: Unit costs derived as weighted averages.

Source: CINEA data from CEF-1 actions (grant agreements).

B-21 Time to obtain vehicle authorisation

Purpose

The fourth railway package has introduced a scheme for a single EU vehicle authorisation, single safety certification of RUs and for ERTMS trackside approval as a mean to enhance interoperability and improve the efficiency of the railway sector. In particular, reducing the time necessary to obtain formal regulatory documents needed for train operation was one of the promises of the technical pillar of the fourth railway package, as time directly translates into costs to the railway sector.

Indicators

The metric used to monitor the duration of the railway vehicle authorisation process is the time elapsed between the submission of the application via the OSS and the issuance of the authorisation.

Findings

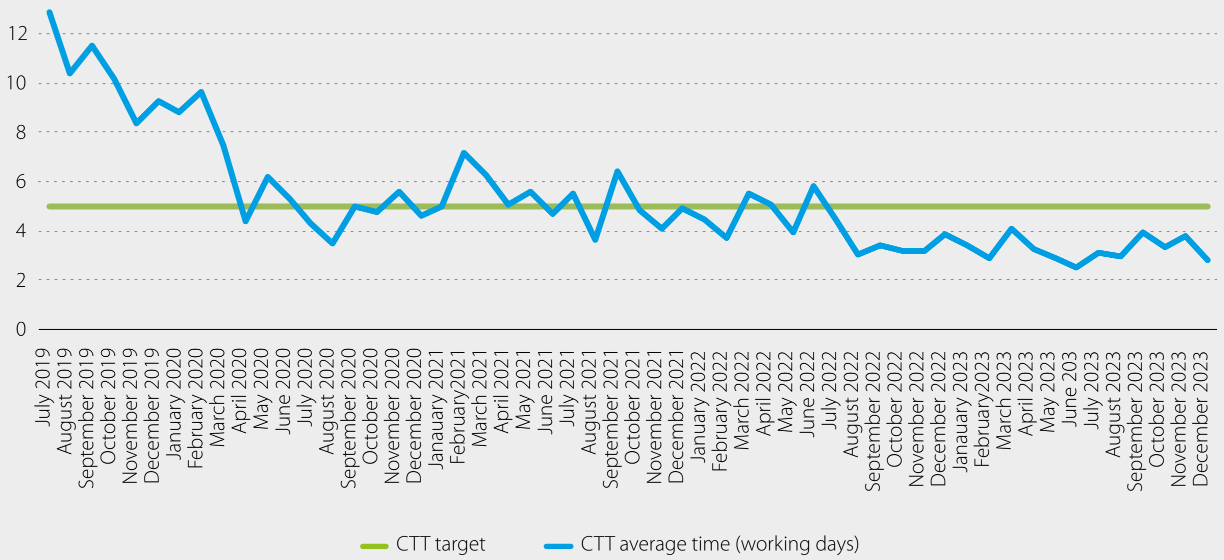
The average time to obtain an authorisation in conformity to type has decreased significantly over time, fluctuating since August 2022 (and for the whole of 2023) well below the target cap of 5 working days. Except for complex vehicle authorisation cases (e.g. locomotives running in several Member States, with CCS involvement), also the average duration of all vehicle authorisations has reduced.

Sources and limitations

Data on vehicle authorisations and vehicles authorised by ERA are retrieved from OSS and can be considered fully reliable. The figures presented refer to all types of authorisations.

Figure B-39: Time frame to obtain vehicle authorisation in conformity to type (2019–2023)

Average duration (over the month) in working days, July 2019–December 2023



Source: OSS.

B-22 European Rail Traffic Management System trackside approvals

As of the end of 2023, 14 ERTMS trackside approvals had been issued by ERA (2 in 2021, 2 in 2022 and 10 in 2023), while 100 applications were ongoing in line with the relevant planning and tendering schedule of IMs.

Annexes

Annex I. Methodological information

Progress with safety

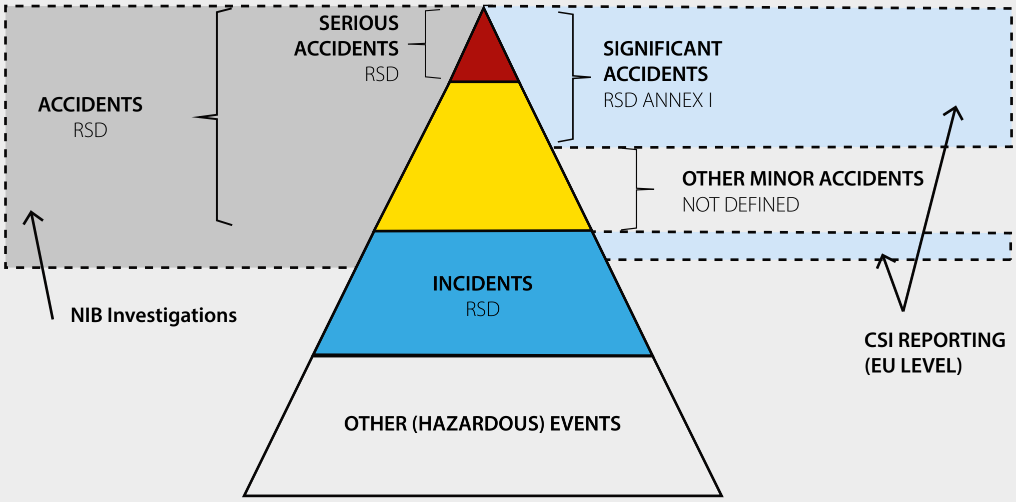
This report is mainly based on CSI data as of the end of December 2022 reported to ERA by the NSAs. Any changes after that date have not been taken into account. Information on serious accidents and their investigations is based on reports available to ERA on 31 December 2023. Any event occurring after that date is not covered by this report.

European legislation requires Member States to report to ERA on significant accidents and serious accidents occurring in their territory. The NSAs must report all significant accidents. The NIBs must investigate all serious accidents, notify ERA of these investigations and, when closed, send the investigation reports to ERA. The term 'significant accident' covers a wider range of events than serious accidents. The RSD (Directive (EU)2016/798) provides the following definitions and ways of reporting for these two groups of accident.

Significant accident (Appendix of Annex I of the RSD, point 1.1)	Serious accident (Article 3.12 of the RSD)
'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. Significant damage is damage that is equivalent to EUR 150 000 or more.	'Any train collision or derailment of trains 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. ' "Extensive damage" means damage that can immediately be assessed by the investigating body to cost at least EUR 2 million in total.'
Annual safety reports by NSAs	Accident investigation reports by NIBs

The current legislative framework does not require Member States to collect information on all railway accidents. Reporting is often limited to significant accidents and a selection of incidents (precursors to accidents). At the Member State level, the information on incidents is not necessarily collected by RUs/IMs, and the NSAs usually rely on accident data when planning their supervisory activities. This absence may represent an obstacle to efficient learning and the early identification of recurring safety issues in the EU railway system.

To facilitate the long-term monitoring of railway safety, this report also uses the accident category 'major accidents' (which includes accidents resulting in five or more fatalities) and the category of 'fatal train collisions and derailments' (which includes train collisions, train derailments and train fires following collisions or derailments in which one or more persons are killed).



Progress with interoperability

Unlike the EU regulatory framework for railway safety, the interoperability regulatory framework does not contain common indicators for monitoring interoperability. A set of indicators has therefore been developed by ERA, in concertation with stakeholders, for assessing the extent to which trains are able to operate safely without interruption while achieving the required level of performance. However, data availability remains an issue: for example, directly measuring the dwell times on national borders in a harmonised way is still in its infancy, and data cannot always be made available centrally for relevant indicators.

This report makes use of various sources of data: databases and registers hosted by ERA, databases of the Commission and other agencies, and databases of representative bodies and international organisations. A regular survey was run among NSAs in late 2023 to gather specific data that are available only at the national level; this survey was integrated into the recommended template for the annual safety report, and several NSAs provided interoperability data on voluntary basis as part of this statutory report. An 81 % response rate to this survey was reached; however, data were not always available for all topics. Therefore, in some instances, assumptions had to be made to produce EU-wide estimates.

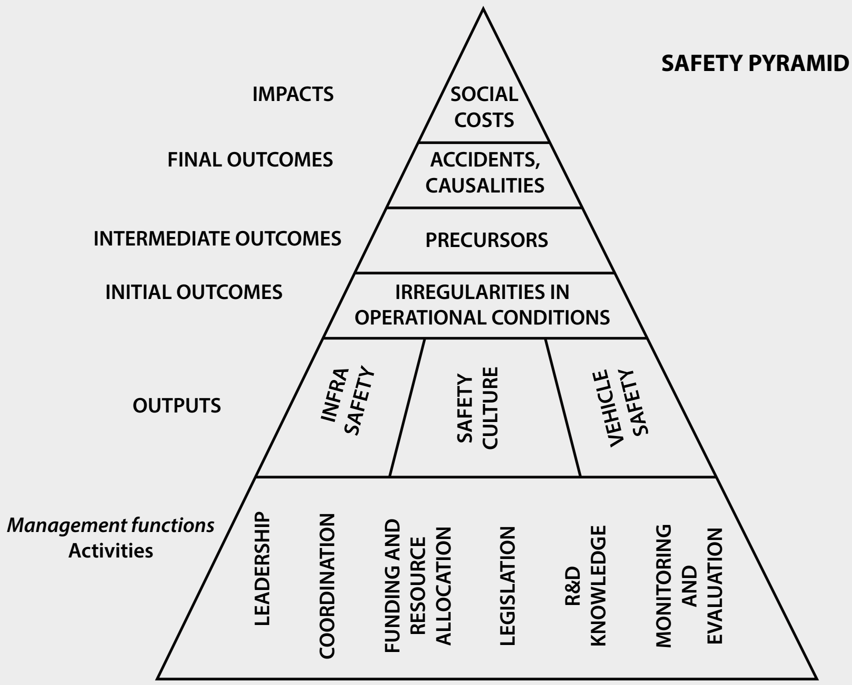
The standard reference dates for this report are the end of 2022 or the end of 2023, depending on the data source (e.g. NSA survey or database/register). The data available for the EU-27, Norway, Switzerland, the United Kingdom (until end of 2020) and the Channel Tunnel are included. The EU aggregate is representative of the EU-27 (as of the end of 2022 and therefore excluding the United Kingdom).

Annex II. Methodological framework for monitoring safety and interoperability

The methodological framework used in this report builds on the universal results framework. Outcomes and impacts are the main focus of a results framework; inputs and implementation processes are generally not emphasised, although outputs are often noted. This conceptual presentation of a results chain (outputs, outcomes and impacts) is often accompanied by a more detailed plan for monitoring progress towards the ultimate objectives through measuring the achievement of outputs, outcomes and impacts at different time intervals. Results are typically defined through indicators, which are often, but not always, quantifiable and measurable or observable. Some indicators are qualitative. The monitoring plan typically includes baseline values and targets expected for outputs and outcomes, and it specifies the measures that will be used to gather data to ensure that the results framework is actually populated with data, updated with information at key points during programme/project implementation and used in decision-making.

Methodological framework for safety monitoring

In the framework for safety monitoring, the impacts refer to evidence on whether outcomes are actually changing beneficiary long-term factors that are important from a societal perspective (e.g. a healthy population or a more efficient transport system), whereas final outcomes consist of long-lasting desirable results, in terms of a reduction in accidents and resulting casualties. Intermediate outcomes are indicators of unsafe operational conditions, with the accident precursors representing the closest directly available measurements. Initial outcomes may then be represented by specific irregularities in operational conditions. In the case of outputs, the conditions and performance of infrastructure, vehicles and humans can be distinguished. The activities can be grouped in a number of ways. Six areas, which can also be viewed as system management functions, are proposed.

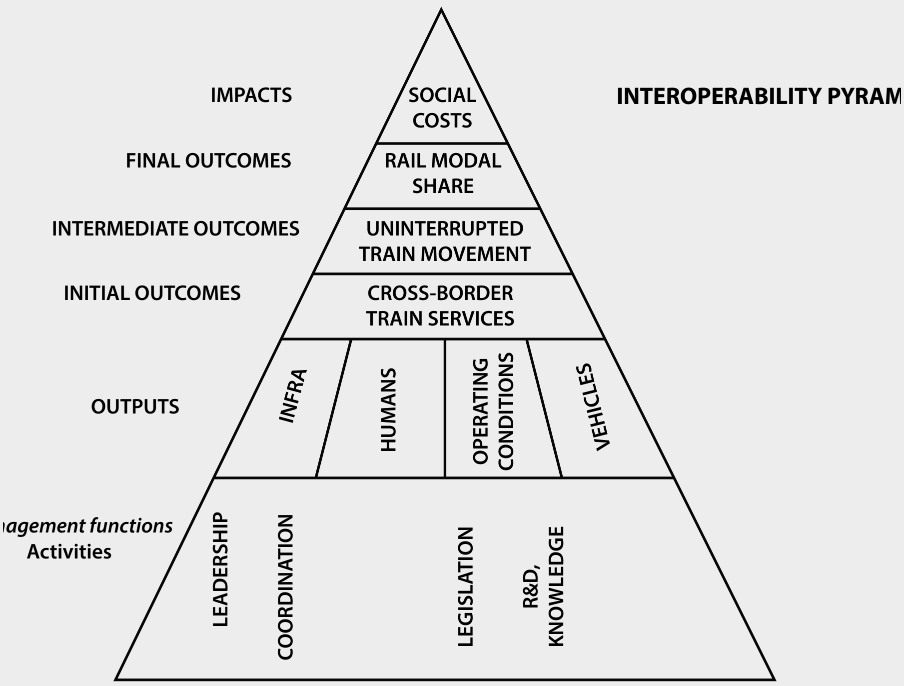


The CSIs include indicators at the levels of impacts, final outcomes and intermediate outcomes, and a few at the level of outputs. Safety culture is a complex concept, and no common indicators exist at the EU level; however, ERA has established a safety culture model ([30]) to allow a shared understanding and provide support to stakeholders. Measurements at the level of activities are crucial for a complete understanding of the full chain and notably of the contribution of organisational, regulatory and other factors. They need to be assessed thoroughly in any evaluation activity. However, for the monitoring of safety performance they remain a secondary focus, also because the underlying cause–effect relationships are not well understood.

Methodological framework for interoperability monitoring

In the proposed framework for interoperability performance monitoring, the impacts refer to evidence on whether outcomes are actually changing beneficiary long-term conditions of interest (e.g. reduced economic costs of transport / improved economic prosperity and reduced environmental impacts). The final outcomes consist of long-lasting desirable results (e.g. an increase in rail modal share). Intermediate outcomes are indications of seamless train operation, related notably to unnecessary train stops at national borders. Initial outcomes may be represented by cross-border operating services. In the case of outputs, the conditions and performance of infrastructure, vehicles and humans along with the overall operating conditions can be identified. Activities can be grouped in a number of ways. Five areas, which can also be viewed as system management functions, are proposed.

The European regulatory framework does not introduce any interoperability indicators, and, so far, ERA has been looking mainly at the outputs level. The impacts have not yet been systematically assessed. However, in this report, for the second time, additional indicators for outcomes (final, intermediate and initial) have been explored and are presented.



([30]) More information is available on ERA's website (European Union Agency for Railways (n.d.), 'Safety culture' (https://www.era.europa.eu/activities/safety-culture_en#meeting2)).

Annex III. Overview of technical specifications for interoperability

Table IIIa: Structural TSIs and their amendments by year

Year	INF		ENE		TSI SRT	TSI PRM	RST				CCS	
	HS TSI INF	CR TSI INF	HS TSI ENE	CR TSI ENE			HS TSI RST	CR TSI LOC&PAS	CR TSI WAG	TSI NOI	HS TSI CCS	CR TSI CCS
1999											Decision 1999/569 on basic parameters EiF: 29/07/1999	
2000												
2001											Decision 2001/260 on basic parameters	
2002	Decision 2002/732 **(1st HS INF TS)** EiF: 30/11/2002		Decision 2002/733 **(1st HS ENE TSI)** EiF: 30/11/2002				Decision 2002/735 **(1st HS RST TSI)** EiF: 30/11/2002				Decision 2002/731 **(1st HS CCS TSI)**	
2003												
2004									Decision 2004/446 (on basic parameters)	Decision 2004/446 (on basic parameters) (CR only)	Decision 2004/447 (amendment)	Decision 2004/447 (on basic parameters)
2005												
2006										Decision 2006/66 **(1st NOI TSI)** (CR only) DoA: 8/8/2006	Decision 2006/860 **(2nd HS CCS TSI)** DoA: 7/11/2006	Decision 2006/679 **(1st CR CCS TSI)** DoA: 28/9/2006
2007											Decision 2007/153 (amendment) DoA: 6/3/2007	Decision 2007/153 (amendment) DoA: 7/3/2007

Year	INF		ENE		TSI SRT	TSI PRM	RST				CCS	
	HS TSI INF	CR TSI INF	HS TSI ENE	CR TSI ENE			HS TSI RST	CR TSI LOC&PAS	CR TSI WAG	TSI NOI	HS TSI CCS	CR TSI CCS
2008	Decision 2008/217 **(2nd HS INF TS)** EiF: 21/12/2007 DoA: 1/7/2008		Decision 2008/284 **(2nd HS ENE TSI)** EiF: 6/3/2008 DoA: 1/10/2008		Decision 2008/163 **(1st SRT TSI)** EiF: 21/12/2007 DoA: 1/7/2008	Decision 2008/164 **(1st PRM TSI)** EiF: 27/12/2007 DoA: 1/7/2008	Decision 2008/232 **(2nd HS RST TSI)** EiF: 21/2/2008 DoA: 1/9/2008		Decision 2006/861 **(1st CR WAG TSI)** DoA 31/01/2008		Decision 2008/386 (amendment) DoA: 1/6/2008	Decision 2008/386 (amendment) DoA: 1/6/2008
2009									Decision 2009/107 (amendment) DoA: 1/7/2009			Decision 2009/561 (amendment) DoA: 1/9/2009
2010											Decision 2010/79 (amendment) DoA: 1/4/2010	Decision 2010/79 (amendment) DoA: 1/4/2010
2011		Decision 2011/275 **(1st CR INF TSI)** DoA: 1/6/2011		Decision 2011/274 **(1st CR ENE TSI)** DoA: 1/6/2011	Decision 2011/291 (amendment) DoA: 1/6/2011			Decision 2011/291 **(1st CR LOC&PAS TSI)** DoA: 1/6/2011		Decision 2011/229 **(2nd NOI TSI)**		
2012	Decision 2012/462 (amendment) DoA: 24/1/2013		Decision 2012/462 (amendment) DoA: 24/1/2013				Decision 2012/462 (amendment) DoA: 24/1/2013			Decision 2012/462 (amendment) DoA: 4/1/2013	Decision 2012/463 (amendment) DoA: 24/1/2013	Decision 2012/463 (amendment) DoA: 24/1/2013
	Decision 2012/464/EU amending Decisions 2006/861/EC, 2008/163/EC, 2008/164/EC, 2008/217/EC, 2008/232/EC, 2008/284/EC, 2011/229/EU, 2011/274/EU, 2011/275/EU, 2011/291/EU etc. DoA: 24/1/2013										Decision 2012/88 **(1st merged CCS TSI)** DoA: 26/7/2012	

Year	INF		ENE		TSI SRT	TSI PRM	RST				CCS	
	HS TSI INF	CR TSI INF	HS TSI ENE	CR TSI ENE			HS TSI RST	CR TSI LOC&PAS	CR TSI WAG	TSI NOI	HS TSI CCS	CR TSI CCS
2013									Regulation 321/2013 **(2nd WAG TSI)** EiF: 13/4/2013 DoA: 1/1/2014		Decision 2012/696 (amendment) DoA: 1/1/2013	
2014									Regulation 1236/2013 (amendment) EiF: 4/12/2013 DoA: 1/1/2014			
2015	Regulation 1299/2014 **(1st merged INF TSI)** EiF/DoA: 1/1/2015		Regulation 1301/2014 **(1st merged ENE TSI)** EiF/DoA: 1/1/2015 Corrigendum L 13/13 (2015) (editorial corrections)		Regulation 1303/2014 **(2nd SRT TSI)** EiF/DoA: 1/1/2015	Regulation 1300/2014 **(2nd PRM TSI)** EiF/DoA: 1/1/2015	Regulation 1302/2014 **(2nd LOC&PAS TSI)** EiF/DoA: 1/1/2015 Corrigendum L 10/45 (2015) (editorial corrections)		Regulation 2015/924 (amendment) DoA: 01/07/2015	Regulation 1304/2014 **(3rd NOI TSI)** EiF/DoA: 1/1/2015	Decision 2015/14 (amendment) DoA: 1/7/2015	
2016					Regulation 2016/912 (correction) EiF: 30/6/2016						Regulation 2016/919 (Recast) EiF: 05/07/2016 Corrigendum L 279/94 (2016) (editorial corrections)	
2017												
2018			Regulation 2018/868 (amendment) EiF: 04/07/2019				Regulation (EU) 2018/868 (amendment) EiF: 04/07/2019					

<table>
<tr><th rowspan="2">Year</th><th colspan="2">INF</th><th colspan="2">ENE</th><th rowspan="2">TSI SRT</th><th rowspan="2">TSI PRM</th><th colspan="4">RST</th><th colspan="2">CCS</th></tr>
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EiF: 16/06/2019</td><td colspan="2">Regulation 2019/776 (amendment)
EiF: 16/06/2019</td><td>Regulation 2019/776 (amendment)
EiF: 16/06/2019</td><td>Regulation 2019/772 (amendment)
EiF: 16/05/2019</td><td colspan="2">Regulation 2019/776 (amendment)
EiF: 16/06/2019</td><td>Regulation 2019/776 (amendment)
EiF: 16/06/2019</td><td>Regulation 2019/774 (amendment)
EiF: 16/06/2019</td><td colspan="2">Regulation 2019/776 (amendment)
EiF: 16/06/2019</td></tr>
<tr><td>2020</td><td colspan="2"></td><td colspan="2"></td><td></td><td></td><td colspan="2">Regulation 2020/387 (amendment)
EiF: 09/03/2020</td><td>Regulation 2020/387 (amendment)
EiF: 09/03/2020</td><td></td><td colspan="2">Regulation 2020/387 (amendment)
EiF: 09/03/2020
Regulation 2020/420 (amendment only DE language)
EiF: 21/03/2020</td></tr>
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<tr><td>2023</td><td colspan="2">Regulation 2023/1694 (amendment)
EiF: 28/09/2023</td><td colspan="2">Regulation 2023/1694 (amendment)
EiF: 28/09/2023</td><td></td><td>Regulation 2023/1694 (amendment)
EiF: 28/09/2023</td><td colspan="2">Regulation 2023/1694 (amendment)
EiF: 28/09/2023</td><td>Regulation 2023/1694 (amendment)
EiF: 28/09/2023</td><td>Regulation 2023/1694 (amendment)
EiF: 28/09/2023</td><td colspan="2">Regulation 2023/1695 (repealing 2016/919)
EiF: 28/09/2023</td></tr>
</table>

N.B.: CR, conventional; DoA, date of application; EiF, entry into force; ENE, energy; HS, high-speed; INF, infrastructure; LOC&PAS, locomotive and passenger rolling stock; NOI, noise; RST, rolling stock; SRT, safety in railway tunnels; WAG, wagon.

Table IIIb: Functional TSIs and their amendments by year

<table>
<thead>
<tr><th rowspan="2">Year</th><th colspan="2">TSI OPE</th><th colspan="2">TA</th></tr>
<tr><th>HS TSI OPE</th><th>CR TSI OPE</th><th>CR TSI TAF</th><th>TSI TAP</th></tr>
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(1st HS OPE TSI)
DoA: 12/3/2003</td><td rowspan="4"></td><td rowspan="2"></td><td rowspan="9"></td></tr>
<tr><td>2003</td></tr>
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(on basic parameters)</td></tr>
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(1st CR OPE TSI)
DoA: 18/05/2007</td><td rowspan="6">Regulation 62/2006
(1st TAF TSI)
EiF: 19/1/2006</td></tr>
<tr><td>2007</td></tr>
<tr><td>2008</td><td rowspan="2">Decision 2008/231
(2nd HS OPE TSI)
DoA: 1/9/2008</td></tr>
<tr><td>2009</td><td>Decision 2009/107
(amendment)
DoA: 1/7/2009</td></tr>
<tr><td>2010</td><td>Decision 2010/640
(amendment)
DoA: 25/10/2010 and 1/1/2014*</td><td>Decision 2010/640
(amendment)
DoA: 25/10/2010 and 1/1/2014*</td></tr>
<tr><td>2011</td><td></td><td>Decision 2011/314
(2nd CR OPE TSI)
DoA: 1/1/2012**</td><td>Regulation 454/2011
(1st TAP TSI)
EiF: 13/5/2011</td></tr>
<tr><td>2012</td><td colspan="2">Decision 2012/464
(amendment)
DoA: 24/1/2013</td><td>Regulation 328/2012
(amendment)
EiF: 08/5/2012</td><td>Regulation 665/2012
(amendment)
EiF: 22/7/2012</td></tr>
<tr><td>2013</td><td colspan="2"></td><td rowspan="2">Regulation 280/2013
(amendment)
EiF: 24/3/2013</td><td rowspan="2">Regulation 1273/2013
(amendment)
EiF: 8/12/2013</td></tr>
<tr><td>2014</td><td colspan="2">Decision 2012/757
OPE:2012
(1st merged OPE TSI)
DoA: 1/1/2014</td></tr>
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(amendment)
EIF/DoA: 20/07/2015</td><td>Regulation 1305/2014
(2nd TAF TSI)
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(amendment)
EIF: 18/03/2015</td></tr>
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(amendment)
EIF: 25/04/2016</td></tr>
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(amendment)
EIF: 16/3/2018</td><td></td></tr>
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(2nd OPE TSI)
EIF: 16/6/2021***</td><td>Regulation 2019/778
(amendment)
EIF: 16/6/2019</td><td>Regulation 2019/775
(amendment)
EIF: 16/6/2019</td></tr>
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<tr><td>2022</td><td colspan="2"></td><td></td><td></td></tr>
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(amendment)
EiF: 28/09/2023</td><td></td><td></td></tr>
</tbody>
</table>

(*) DoA of 1 January 2014 is only for point 6 of Annex I and point 5 of Annex II.

(**) Appendices P and Pa have different dates of application, that is Appendix P applies from 1 January 2012 until 31 December 2013 and Appendix Pa applies from 1 January 2014.

(***) Sections 4.2.2.1.3.2 and 4.4 of the Annex apply from 16 June 2019. Section 4.2.2.5 and Appendix D1 of the Annex to this regulation apply from 16 June 2019 in the Member States that have not notified ERA and the Commission in accordance with Article 57(2) of Directive (EU) 2016/797. Section 4.2.2.5 and Appendix D1 of the Annex to this regulation apply from 16 June 2020 in the Member States that have notified ERA and the Commission in accordance with Article 57(2) of Directive (EU) 2016/797. Appendices A and C of the Annex to this regulation will apply from 16 June 2024 at the latest.

N.B.: DoA, date of application; EiF, entry into force; OPE, operation and traffic management.

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