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

2020

EUROPEAN UNION AGENCY FOR RAILWAYS

* Following the entry into force of the technical pillar of the Fourth Railway Package (Reg. 2016/796), the European Union Agency for Railways replaces and succeeds the European Railway Agency. In several parts of the report, this may be referred to as the "Agency".

Printed by the Publications Office in Luxembourg

Manuscript completed in June 2020

Luxembourg: Publications Office of the European Union, 2020

Print	ISBN 978-92-9205-803-6	ISSN 2467-3730	doi:10.2821/469518	TR-AF-19-001-EN-C
PDF	ISBN 978-92-9205-802-9	ISSN 2467-3749	doi:10.2821/30980	TR-AF-19-001-EN-N

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List of abbreviations

ATP	Automatic Train Protection
CAPEX	Capital Expenditure
CCM	Change Control Management
CCS TSI	Control Command and Signalling Technical Specification for Interoperability
CEF	Connecting Europe Facility
CNC	Core Network Corridors
CSI	Common Safety Indicators
CSM	Common Safety Method
CST	Common Safety Target
CUI	Common User Interface
CT	Channel Tunnel
DG MOVE	Directorate General for Mobility and Transport
EASA	European Aviation Safety Agency
EC	European Commission
ECM	Entity in Charge of Maintenance
ECVVR	European Centralised Virtual Vehicle Register
EMSA	European Maritime Safety Agency
ENE TSI	Energy Technical Specification for Interoperability
ERA	European Union Agency for Railways
ERADIS	European Railway Agency Database of Interoperability and Safety
ERAIL	European Railway Accident Information links
ERATV	European Register of Authorised Types of Vehicles
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
EU	European Union
FWSI	Fatalities and weighted serious injuries
GSM-R	Global System for Mobile Communications – Railway
IM	Infrastructure Manager
INEA	Innovation & Networks Executive Agency
INF TSI	Infrastructure Technical Specification for Interoperability
LOC&PAS TSI	Locomotive and Passenger Rolling Stock Technical Specification for Interoperability
MS	Member State
MWA	Moving Weighted Average
NIB	National Investigation Body
NOI TSI	Noise Technical Specification for Interoperability
NRV	National Reference Values
NSA	National Safety Authority
NTR	National Technical Rules
NVR	National Vehicle Register
OB	On-Board
OBU	On-Board Unit

OSS	One Stop Shop
PRM TSI	Persons with Reduced Mobility Technical Specification for Interoperability
RDD	Reference Document Database
RID	Regulation concerning the International Carriage of Dangerous Goods by Rail
RINF	Register of Infrastructure
RST	Rolling Stock
RU	Railway Undertaking
SAIT	Safety Alert IT tool
SERA	Single European Railway Area
SIS	Safety Information System
SRT TSI	Safety in Railway Tunnels Technical Specification for Interoperability
SSC	Single Safety Certificate
TAF TSI	Telematics Applications for Freight Services Technical Specification for Interoperability
TAP TSI	Telematics Applications for Passenger Services Technical Specification for Interoperability
TDD	Train Drivers Directive
TEN-T	Trans-European Transport Network
TPS	Train Protection System
TSI	Technical Specification for Interoperability
UNIFE	The Association of the European Rail Industry
WAG TSI	Wagon Technical Specification for Interoperability

Country codes

AT	Austria
BE	Belgium
BG	Bulgaria
CH	Switzerland
CY	Cyprus
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
CT	Channel Tunnel

Foreword by the Executive Director

Josef Doppelbauer

Dear reader,

I am very pleased to introduce the 2020 edition of the Agency report on the progress with safety and interoperability of the railway system in the European Union. It is a key element in our continuous effort to better understand the situation of European railways and its evolution in terms of safety and interoperability. The data contained in this report can be used to identify areas for improvement towards reaching a more efficient and effective railway system for all citizens in Europe: the Single European Railway Area. Finally, the report is an important source of information for decision making at EU and Member State level.

The current worldwide sanitary crisis entailing a slowdown of economic and railway activities across Europe at the same time creates an opportunity to thoroughly reflect on how to make the railway system work better for society after the pandemic lockdown. Let us all make the best of this period by carefully analysing the data contained in this report, in order 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 under the European legal framework. However, several indicators rely on non-statutory data provided by national Bodies and other stakeholders on a voluntary basis. We warmly thank the National Safety Authorities 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 one passenger fatality occurring each 25 billion kilometers on average. Major accidents with more than five fatalities are becoming increasingly rare, 2018 being the first year since the late 1980s with no major railway accident reported. We notice, however, a rise in the number of significant accidents and incidents with potentially serious consequences and unfortunately see little improvements over the past few years in this area. Recent accidents involving high speed passenger trains remind us of the inherent risks in railway transport and the necessity for all parties involved to continue their efforts to ensure efficient safety management.

The railway community 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 still have not implemented a systematic and comprehensive EU-wide safety occurrence reporting scheme, which would enable not only to learn effectively 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, or rolling stock fires, would particularly benefit from wider information sharing. The ongoing digital revolution offers both inspiration and potential solutions. I invite all railway parties to be strongly committed to enhancing railway safety by rigorously applying a robust Safety Management System and by implementing a positive railway safety culture.

The Agency is actively fostering a common positive European railway safety culture. Safety is not only about regulation, rules and procedures. Safety is about a living and collective commitment. By developing useful instruments to support the sector, the Agency is demonstrating its engagement to develop a positive safety culture. However, we need the

commitment of all players to achieve a sustainable and safe performance across the Single European Railway Area. You can find more information on safety culture on our website.

Progress with railway interoperability

Our records confirm that we have already reached 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. Whereas a sound progress could be seen in aligning operational frameworks in terms of rules, only modest improvements are visible in making the railway assets interoperable. As a consequence, railways could not increase their modal share in the transportation mix in the past decade, despite being currently the most sustainable mode of transport.

At border crossings the weaknesses in railway interoperability are most visible. Even the core corridors in Europe suffer from the lack of technical interoperability due to patchy ERTMS deployment and non-conformity with TSIs in new infrastructure projects. In many areas, delays in the implementation of legal requirements in a few Member States consequently delay the interoperable deployment of railways in other countries, not allowing them to fully benefit from the harmonised system. For example, the delayed implementation of TAP / TAF TSIs, PRM TSIs and RINF negatively affects railway customers daily experience and the reputation of European railways as a whole. The ongoing economic crisis should not be used as an excuse for any delays in the implementation of requirements for which the deadline has already passed.

We all need to enhance our efforts in particular in the area of railway data interoperability. High quality interoperable railway data are essential for European railways. After years of building single purpose databases, our focus must now shift towards synergies enabled by connected data and underlying IT systems. To significantly improve the current incompleteness and inaccuracy of data in certain registers I invite all parties involved to intensify their collaboration with the Agency.

Besides, our new approach to the revisions of TSIs should enable the Agency and the sector to allocate expert resources more efficiently, to enhance international standardisation and to react rapidly on emerging technologies to considerably shorten their time-to-market.

Finally, with its mandate under the Fourth Railway Package, the Agency is now the European authorisation and certification body for international railway transport, issuing vehicle authorisations, granting safety certificates and deciding on ERTMS trackside approvals. The experience of those Member States benefiting since June 2019 from this new procedure is overall positive and promising for the future.

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

Introduction

This report is one of the visible results of the Agency's activities in monitoring safety performance. It is also part of the Agency's effort to provide to its stakeholders a thorough overview of the development of railway safety and interoperability in the European Union. In accordance with EU legislation, it has been published by the Agency on a biennial basis since 2006.

Specifically, this publication represents a second edition of the Report on progress on safety and interoperability in the single European railway area, a joint biennial statutory report foreseen under recast Agency Regulation. It follows on from the two thematic reports produced by the Agency since 2006.

Monitoring safety and interoperability of the Union railway system is one of the key tasks of the Agency. The Agency collects, processes and analyses different sets of data in order to support recommendations on actions to be taken. In this way, the Agency facilitates evidence-based policy-making at the EU level. By continuously monitoring and analysing safety and interoperability performance of the Union railway system, the Agency provides assurance that the common goals are achieved.

Report scope

This report is based on data for the reporting period 2018, and where available, for 2019. It therefore geographically covers the 28 Member States as of end 2019. Since Cyprus and Malta do not have railway systems that are covered by the EU legislation, the Union railway system is constituted by railway systems of 26 Member States. The Channel Tunnel (CT) is a separate reporting entity, so that relevant data are given separately to the French and UK data. The data are also reported by Norway and Switzerland. Therefore, there were a total of 29 reporting entities in 2019; they are refered as "ERA countries" in this report.

Information sources

The basis for this report is data available in various EU databases and registers and provided therein by National authorities, such as National Safety Authorities and National Investigation Bodies, operators and other actors.

Specifically, in the area of safety, the national bodies have a legal obligation to report to the Agency a set of defined information that can be used to assess the development of railway safety in the EU. Notably, the National Safety Authorities gather Common Safety Indicators, defined in legislation, from the railway undertakings and infrastructure managers which provide a footprint for safety performance in Member States and the Union.

Specifically, in the area of interoperability, the report draws on data available in the databases and registers hosted by the Agency, complemented by a biennial data survey among National Safety Authorities. Furthemore, the official data available at European Commission are used. Finally, data from industry associations complement the picture.

Report and chapter overview

This reports consist of two main parts: Progress with safety (A) and Progress with interoperability (B). To monitor the progress with the two qualities of the Union railway system, a series of standard Indicators is used. A comprehensive methodological framework outlined in Annex B governs their selection. Indicators take inspiration from the logical framework for evaluation, whereas indicators are designed for three main areas: inputs, outputs and outcomes. The indicators are presented in the following way:

Purpose describes the motivation for the indicator, its importance in the quest for safety and interoperability, goal, or official target if available, and expected use.

Indicators describes the measures of quantitative assessment used for comparing, and tracking performance.

Findings provides main observations along with the results of the data analysis.

Meta-data provides additional information on the data source, production and other aspects influencing the metric and its quality.

Metrics for each indicator are showed with the help of data visualizations. Where available, two visuals are used: the first provides an overview, while the second provides further insight.

A. Progress with Safety

Summary

The railway safety level of the Union railway system remains high; it is actually one of the highest worldwide. In a multi-modal comparison, rail appears as the safest mode of land transport in the EU, with the fatality rate for passenger gradually approaching that for aircraft on-board passengers.

The safety level in terms of fatal accident rate has improved continuously since 1990, with an average annual reduction of more than 5 %. Major accidents resulting in five or more fatalities have become rare: only two such accidents occurred in the last two years.

While the safety levels have continued to improve in recent years, the pace of improvements has slowed down and almost came to a standstill in 2016-2017. The safety levels registered for 2018 are however historically the highest.

With 1 721 significant accidents in 2018 resulting in 885 fatalities and 760 serious injuries, the total costs of railway accidents is estimated at about 5 billion EUR, based on latest available unit cost estimates.

Behind the overall positive trends are the realities requiring attention of both the railway sector and policy makers. Despite an overall decrease in significant accidents since 2010, the "internal" accidents (collisions, derailments and fires in rolling stock) are stagnating. The progress has also been very uneven across the EU Member States, with the variance in safety levels remaining high. Remarkably, the speed of convergence of safety levels has lessened and safety performance of MSs no longer converges since 2016.

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

No progress can be seen in reducing railway workers casualties since 2014, if looking at absolute figures. Each year, close to 30 fatalities are reported among railway workers. Moreover, some 60 workers are seriously injured each year. However, the fatality rate (casualties per traffic volume) shows a decreasing trend since 2014, which is however less pronounced for employees than for passengers.

Safety at level crossings has been improving in the past decade: the annual average reduction over the period 2010-2018 has been 3 % for accidents, 4 % for fatalities. Over the same period, the reduction was higher in other types of railway accidents and resulting fatalities and lower in other types of road accidents and resulting fatalities. Notably it appears that a slower pace of improvements in road safety (compared to rail safety) impacts the progress in improving level crossing safety levels.

One of the main drivers of disparities in safety levels seems to be the level of safety of the railway infrastructure: the share of deployment of advanced train protection systems and rail-side protected level crossing devices vary greatly across Europe. The latter comes on top of the differences in terms of density of level crossings in general, and other structural factors inherently increasing the likelihood of an accident (share of single track lines, density of switches, etc.).

The accident investigation reports as well as high numbers of reported precursors highlights the potential for further safety improvements through learning from experience. This potential can only be fully exploited if the information and knowledge is shared across the Union.

Overview of indicators and figures

Part A: Progress with safety

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A-1 Cost of railway accidents

Purpose

An unsafe railway system has direct and indirect impacts on society. Economic theory allows the expression of those impacts in monetary terms. This then gives an idea of the costs of unsafety of railway operation to both industry and to the society. Whereas the monetisation of costs to business is quite straightforward, the estimation of socio-economic costs draw from economic studies pro unit cost estimates, which evolves in time along with more empirical evidence.

Indicators

In application of the Railway Safety Directive, the economic impact of accidents is measured by the economic impact of fatalities and serious injuries, costs of delays, costs of material damage to rolling stock or infrastructure and costs to the environment. Other types of the costs have been recognized, but they represent a minor addition to the statutory types of costs.

Findings

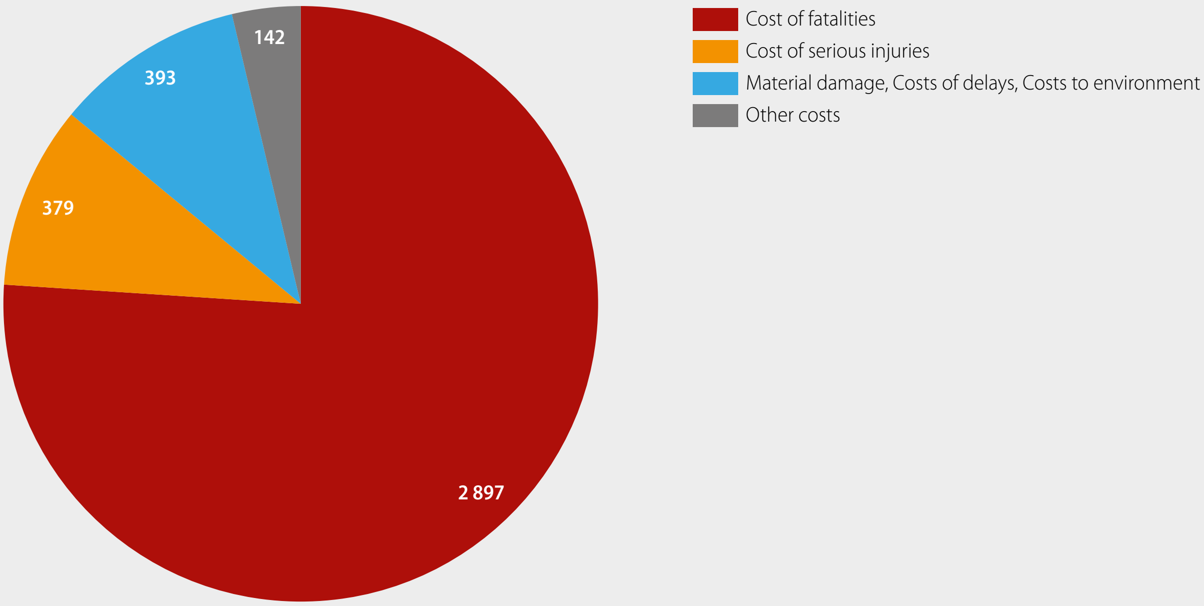
Total costs of railway accidents in 2018 is estimated at about 5 billion EUR, more than double the figure published in previous years. This is due to the significant increase in casualty unit costs. Other types of cost such as cost of modal shift or loss of productivity account for a mere three percent of the total costs. The costs reported and estimated for individual MSs reflect both the accident outcomes, but also the economic situation, as per unit cost estimates for casualties.

Meta-data

While the economic impact of casualties can be estimated for all countries thanks to EU wide studies on the unit costs, the costs of delays are only available for 21 EU countries. Four MSs were not able to monetise the total material damage in significant accidents in 2018, whereas only four recorded environmental damage in relation to those accidents. Data is reported by NSAs for more than ten years, under Annex I to the Railway Safety Directive (CSIs), where detailed guidance material, which also contains fall back values, is available. At the same time, some countries fail to report some types of costs, so the reliability should be considered on a case by case basis.

Figure A-1: Costs of railway accidents (EU-28, 2018)

Estimated costs in million EUR

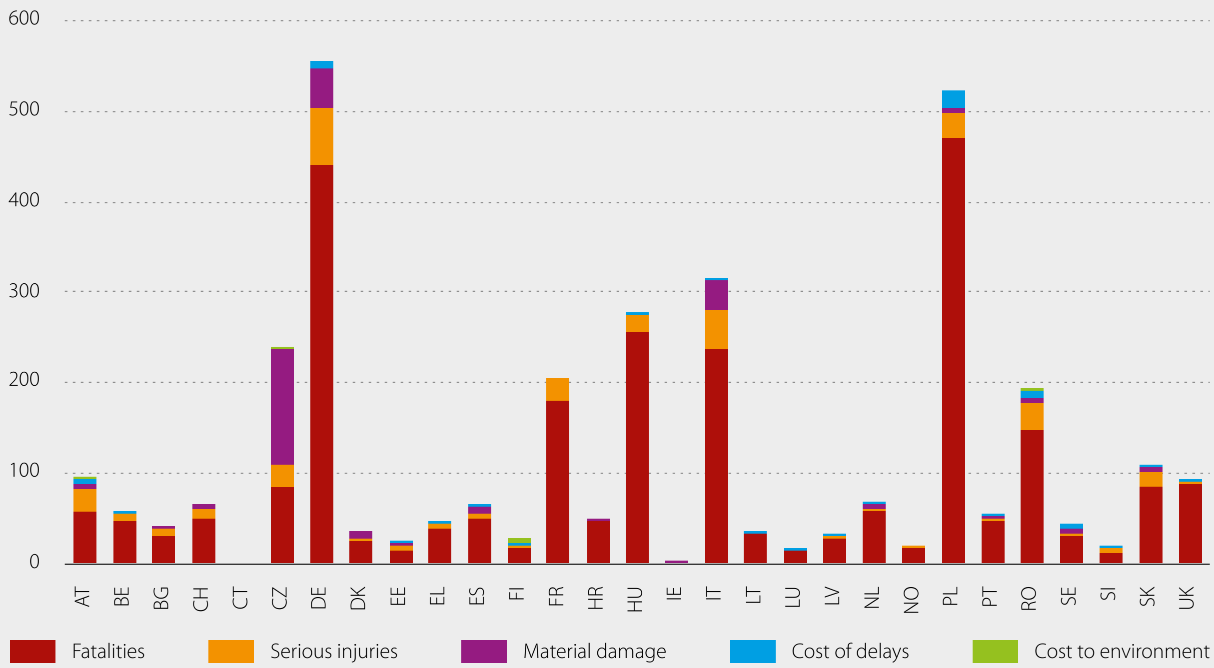


Notes: Other costs: Modal shift, Air polution, Administrative, Rerouting, Reputational damage, Productivity losses, estimated from unit costs developed by consultant for ERA

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

Figure A-2: Costs of railway accidents per country (EU-28, 2018)

Reported costs in million EUR



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

A-2 Accidents and their outcomes

Purpose

Significant accidents and resulting casualties provide a final account of the unsafety in a railway system. As practically all accidents resulting in fatal or serious injury are the product of a significant accident, a strong correlation exists between various indicators. There are no explicit desired target values other than to maintain or, where practically possible, to improve railway safety in the Single European Railway Area (SERA), whereas the monitoring and assessment of this goal is assured with the use of rates (casualties normalized by transport volume).

Indicators

The absolute number of significant accidents and resulting serious and fatal injuries.

Findings

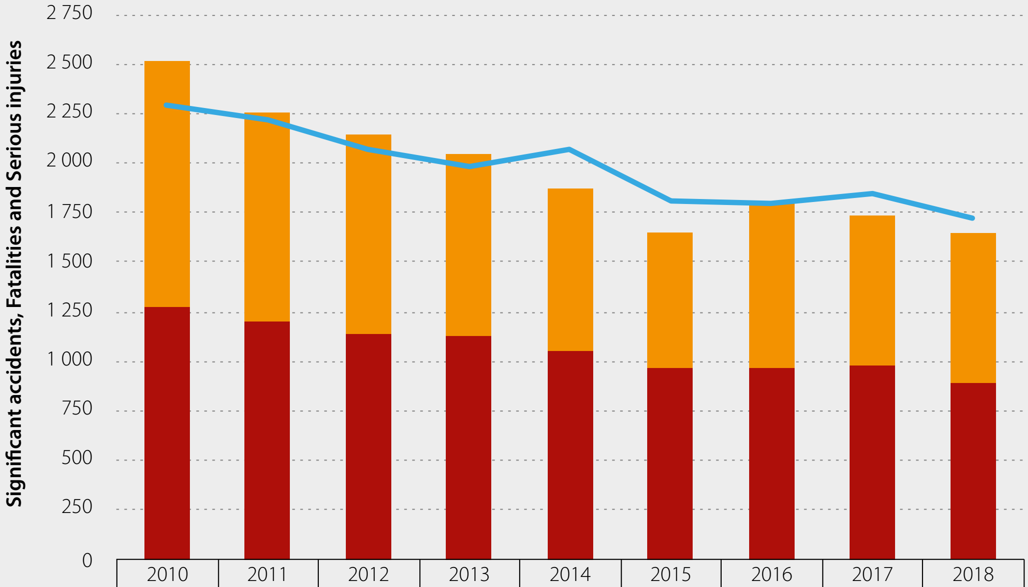
Altogether 1 721 significant accidents, 885 fatalities and 760 serious injuries were recorded in the EU-28 countries in 2018. A steady decrease in significant accidents and resulting casualties has been recorded in the period 2010-2018, for which harmonised data are available across the Union. However, the decrease is less pronounced since 2015, as no year-to-year reduction was observed in 2016 and 2017. The 2017/2018 year to year decrease of 7 % is statistically significant; it is also significant when compared to the average of the four preceding years. The decrease occurred across all accident categories except collisions and fires in rolling stock. In parallel, a similar drop has been observed for suicides on railway premises, which are not accounted for among railway accidents.

Meta-data

Data used to monitor progress with safety outcomes are part of the Common Safety Indicators (CSIs) supplied by the National Safety Authorities (NSAs) to the Agency. More than ten years of continuous work on data quality in Member States and at the Agency provides assurance on the accuracy of the data.

Figure A-3: Main safety outcomes (EU-28, 2010-18)

Significant accidents, fatalities and serious injuries



	2010	2011	2012	2013	2014	2015	2016	2017	2018
Serious injuries	1 249	1 050	1 015	911	819	682	825	756	760
Fatalities	1 270	1 206	1 135	1 129	1 054	962	970	974	885
Significant accidents	2 292	2 224	2 069	1 980	2 076	1 804	1 795	1 848	1 721

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

Figure A-4: Significance of changes in annual counts of significant accidents (EU-28)

Poisson statistical significance test for significant accidents

Significance of change in outcomes	2018/2017	2018/(2014-2017)
Collisions of trains	5%	3%
Derailments of trains	-23%	-14%
Level-crossing accidents	-4%	-5%
Accidents to persons	-9%	-11%
Fires in rolling stock	71%	23%
Other accidents	-8%	-18%
All accidents	-7%	-8%
Suicides	-5%	-7%

Statistically significant changes highlighted as orange cells

Note: Statistical significance at 95%

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

A-3 Major accidents

Purpose

Since past accident records may not always be complete in all EU countries, narrowing the scope to railway accidents with severe consequences may provide a more robust confirmation of the trends identified and, at the same time, highlight the most serious events that occurred in the past and their impact on overall accident statistics. Accidents with multiple fatalities rarely escape the attention of the media and the public, so data on these accidents are assumed to be complete. Historical data on serious accidents that caused five or more fatalities in ERA countries (EU-28+CH+NO), hereby referred to as major, have been maintained by the Agency on top of regulatory data collection.

Indicators

Major accidents that include not only the train collisions and derailments with five or more fatalities, but also the major level-crossing accidents, train fires and accidents involving groups of people struck by rolling stock in motion.

Besides, fatal train collisions and derailments allows one to isolate the most serious operational accident.

Findings

After the exceptional year 2018, with no single major accident recorded, two such accidents occurred in 2019. **An overall downward trend has been observed since 1988, whereas the rate of improvement has been 'softening' over the past two decades.** There were on average 13 major railway accidents each year during the 1990s; this figure has now reduced to an average of eight accidents per year in the 2000s and four in the 2010s. Estimated for the most recent past years, major accident occur after train runs more than one billion kilometres.

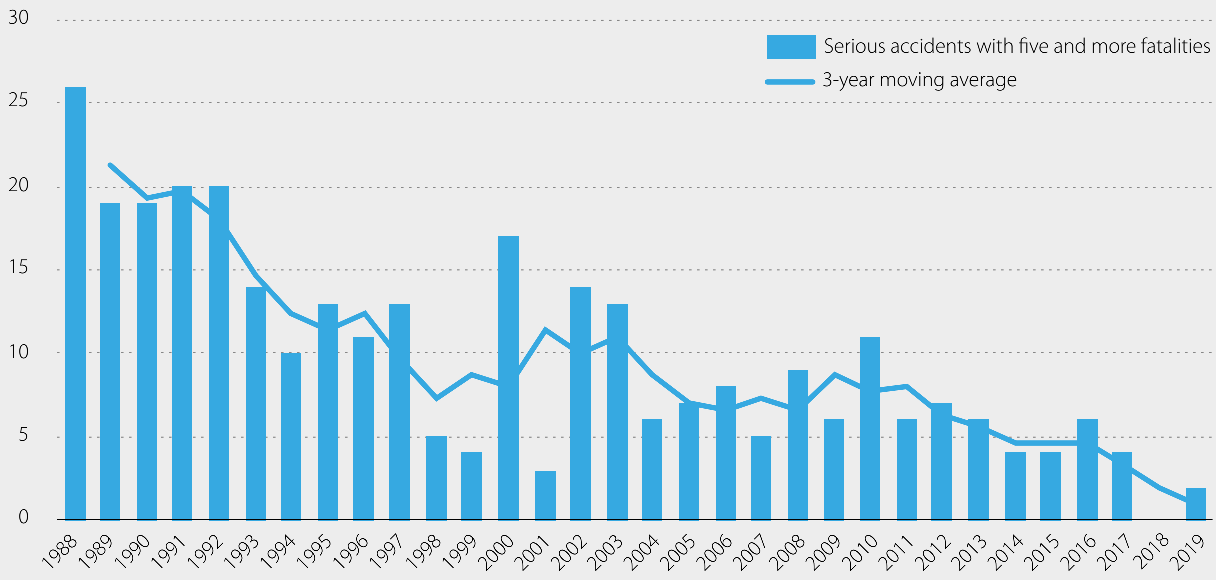
Situated between significant and major accidents, the fatal train collisions and derailments provide a good basis for an analysis of trends in railway safety in Europe. The estimation is done for accident rates to take into account the underlying changes in traffic volume. The accident rate is strongly downward over the period 1990–2018. The estimated rate of change in the fatal accident rate is a fall of 5.4 % per year over the entire period. This implies a 43 % reduction over a decade.

Meta-data

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

Figure A-5: Major accidents in Europe (ERA countries, 1988-2019)

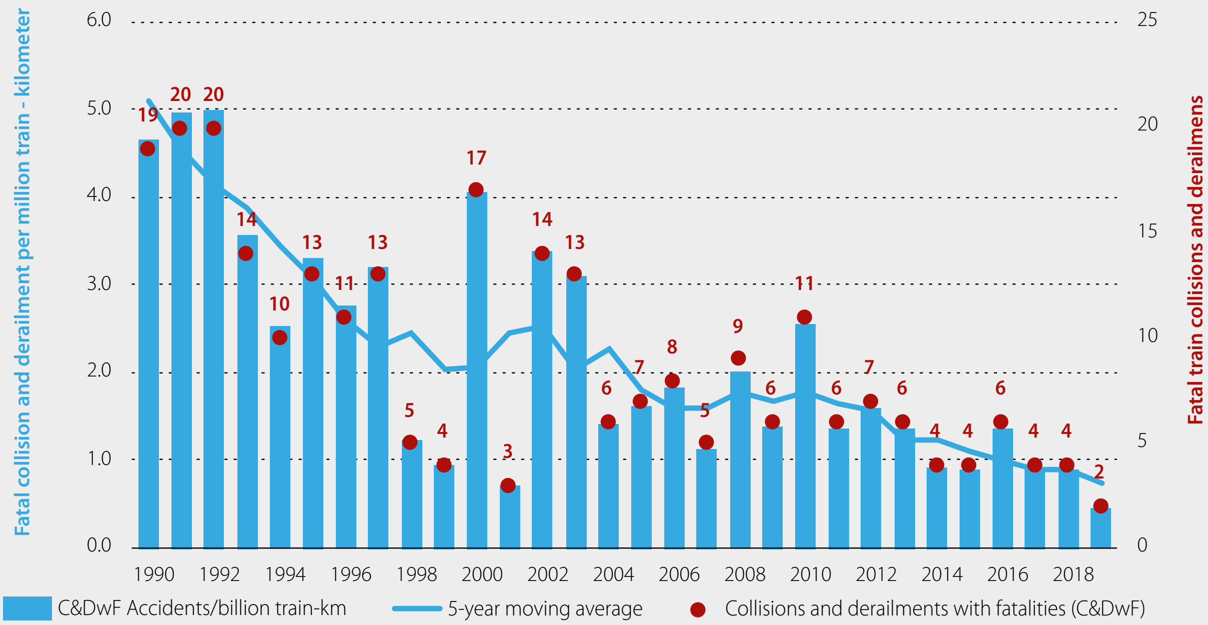
Serious accidents resulting in five or more fatalities



Source: ERAIL and Database of historical accidents - Courtesy of Andrew Evans, Imperial College London

Figure A-6: Fatal train collisions and derailments (ERA countries, 1990-2019)

Accident and accident rate per million train kilometer



Source: ERAIL and Database of historical accidents - Courtesy of Andrew Evans, Imperial College London

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

Purpose

Since traffic volume is the single most important factor in the occurrence of accidents, it is usual to discount it when monitoring accident trends.

Indicators

Three main indicators are used here: Significant accident rate and two fatality rates: Significant accidents normalized by train kilometres and railway fatalities normalised by train kilometres, capturing the manifested overall risk in railway operation and passenger fatality rate: passenger fatalities per passenger kilometres capturing the personal manifested risk for people using trains.

Findings

The overall fatality rate is currently 0.2 fatalities per million kilometres (one fatality each 5 million train kilometre on average), whereas the overall passenger fatality rate is 0.04 passenger fatality per billion passenger kilometre (one fatality each 25 billion passenger kilometres).

All three rates have decreased substantially since 2010. The annual average reduction in fatality rate was 5 % p.a., while it was 4 % p.a. for significant accidents. The annual average reduction in passenger fatality rate was 15 % p.a. Fatality rates have decreased even in the years 2016-2017 when no reduction in main accident outcomes could be observed.

Behind the general EU picture, a much more diverse reality exists, with notably large differences in casualty rates between Member States. Achieving a single safety area implicitly implies comparable safety levels in Member States. To monitor the achievement of this long-term goal, the variation in safety levels of MSs metric is used.

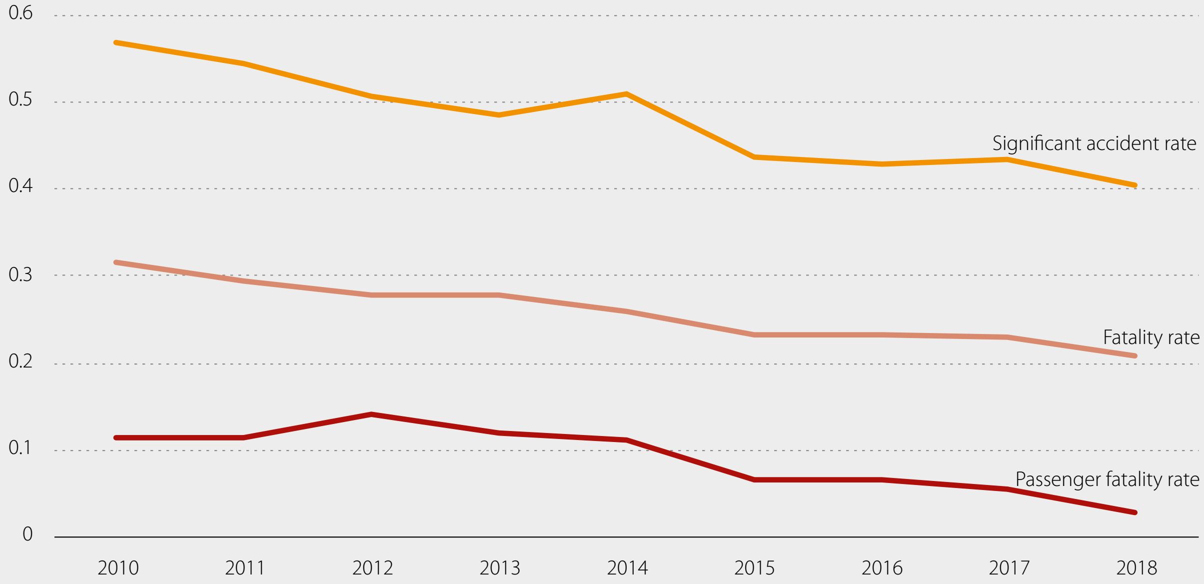
The variation in FWSI rate between Member States (measured through the standard deviation) has been decreasing over the period 2010-2016 at the same pace as the average FWSI rate of Member States with the coefficient of variation staying close to one, which means that the levels of safety of MSs have been converging at the same speed as they were decreasing over time, in that period. However, the speed of convergence has slowed down and safety performance of MSs does not converge anymore since 2016.

Meta-data

Data used to monitor progress with safety outcomes are part of Common Safety Indicators (CSIs) supplied by the National Safety Authorities (NSAs) to the Agency. More than ten 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-28, 2010-18)

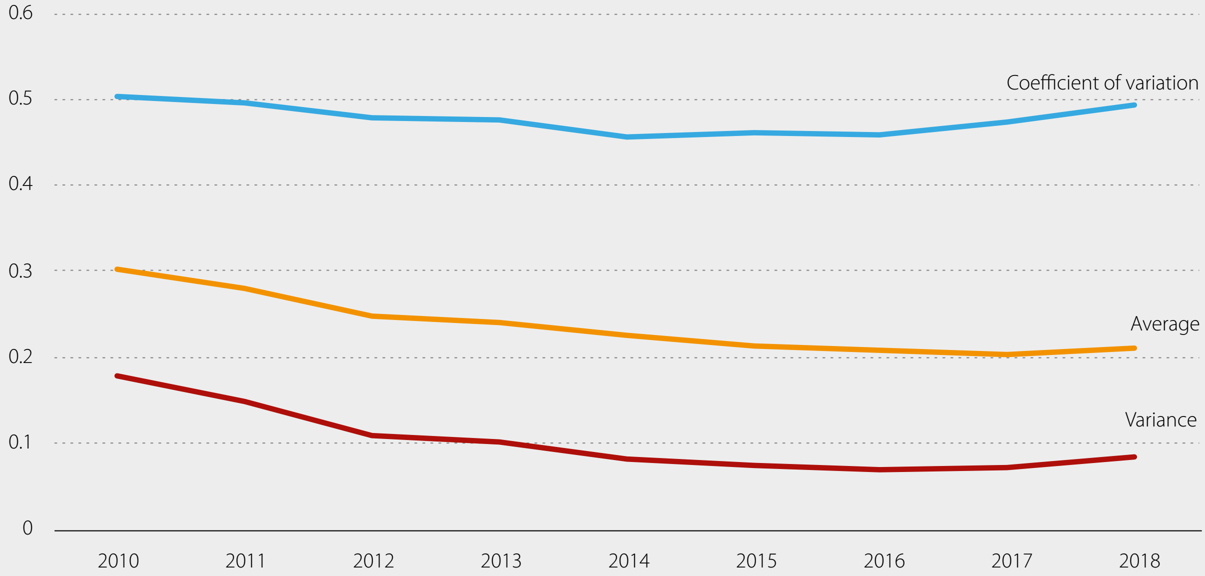
Significant accidents and fatalities per million train-km. Passenger fatalities per billion passenger kilometers



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

Figure A-8: Fatalities and weighted serious injuries rates (EU-28, 2010-18)

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



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

A-5 Railway and passenger fatality rates

Purpose

Plotting the fatality rates for individual MSs allows one to unveil the extent of existing disparities in safety levels. Ranking the countries then provides further insight into the underlying differences.

Indicators

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

Findings

The figures unveil at least a ten-fold difference in fatality rates for countries with the lowest and highest values. For both rates, the distribution of values show positive skew, with the mass of the distribution concentrated on the left. In both cases, the median values are much lower than mean values, since the rates for MSs with relatively higher rates are much higher than rates for other countries. For railway fatality rate, a cluster of 11 countries emerges, almost stark contrast to remaining EU Member States.

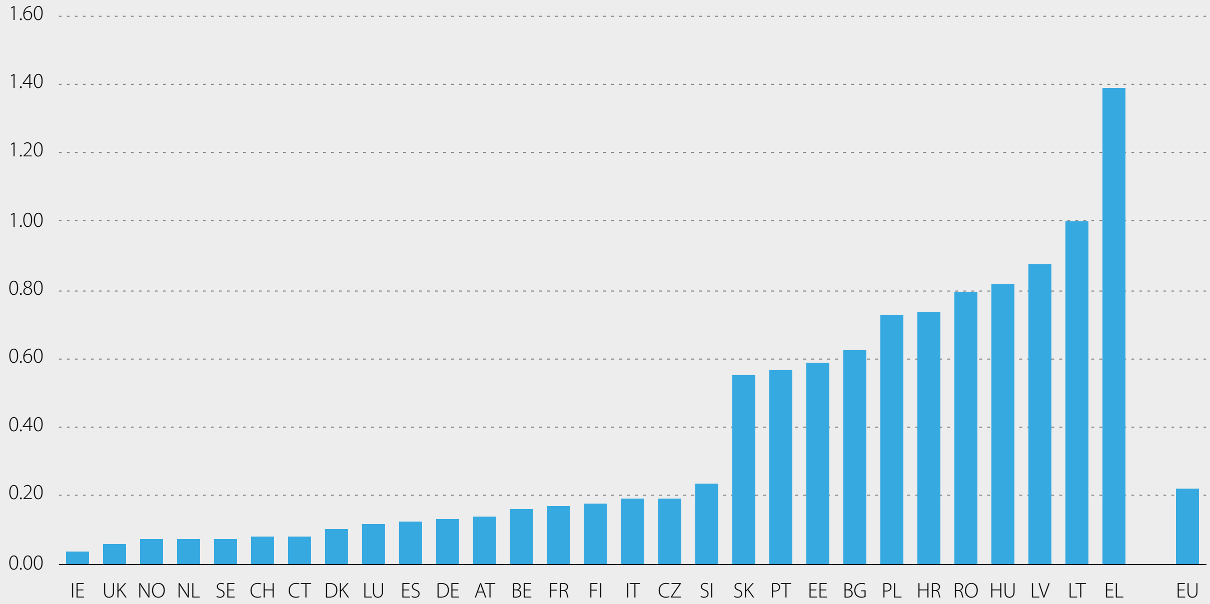
Meta-data

Although the rates are estimated for a period of three and ten years respectively, major accidents with large number of passenger casualties still weigh heavily in the estimates. The extreme case is the derailment in Santiago de Compostela, in 2013, making the passenger fatality rate for Spain the highest among its peers.

Data used to monitor progress with safety outcomes are part of Common Safety Indicators (CSIs) supplied by the National Safety Authorities (NSAs) to the Agency. More than ten 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 (ERA countries, 2016-18)

All fatalities per million train kilometers over 2016-2018

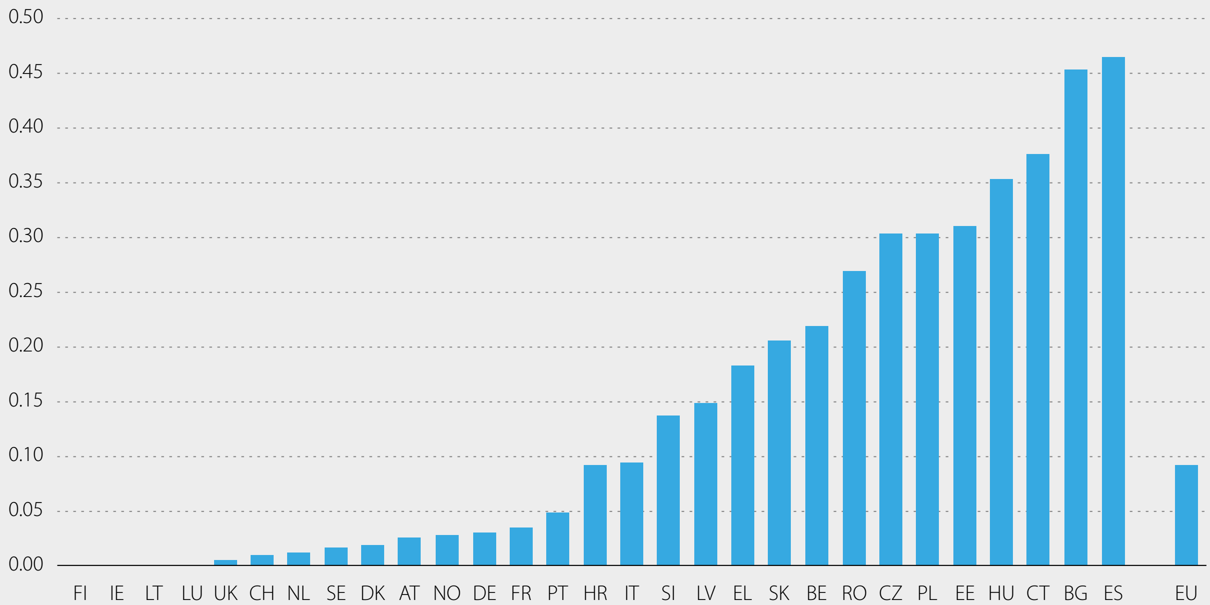


Notes: EU= 28 Member States as of 2019

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

Figure A-10: Railway passenger fatality rates (ERA countries, 2009-18)

Passenger fatalities per billion passenger-km over 2009-18



Notes: EU= 28 Member States as of 2019

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

A-6 Safety in different transport modes

Purpose

Different means of transport imply different risk levels for the traveller. The user fatality risk is estimated here for the four main transport modes for which comparable data are available.

Indicators

The indicator measures the risk of fatality for a passenger travelling over a given distance using different transport modes. The indicator looks at five-year blocks of data (2014-18). Although the use and nature of transport modes differ widely, a direct comparison of safety levels is possible using certain travel scenario hypotheses.

Findings

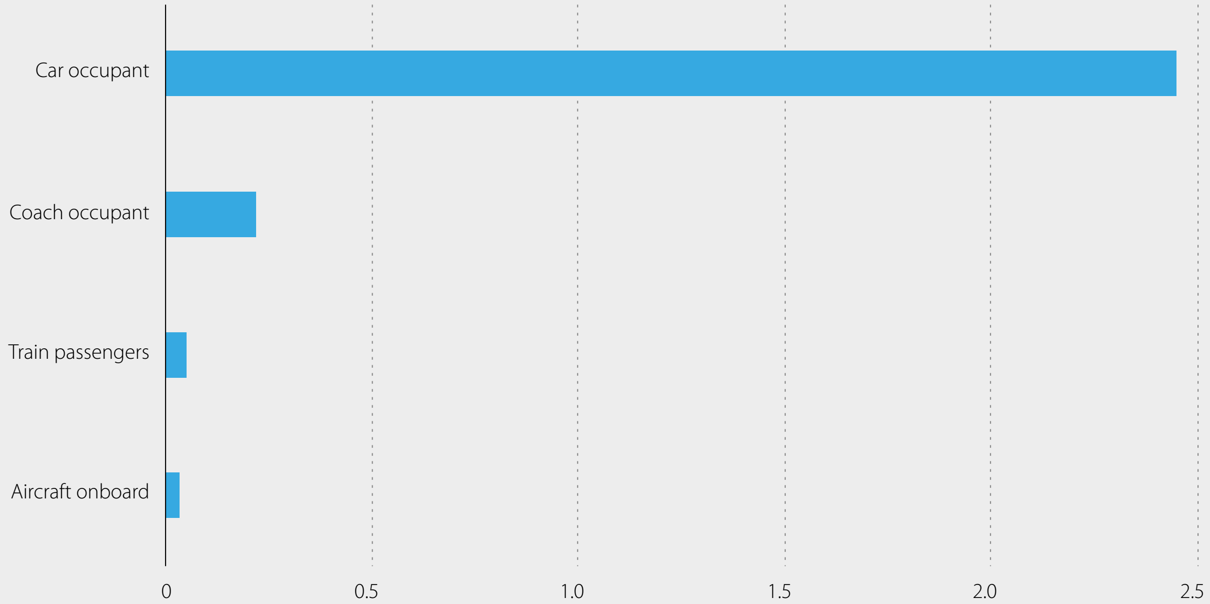
The fatality risk for a train passenger is one fourth of the risk for a bus/coach passenger, but almost twice as high as that for commercial aircraft passenger. The use of individual transport means, such as passenger car carries substantially higher fatality risk: car occupants have almost 50 times higher likelihood of dying compared to train passenger travelling over the same distance. **The fatality risk for an average train passenger is now about 0.05 fatalities per billion passenger kilometres, making it comparatively the safest mode of land transport in the EU.**

Meta-data

One should note here that the risk estimated for commercial air travel, but also for bus and train travel, is subject to wider variations, as one single accident may result in dozens of fatalities. Since the annual number of aircraft, train and coach fatal accidents is relatively small, the risk estimated for a relatively short period, in this case, for five years, should be read with caution. Last, but not least, the results of such a comparative exercise also strongly depend on the type of exposure data considered (e.g. number of journeys or time spent by passengers).

Figure A-11: Passenger and driver fatality rates for different transport modes (EU-28, 2014-18)

Onboard fatalities per billion passenger kilometers



Notes: Fatalities for all onboard persons/persons in the vehicle, except for rail: only passengers

Source: CARE (DG MOVE), EASA, EMSA

A-7 Worldwide railway safety

Purpose

Despite structural differences, the overall safety level of the Union railway system can be compared to safety levels of different countries worldwide, in a benchmarking exercise. In the Agency's view, it should be an aspiration of the entire sector that the Union railway system becomes the safest in the world.

Indicators

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

Findings

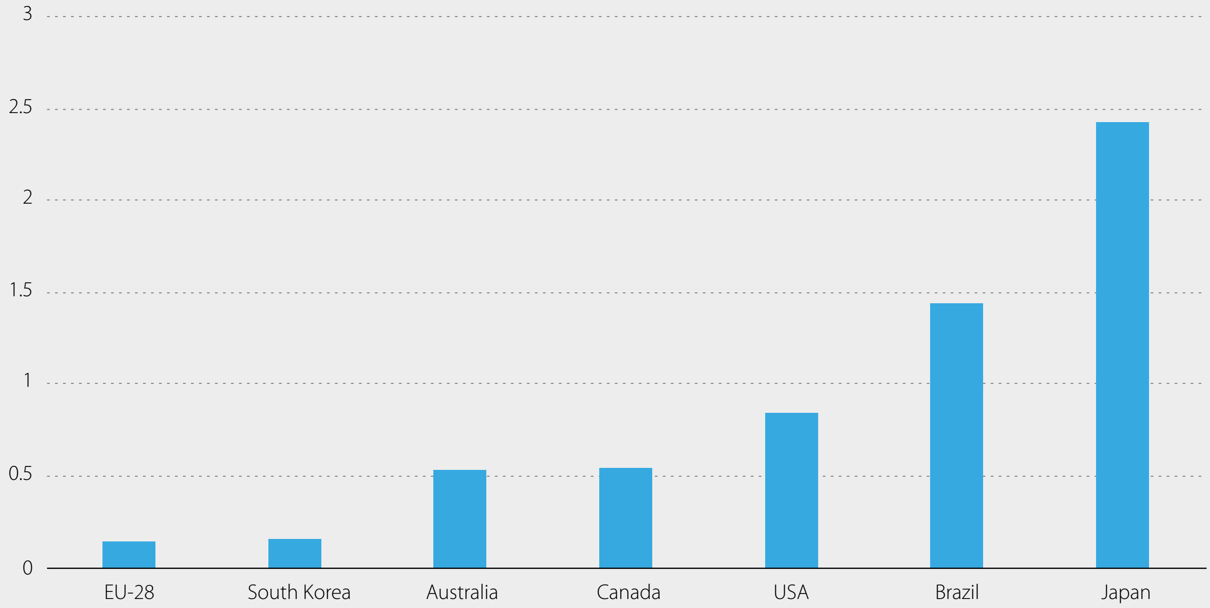
As per railway fatality rates estimated for seven jurisdiction, the Union railway system is, together with the South Korean one, the safest. **A passenger on board of a train in the Union railway system also enjoys the relatively lowest risk, in a comparison with other four countries.** Nevertheless, the unpublished data for Japan suggest that passenger travel using train is even safer, whereas the gap in passenger fatality rate between the EU and Japan is high and it may be challenging for the EU countries to close it over the mid-term.

Meta-data

Data used here is taken from statutory reports produced by the national railway safety or safety administrations of the concerned jurisdictions. There is no guarantee that all the countries use the same, internationally agreed, definition of a railway fatality which occurs "…within 30 days of accident" and that the train-km are recorded in the same fashion for all railway undertakings. Trespasser fatalities (so as to exclude suicide fatalities) is also likely to be an issue. Nevertheless, the comparability of data may be satisfactory for the given purpose of an international benchmark. Lastly, the selection of countries used in the two benchmark figures are driven by: comparability of the railway system in terms of size and volumes (1) and availability of comparable data (2).

Figure A-12: Railway fatality rates for countries worldwide (2014-18)

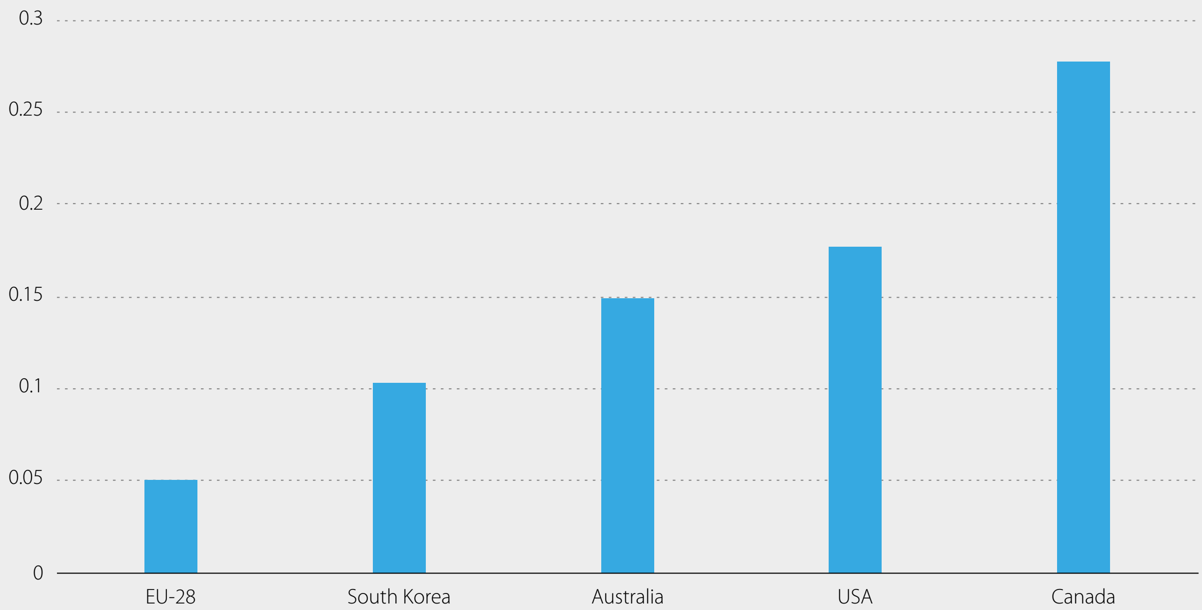
All railway fatalities per million train-km



Source: Statutory reports produced by national administrations of concerned jurisdictions

Figure A-13: Passenger fatality rates for countries worldwide (2014-18)

Railway passenger fatalities per billion passenger kilometers



Source: Statutory reports produced by national administrations of concerned jurisdictions

A-8 Achievement of safety targets

Purpose

Common safety targets (CSTs) are the lowest acceptable safety levels prescribed for the railway systems of the Union and of Member States. They are used as a reference when assessing whether the current safety levels are at least maintained. In the long term, they could also help to drive efforts to reduce current variance in safety levels across the Union. Railway transport is the only mode of transport for which targets have been prescribed by European legislation. Assessment of achievement of safety targets is carried out by the Agency on an annual basis, by applying the Common safety method[1]. The latest assessment available is the 2020 Assessment that compares the 2018 safety levels with the reference values published as the second set of safety targets and national reference values[2].

Indicators

The safety level (manifested risk level) is measured in terms of the number of fatalities and weighted serious injuries 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 result of this latest assessment indicate that **safety performance remains acceptable at the Union level, whereas possible deterioration of safety performance was identified in seven instances.** Such a result is in line with the ten previous assessments, which typically identified possible deterioration 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. Possible or probable deterioration of safety performance is most frequently registered for employees and unauthorised persons. Whereas possible deterioration has at least been identified in half of all Member States, only in two countries was this result achieved in the majority of assessments.

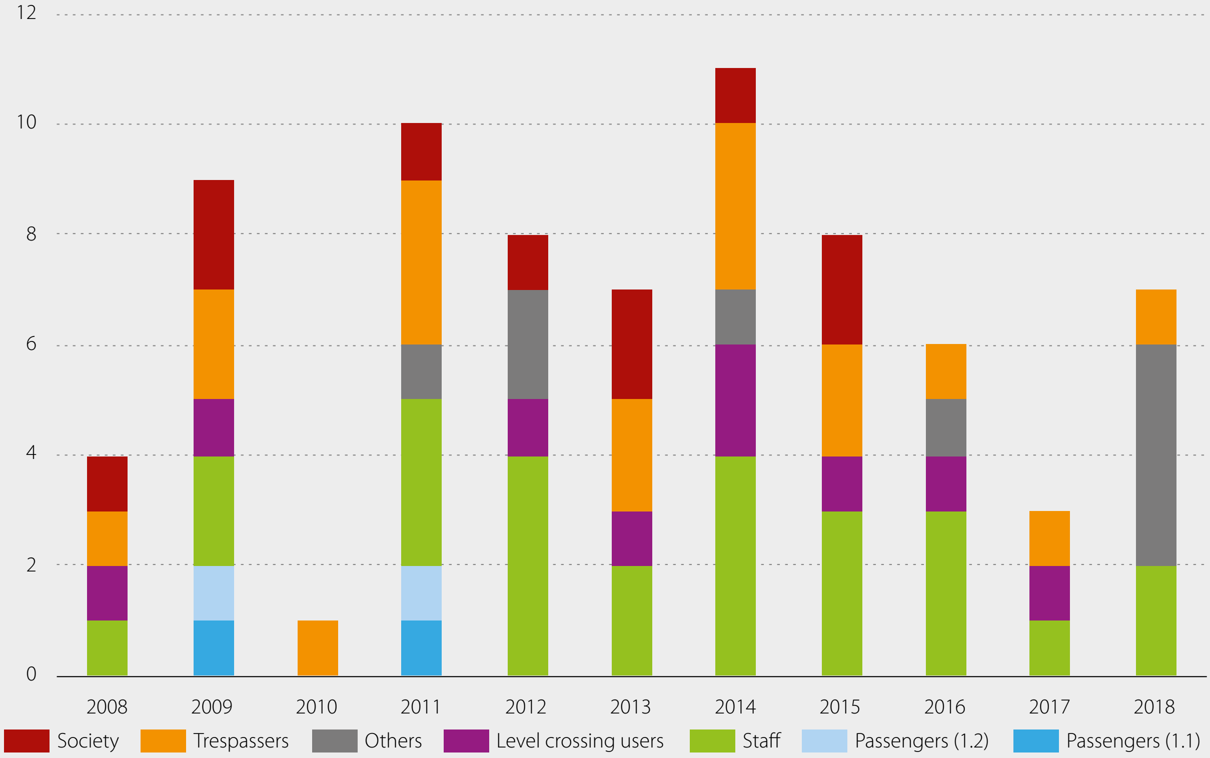
Meta-data

Risk categories as defined in the RSD are used. For Passenger category, two measures are applied: FWSI per passenger train kilometres (1.1) and FWSI per passenger kilometres (1.2). Fatalities and weighted serious injuries (FWSIs)' means a measurement of the consequences of significant accidents combining fatalities and serious injuries, where 1 serious injury is considered statistically equivalent to 0.1 fatalities.

[1] Commission Decision 2009/460/EC
[2] Commision Decision 2012/226/EU

Figure A-14: Instances of identified non-acceptable safety performance by risk category (EU-28 and NO, 2008-18)

Probable or possible deterioration of safety performance as per annual CST assessment



Source: Annual CST assessment reports published by the Agency

A-15: Instances of possible/probable deterioration of safety performance (EU-28 and NO, 2008-18)

Instances across all risk categories

	LT	HR	CZ	LV	PT	FR	IT	SE	HU	NO	BG	RO	SK	Total
2008	0	0	0	0	0	0	0	0	0	0	0	4	0	4
2009	1	0	0	0	0	0	0	0	0	0	0	4	4	8
2010	0	0	0	0	0	0	0	1	0	0	0	0	0	1
2011	0	0	0	0	0	0	0	1	0	0	1	4	4	10
2012	0	1	0	0	0	0	0	1	0	1	2	2	1	7
2013	0	0	0	0	0	0	1	0	0	2	1	1	2	7
2014	0	0	0	0	0	1	1	1	2	2	1	1	2	11
2015	0	0	0	0	0	0	1	1	0	3	1	0	2	8
2016	0	0	0	0	0	0	1	0	2	0	2	0	1	6
2017	0	0	0	0	0	1	0	0	0	1	0	0	1	3
2018	0	0	1	1	1	1	0	0	1	0	1	0	1	7
Total	1	1	1	1	1	3	4	5	5	9	9	16	18	

Notes: Colours correspond to the number of instances

Source: Annual CST assesment reports published by the Agency

A-9 Significant accidents

Purpose

Significant accidents represent the basis for harmonized 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. Their further sub-categorization allows one to identify the parts of the railway systems with relatively high prevalence of accidents and those with relative underperformance over time.

Indicators

Absolute number of significant accidents using two types of disaggregation: per type of railway accident, as prescribed by the RSD (1) and per type that reflects the presence of third party (2).

Findings

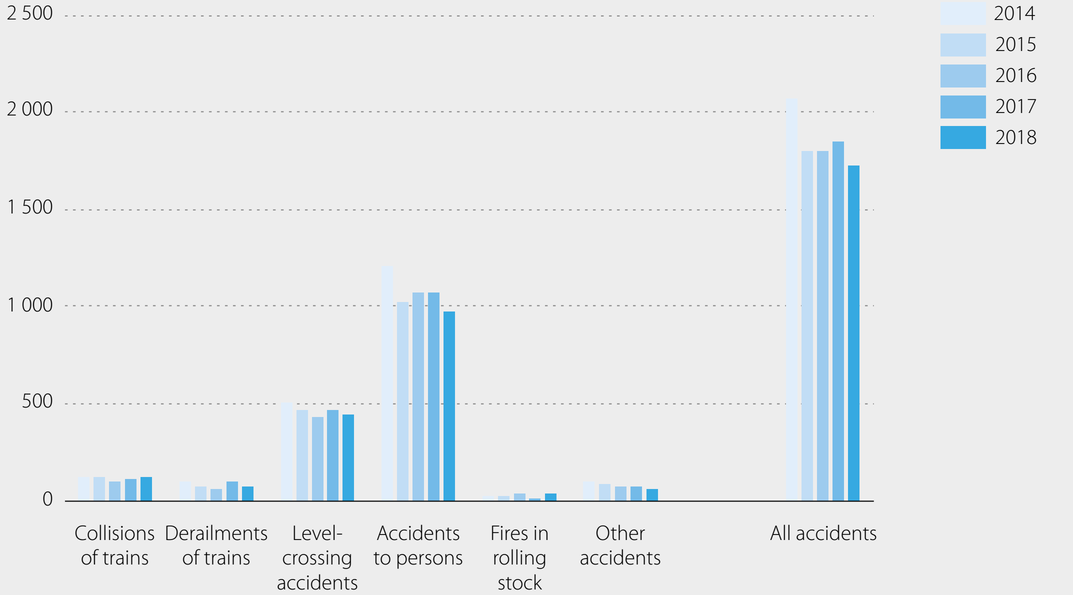
Altogether 1 721 significant accidents were reported by Member States for 2018 alone, almost five per day on average. This is the lowest number recorded ever since 2010. However, the decrease has been mainly driven by "external" accidents, in which third party (trespasser and level crossing users) participate. Collisions and derailments account for about 200 accidents each year, with no decrease observed in recent years. Similarly, no decreasing trend has been observed in the category of ˙fire in rolling stock˙.

A wide range of accidents, not included within the specific types, are included in the category of ˙other accident˙. The 70 cases reported in 2018 include people stroke on platform, collisions and derailments of shunting rolling stock/maintenance machines, dangerous goods released during transport, objects projected by the running train and electrocution in connection with rolling stock in motion.

Meta-data

Data used to monitor progress with safety outcomes are part of Common Safety Indicators (CSIs) supplied by the National Safety Authorities (NSAs) to the Agency. More than ten years of continuous work on data quality in Member States and at the Agency provides assurance on the accuracy of the data.

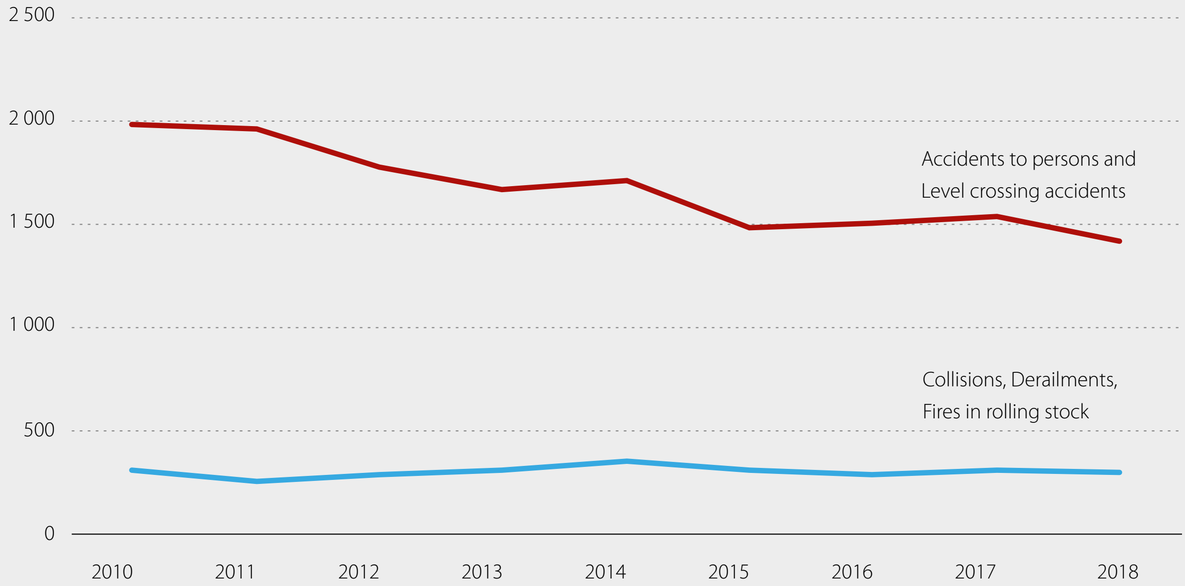
Figure A-16: Significant accidents per type (EU-28, 2014-18)



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

Figure A-17: "Internal" and "external" significant accidents (EU-28, 2010-18)

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



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

A-10 Accidents and incidents involving transport of dangerous goods

Purpose

Due to its potential for disastrous consequences, the transport of dangerous goods is subject to extra regulatory provisions and extensive supervision by relevant authorities. Nevertheless, accidents involving transport of dangerous goods continue to occur and are subject to a particular reporting regime under the convention for the international carriage of Dangerous goods by rail (commonly referred to as RID). Depending on the type and consequences, such accidents may also be reported as a significant accident.

Indicators

The indicator used under the RSD and originally taken from the RID is the number of accidents and incidents involving the transport of dangerous goods with and without the release of those goods.

Findings

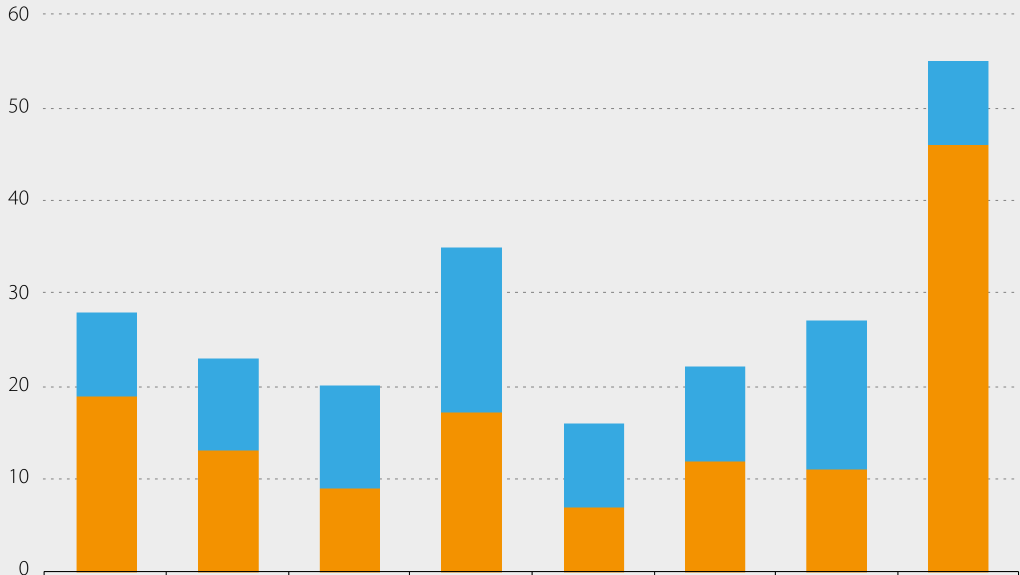
For 2018, Member States reported a total of 55 accidents and incidents involving dangerous goods of which 46 involved a release of the dangerous goods being transported during the accident. These 55 accidents and incidents involving transport of dangerous goods occurred in ten EU Member States. The peak in 2018 is due to single country reporting 34 accidents and incidents in that year. Six Member States reported no dangerous goods accidents and incidents during the period 2011-18.

Meta-data

Accidents and incidents involving the transport of dangerous goods are reported in parallel to significant accidents, applying the criteria outlined in the RID. The reporting under RID is limited to international railway traffic and does not lead to systematic data collection, analysis and exchange. This setting reportedly creates certain ambiguity which may be impacting data completeness and reliability. The Agency has recently made a proposal for improvements to the framework for reporting of safety occurrences in general and occurrences in transport of dangerous goods in particular.

Figure A-18: Accidents involving transport of dangerous goods (EU-28, 2011-18)

Railway accidents with and without release of dangerous goods



	2011	2012	2013	2014	2015	2016	2017	2018
without DG release	9	10	11	18	9	10	16	9
with DG release	19	13	9	17	7	12	11	46

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

A-11 Casualties from significant accidents

Purpose

The seriousness of accidents reflected in the number of casualties differ for different types of accidents. Monitoring the casualties per accident type thus enables one to target those types with relatively high impacts.

Indicators

Significant accidents per type of accidents, as foreseen in the RSD, Annex I.

Findings

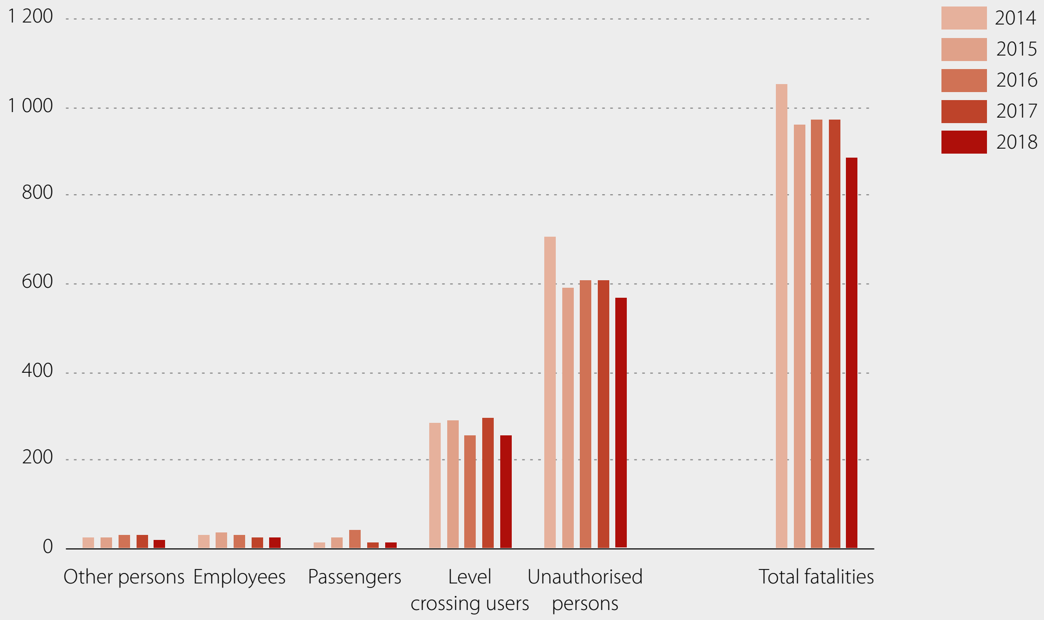
In parallel with the decrease in railway accidents, the total number of casualties, excluding suicides, has fallen steadily in recent years. **There were 885 fatalities reported for the year 2018, a nine per cent decrease from the previous year (974 fatalities recorded in 2017).** Between 2006 and 2018, the number of railway fatalities decreased by 60 % (4.6 % p.a. on average). The number of fatalities in a combined category of passengers and employees has been decreasing at a pace of 8 % per year on average, whereas trespasser and level crossing fatalities have decreased by 4 % per year on average. If we exclude suicide fatalities, the majority of fatalities on railway premises are from accidents to persons. Fatalities from level-crossing accidents account for 29 % of fatalities. Fatalities from collisions and derailments represent less than two per cent of all railway fatalities. People strictly internal to railway operation (passengers, employees and other persons) represent only 3 % per cent of people killed on EU railways.

Meta-data

Data on fatalities from railway accidents have been recorded for several decades, including the application of the 30 days definition. As a result, it is probably the most accurate metric of railway safety in the EU.

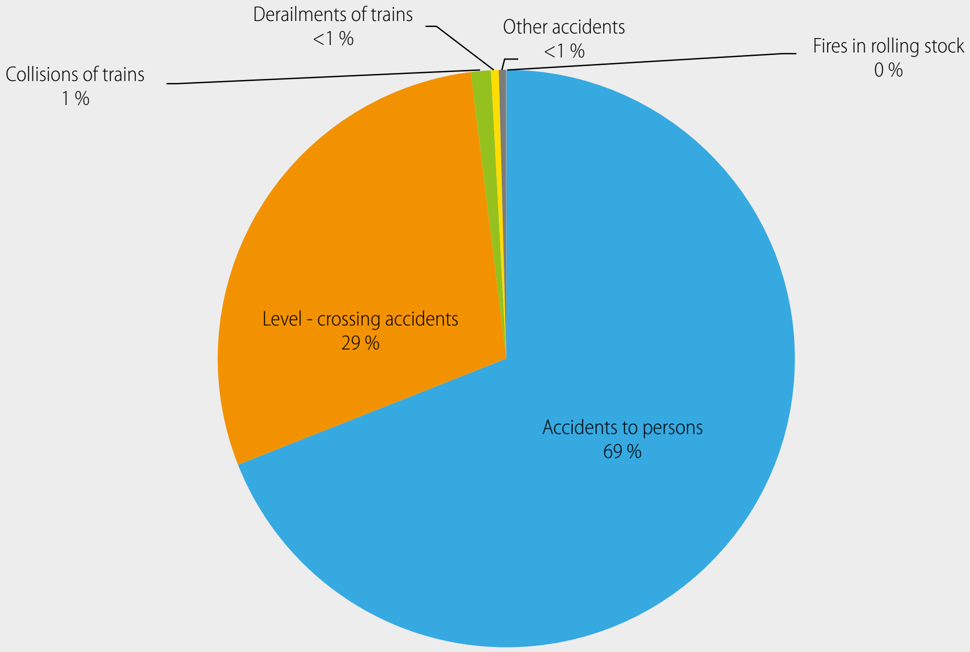
Data on seriously injured persons are slightly less reliable than statistics on deceased persons. This is because reporting and hospital procedures may vary in Member States and may be evolving over time. This has only limited impact on the CST framework, where the weight attributed to a seriously injured person is relatively low, but may have an impact on casualty statistics. Over the past five years, there were 8 seriously injured persons per 10 fatalities on EU railways. People being hit by a train are the users most likely to die from the injuries sustained. There were two killed trespassers per one seriously injured persons. Among all railway users, passengers are most likely to survive in significant accidents.

Figure A-19: Fatalities from railway accidents (EU-28, 2014-18)



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

Figure A-20: Fatalities per type of accident (EU-28, 2014-18)



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

A-12 Suicides and trespasser fatalities

Purpose

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

Indicators

Suicide (intentional) and trespasser (unintentional) fatalities on railway premises.

Findings

Suicides are reported separately from accident fatalities. They represent 75 % of all fatalities on railways and, together with the unauthorised person fatalities, constitute an overwhelming 91 % of all fatalities occurring within the railway system. **In 2018, on average more than seven suicides were recorded every day on EU railways, totalling 2 637**.

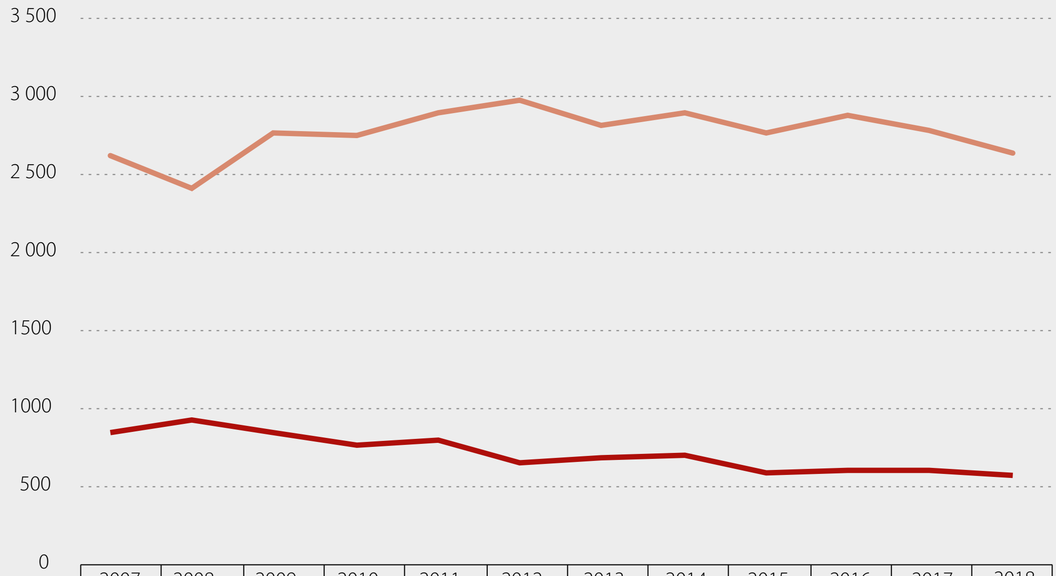
While trespass fatalities have seen a steady decrease since 2007, suicides were on the rise following the financial crisis of 2008 and peaked in 2012. They have been decreasing since, but not yet to the level seen before 2008.

Countries situated in the right-low quadrant have relatively high third party fatality rates, while the exposure to running trains is low (relatively low train frequency). In many of those countries, trespassing is a relatively common practice, while their railway lines are marginally fenced. However, other factors play roles as well. None of the two indicators take sufficiently into account the density of population along the railway lines, which is another known risk factor.

Meta-data

Given the objective difficulties in classifying some third party fatalities on railways and slightly diverging national practices in their classification and reporting, suicides and trespass fatalities are taken together when comparing countries between each other. Two rates are available that take into consideration the potential exposure to running trains: third party fatalities per train kilometre and per line kilometre.

Figure A-21: Railway suicide and trespasser fatalities (EU-28, 2007-18)

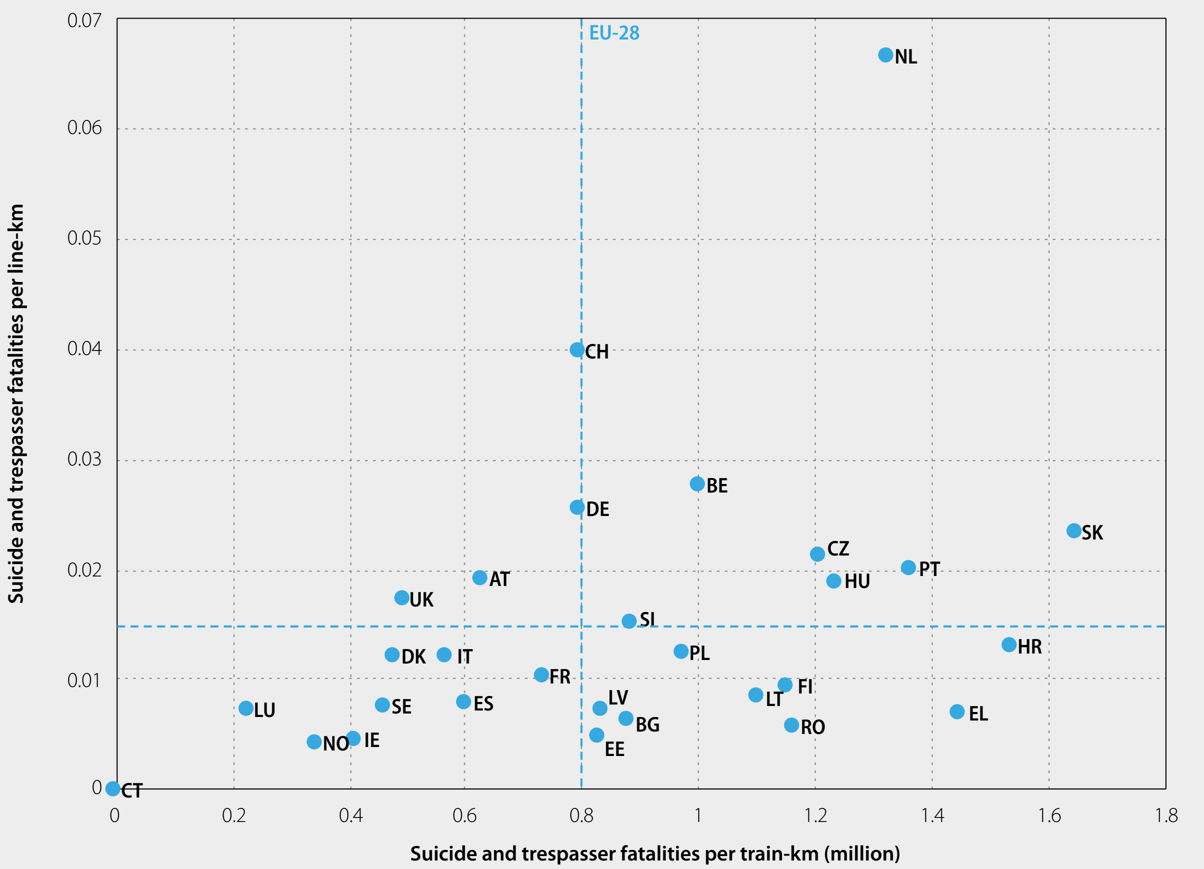


	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Suicides	2 614	2 413	2 762	2 756	2 890	2 982	2 819	2 895	2 765	2 881	2 777	2 637
Trespasser fatalities	855	928	849	766	804	655	681	704	589	605	607	569

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

Figure A-22: Suicides and trespasser fatalities rates (ERA countries, 2016-18)

Deaths per million train-km



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

A-13 Railway suicides versus overall suicides

Purpose

Plotting the railway suicide rate against suicide mortality for single countries provides an indication on how those managing the railway system have succeeded in curbing suicides compared to other parts of society.

Indicators

Railway suicide rate (suicides per train million kilometres) and suicide mortality rate (suicides per 100 000 persons) are used here.

Findings

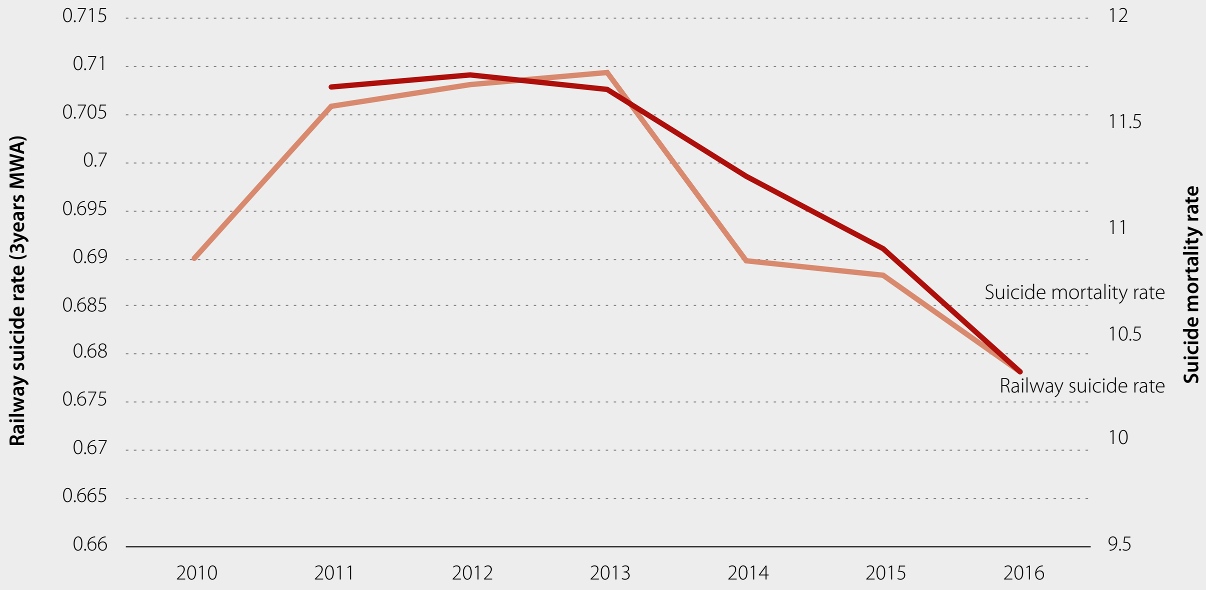
Suicides on railway premises saw a decreasing trend in recent years. However, the number of total number of suicides in society decreased as well. Plotting together the trends in railway suicide rate (suicides per train million kilometres) and suicide mortality rate (suicides per 100 000 persons) reveals a strong correlation between the two indicators. This means that the decrease in railway suicides over the past years can barely be attributed to measures taken within the railway system.

However, the countries with high train frequency and population density along railway lines remain heavily penalized in this comparison. In general, the countries situated below the diagonal line have a relatively high number of suicide fatalities occurring on railways among all suicides.

Meta-data

Railway suicide data are the result of a classification of fatalities on railways done by coroner's courts, Police or other judicial bodies. From this judicial determination, e.g. suicide or trespasser, the National Safety Authorities (NSAs) supply this data to the Agency. The suicide mortality is collected by health authorities of Member States and provided by their statistical offices to Eurostat. There is an important delay in data availability at the EU level, with the result that more recent years are not yet included.

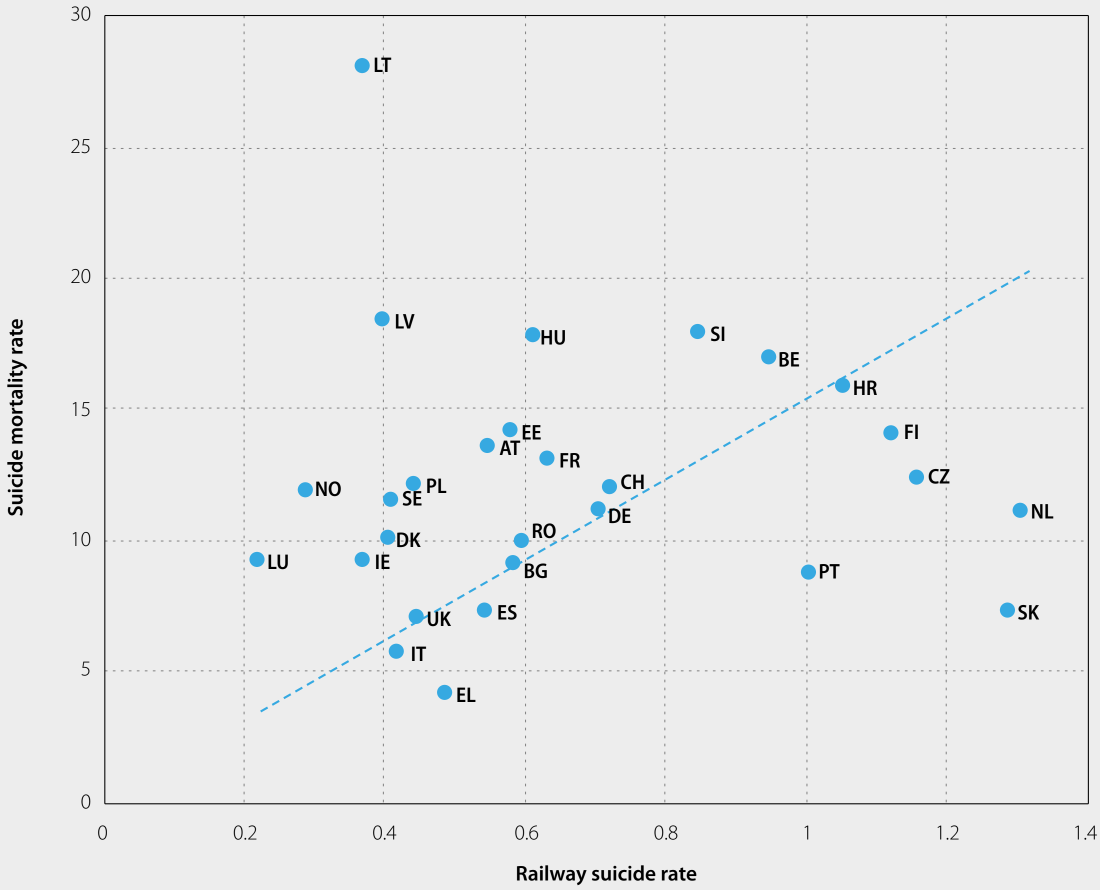
Figure A-23: Railway suicide rate and suicide mortality rate (EU-28, 2010-16)



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

Figure A-24: Suicide mortality against railway suicide rate (EU-28, 2016, 2016-18)

Fatalities per 100 000 population in 2016, Fatalities per million train-km 2016-2018



Source: Suicide mortality: Eurostat - dataset *Death due to suicide, by sex [TPS00122]*

A-14 Railway workers safety

Purpose

A century ago, railway employees were the main victim of railway accidents. However, with a continuous focus on their safety, the railway operators have since managed to significantly reduce staff casualties. Many of them have adopted a policy of no acceptance of fatal injury in the workplace and adopted policies and measures to this end. However, worker casualties are still recorded and the trend line have flattened in recent years.

Indicators

Killed and seriously injured railway workers (employees and contractors) and their rate per train kilometres.

Findings

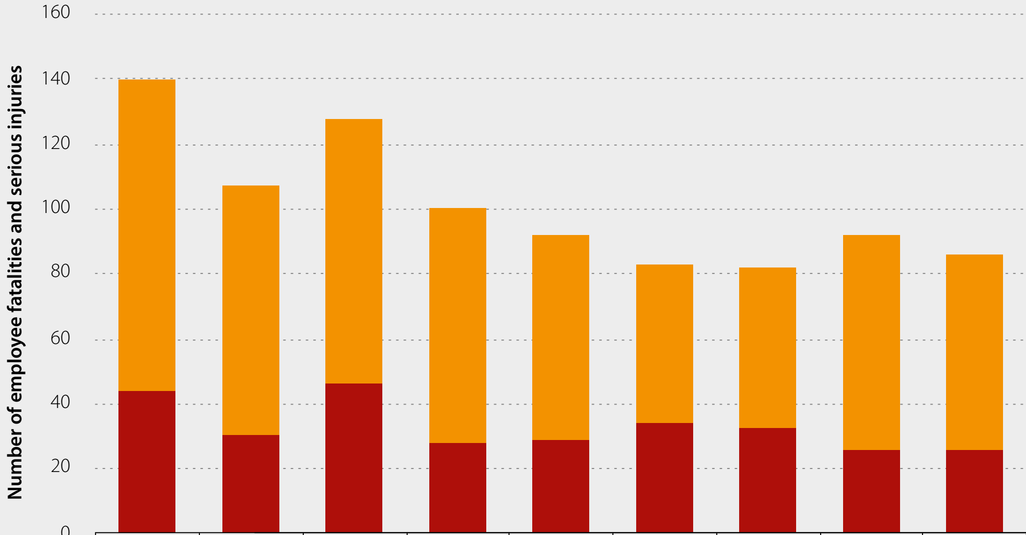
No progress can be seen in reducing railway workers casualties since 2014, if looking at absolute figures. Each year, close to 30 fatalities are reported among railway workers. Moreover, some 60 employees are seriously injured each year. The fatality rate shows a decreasing trend, which is however less pronounced for employees than for passengers.

Meta-data

Data used to monitor progress with safety outcomes are part of Common Safety Indicators (CSIs) supplied by the National Safety Authorities (NSAs) to the Agency. More than ten years of continuous work on data quality in Member States and by the Agency provides assurance on the accuracy of the data.

Figure A-25: Railway employee casualties (EU-28, 2010-18)

Fatalities, serious injuries

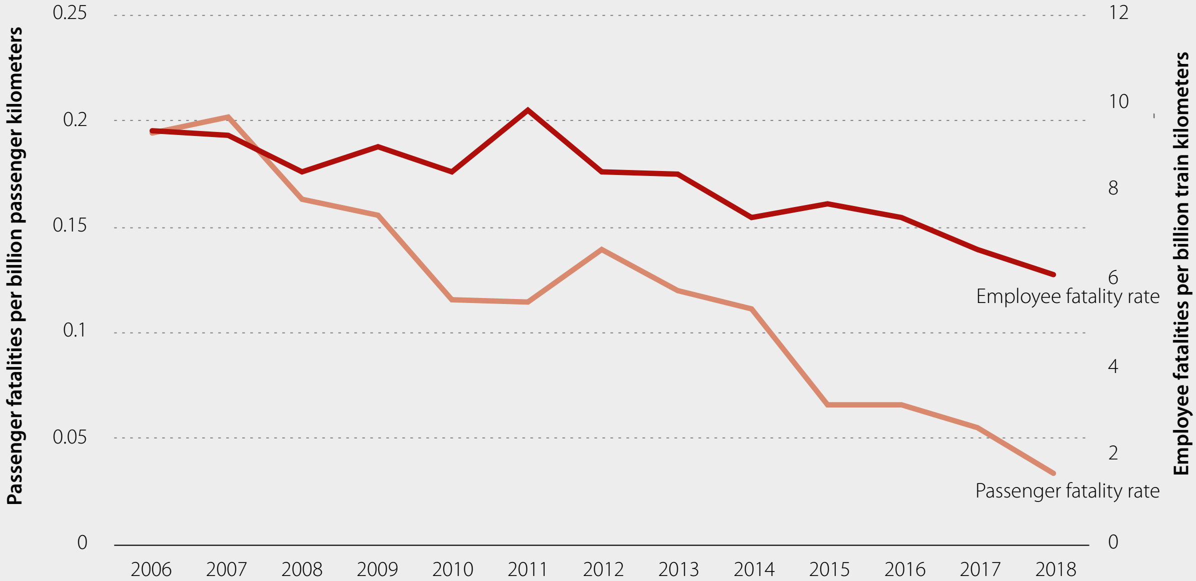


	2010	2011	2012	2013	2014	2015	2016	2017	2018
Seriously injured	96	77	82	72	63	49	49	66	60
Killed	44	30	46	28	29	34	33	26	26

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

Figure A-26: Passenger and employee fatality rates (EU-28, 2006-18)

Passenger fatalities per billion passenger kilometers, Employee fatalities per billion train kilometers, 3-years moving average



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

A-15 Level crossing safety

Purpose

Level-crossing accidents and fatalities represent more than one quarter of all railway accidents on EU railways. Almost 300 people die annually in LC accidents (EU-28), causing economic damage estimated at €1 billion. Level-crossings not only represent the physical intersection (of a railway track and a road), but also an intersection of responsibilities and interests. A high-level monitoring of outcomes therefore provides objective evidence for efficient safety improvements.

Indicators

Absolute numbers of significant level crossing accidents and resulting fatalities and serious injuries and the accident rate (significant accidents per train kilometres).

Findings

In recent years, a weekly average of six fatalities and an additional six serious injuries occur at level crossings in Europe. Safety at LCs has been improving in the past decade: the annual average reduction over the period 2010-18 has been 3 % for accidents, 4 % for fatalities. Over the same period, the reduction was higher in other types of railway accidents and resulting fatalities and lower in other types of road accidents and resulting fatalities. Notably it appears that a slower pace of improvements in road safety (compared to rail safety) impacts the progress of improving level crossing safety levels.

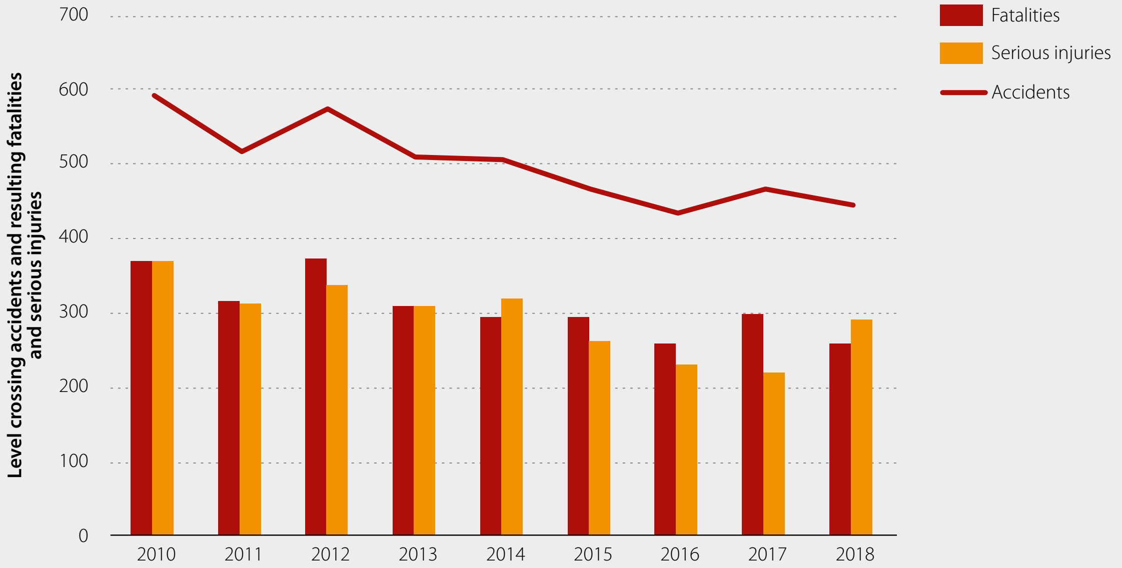
Level crossing accident rates vary considerably among ERA countries. Countries with the lowest accident rates typically feature comprehensive strategies for level crossing safety improvements visible that translate, among else, in low number of poorly or no protected level crossings. A common feature of the countries with the highest accident rates is a low population density and low railway traffic volumes. These conditions perhaps provide less incentive for a comprehensive management of level crossing safety.

Meta-data

Data used to monitor progress with safety outcomes are part of Common Safety Indicators (CSIs) supplied by the National Safety Authorities (NSAs) to the Agency. More than ten 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-28, 2010-18)

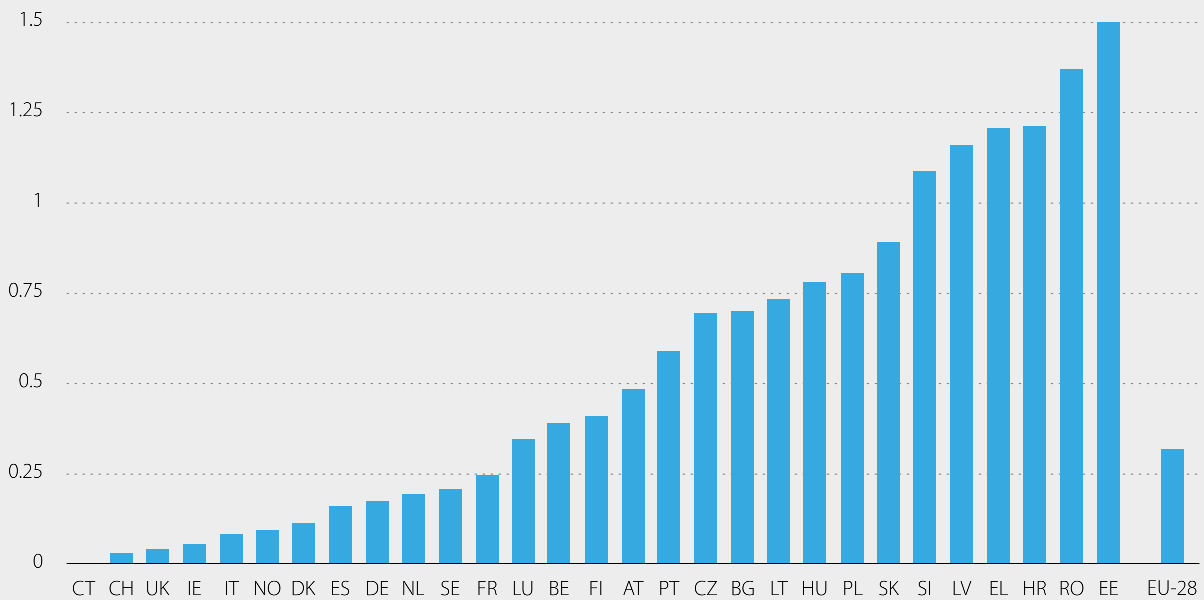
Significant accidents, fatalities and serious injuries



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

Figure A-28: Level crossing accident rates per country (ERA countries, 2016-18)

Significant accidents at level crossings per million train-km



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

A-16 Precursors to accidents

Purpose

As accidents on railways are rare, monitoring events with no harmful consequences that occur on railways is an essential tool of a proactive safety management system (SMS). 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, danger signals passed, wrong-side signalling failures, broken wheels and broken axles. Their absolute numbers provide a first indication of their relevance and trends.

Findings

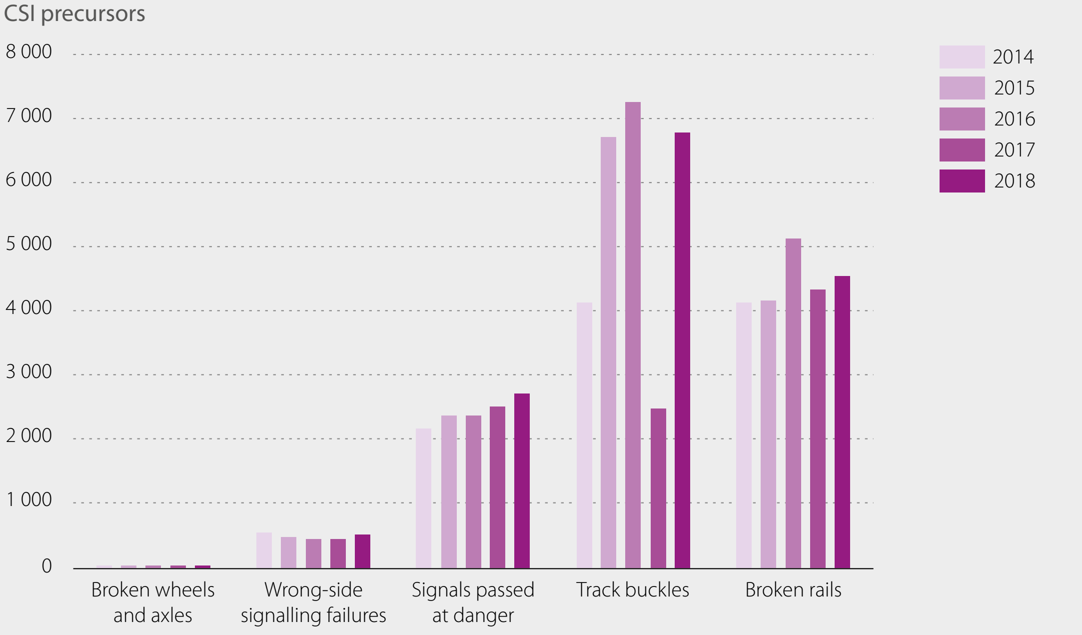
Over the period between 2014-2018, EU Member States reported more than 12 500 precursors to accidents as defined under CSIs each year; this is a ratio of about seven precursors to one significant accident. However, if we discard accidents to persons caused by rolling stock in motion, the ratio between the precursors and accidents rises to 17:1. This unveils a learning potential of precursors to accidents. Among the Signal passed at Danger (SPAD) incidents, those in which a danger point was passed represent a particularly high risk of collision. Among 2 500 SPADs recorded each year on EU railways, only one quarter are of this type.

The variation in yearly occurrence of track buckles and broken rails reflects the poor maturity of their reporting in several Member States and does not provide a genuine picture of the situation. This is further illustrated by plotting the accidents to accident precursors ratios.

Meta-data

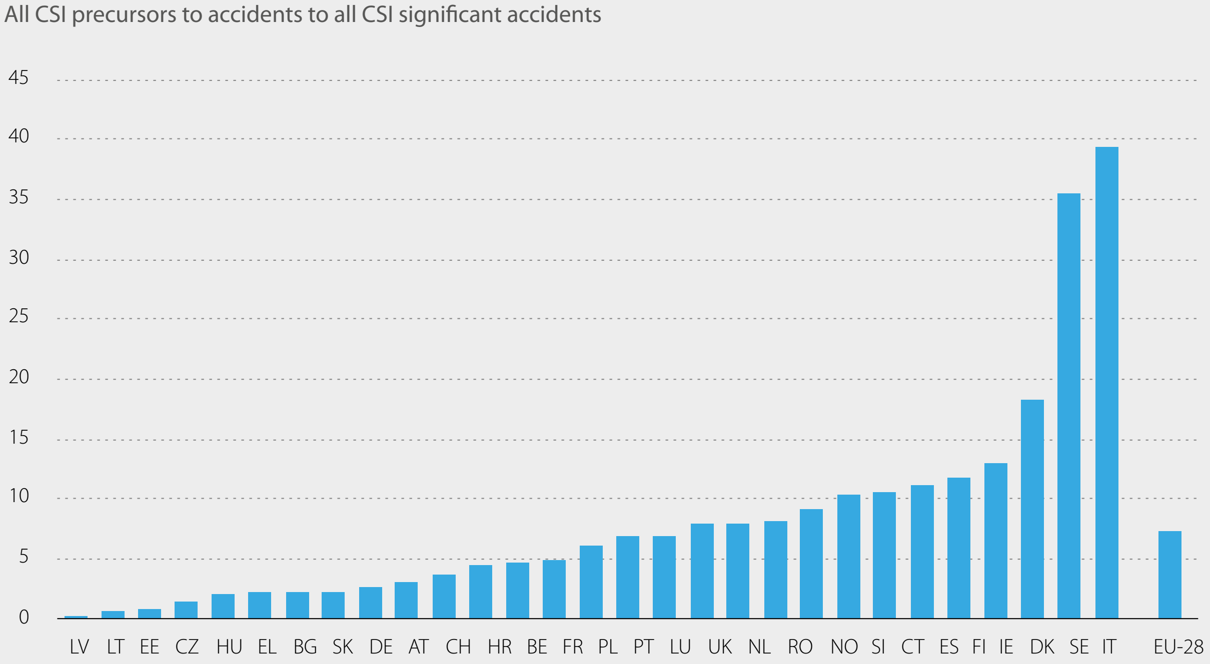
Despite gradual improvements in the precursor data quality, the data may not yet be fully comparable between Member States, so certain caution should be exercised when interpreting these data. Underreporting is not uncommon in case of incidents in general, and for certain accident precursors in particular.

Figure A-29: Precursors to accidents (EU-28, 2014-18)



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

Figure A-30: Accident precursors to accidents ratios per country (EU-28, 2014-18)



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

A-17 Accidents investigations

Purpose

Independent accident investigation into the causes of accidents is invaluable to society in general and in learning potential in particular. It assures that lessons are drawn from past accidents and that action can be taken to prevent a similar accident from happening in the future. Independent accident investigation is a responsibility of each Member State, where the role of the Agency is limited to supporting the relevant national bodies in carrying out their tasks. The Railway Safety Directive requires that serious accidents are independently investigated by an independent National Investigation Body (NIB).

Indicators

The absolute number of accidents and incidents investigated by NIBs and their further sub-classification per investigation mandatoriness and accident type.

Findings

Since 2006, the NIBs opened investigations into 210 accidents and incidents per year on average, whereas final reports are available in ERAIL for some 90 % of them. Occurrences for which an independent investigation is legally prescribed represent 18 % of all investigated occurrences. Since this proportion has been stable, it could be an indication of stability in their overall priorities and available budget.

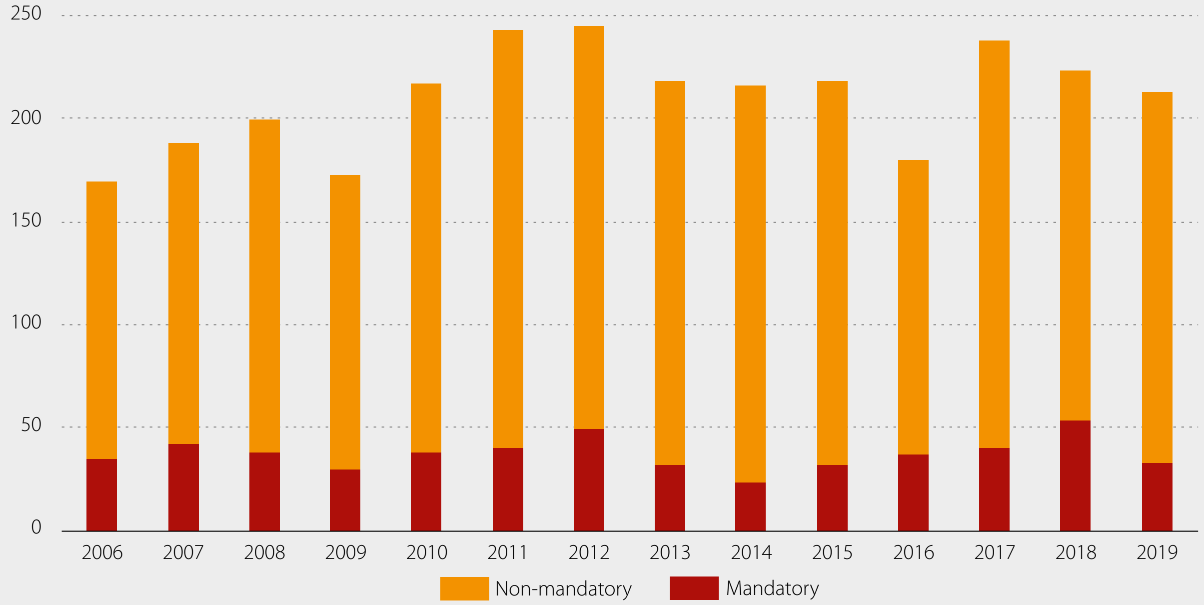
NIBs have a certain discretion as to the investigation of occurrences on top of those that must be investigated by them. As per the distribution of accident types investigated since 2006, it is apparent that the NIBs are inclined to investigate derailments, level crossing accidents and accidents to persons. Only one in more than ten collisions is subject to NIB investigations.

Meta-data

The investigations by NIBs are recorded in the ERAIL database and consist of a notification and a final report. The completeness of data depends on the inputs provided by the NIBs.

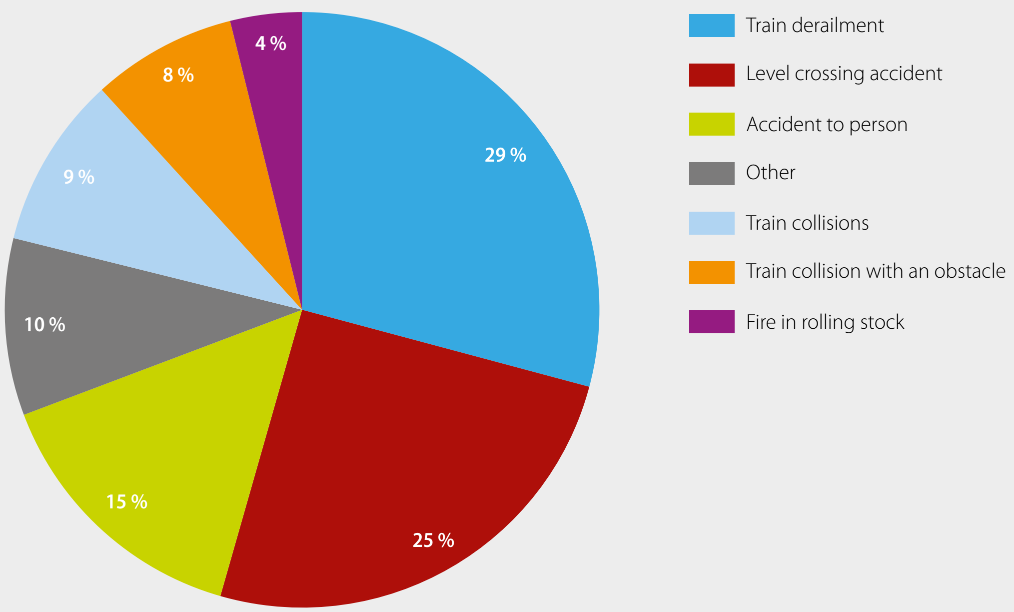
Figure A-31: Accidents and incidents subject to independent investigation (EU-28, 2006-19)

Mandatory and volutary investigations by National Investigation Bodies per year of occurrence



Source: Investigations by NIBs notified to ERA, ERAIL-INV database

Figure A-32: Accident types of NIB-investigated accidents (EU-28, 2006-19)



Notes: Accidents subject to independent investigations, for which a final report is available in ERAIL

Source: ERAIL-INV database; data provided by NIBs

A-18 Deployment of train protection systems

Purpose

Installation of Train protection systems (TPSs) is widely considered to be one of the most effective railway safety measures to reduce the risk of collisions between trains on main-line railways. The deployment of these systems on the national railway network and their use is monitored under the CSIs. Given the myriad of options and versions of train protection systems in the EU, a classification focusing on three levels of assistance provided to the train driver provides a solid basis for reporting comparable statistical data.

Indicators

Share of railway lines equipped with TPSs per three levels of assistance and ERTMS (all levels together).

Findings

Eleven EU Member reported zero values across all three TPSs functional levels, whereas in some of them, advanced TPS, such as ETCS are in place. Among countries providing TPS data, the Netherlands, Luxembourg, Spain and Germany have equipped an overwhelming majority of their network with TPS that provide the highest level of train protection (warning and automatic stop and discrete supervision of speed).

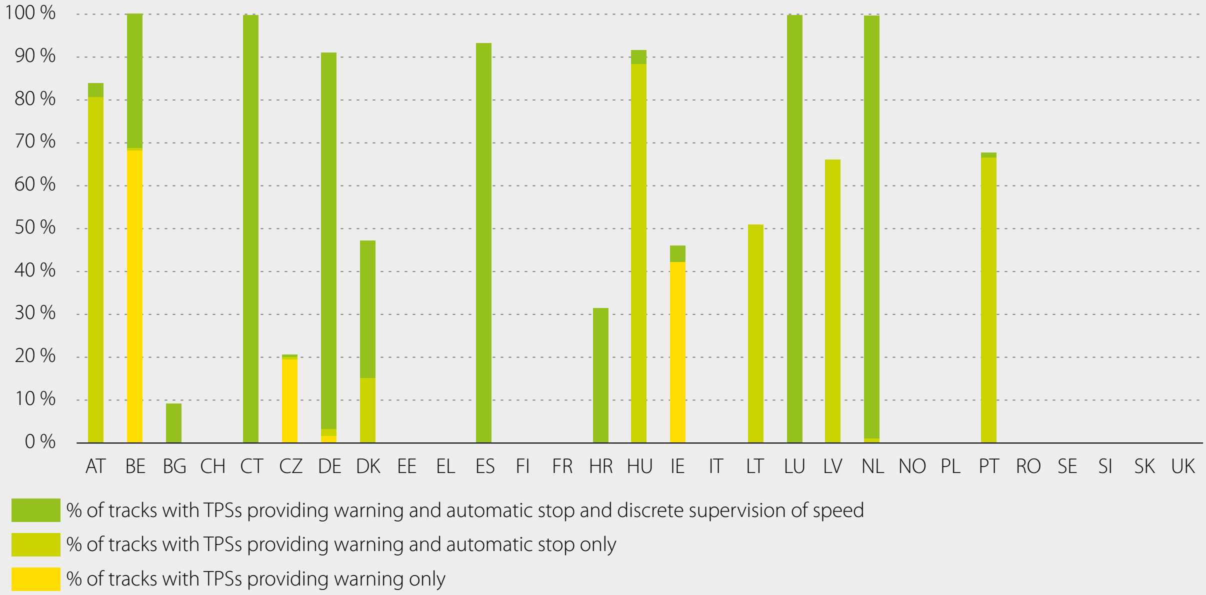
The deployment of the European Train Control System (ETCS) in particular has been limited so far whereas only a few countries have deployed the system on a significant proportion of their network. The league is led by Luxembourg, followed by Slovenia, Belgium and Spain.

Meta-data

Although being part of CSI data collection for long, the three levels have been redefined recently with a view to assure harmonized reporting. However, not all infrastructure managers provide the data and some might still be inaccurate.

Figure A-33: Tracks equipped with train protection systems (ERA countries, 2018)

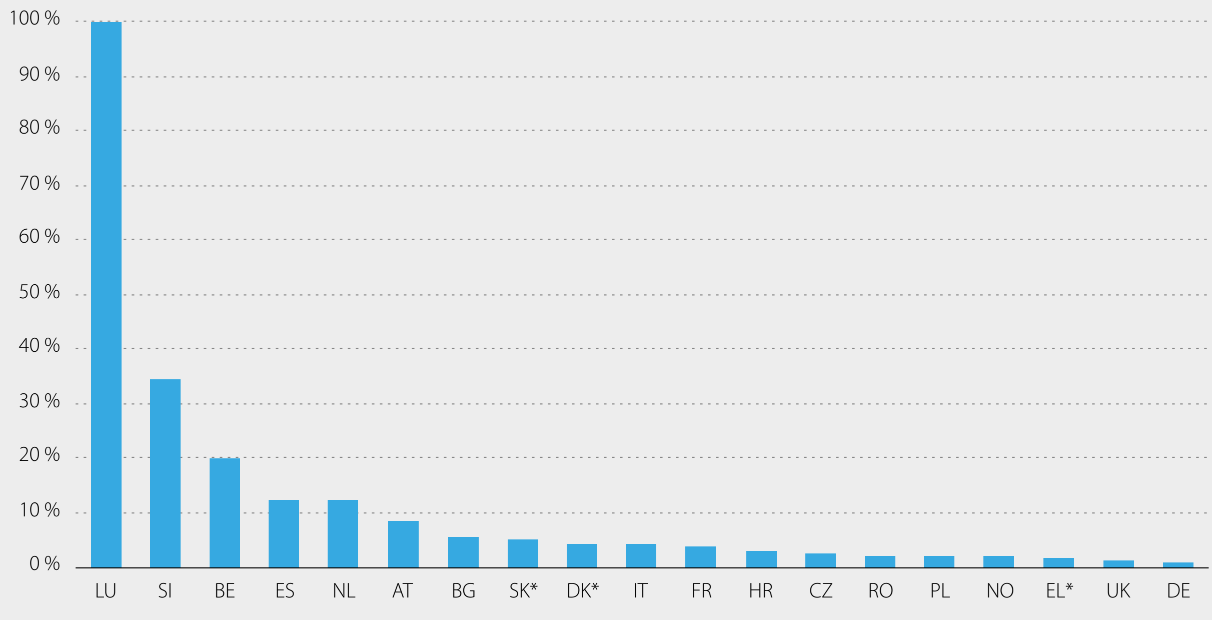
Share of main tracks equipped



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

Figure A-34: Share of main lines equipped with ETCS (ERA countries, end 2019)

Percentage of main lines equipped among all lines



Notes: ETCS tracside data: RINF and TENtec* for end 2019, Total lines data Eurostat for end 2017

Source: Register of Infrastructure (RINF), TENtec, Eurostat

A-19 Deployment of level crossing protection systems

Purpose

Level crossings are high risk spots on the railway network, as they represent an inherent safety risk to both road and railway users. Installation of various protection systems has historically been a cheaper, yet less efficient, alternative to its replacement with an overpass or underpass or a bridge, but still expensive to be deployed on the whole railway network. Empirical data shows that any type of protection is better than none, only manual and rail-side protected level crossings reduces the risk of an accident towards zero.

Indicators

Absolute number of level crossings per type of protection as defined in the RSD (Annex I).

Findings

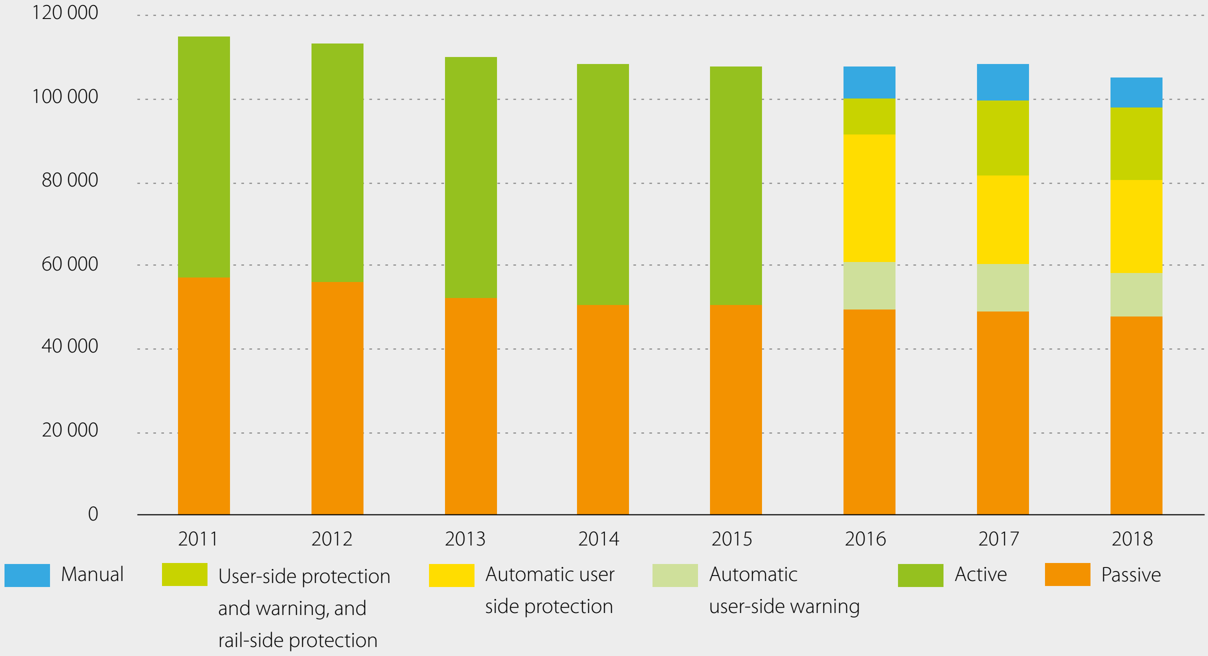
There are about 105 000 level crossings in the EU-28 countries. Passive level crossings represent 49 % of all level crossings. These level crossings are usually equipped with a St Andrew cross traffic sign, but do not provide any active warning to road users. Level crossings with user-side protection (arm barriers and flashing lights) are the most common type of active level crossings (45 %). Level crossings that combine full road-side protection with rail protection (17 277) represent 16 % of all level crossings.

Passive level crossings and level crossings in general disappear at a low pace. If the current trend continues, there will be still some 35 000 level crossings on the Union railway network by the end of century, of which 5 000 passive.

Meta-data

As there is no standard for level crossing protective equipment, dozens of types, using various combinations of features exists in Europe. However, a basic classification has been agreed, featuring five main types, characterized by main functional capacities and risk reduction potential.

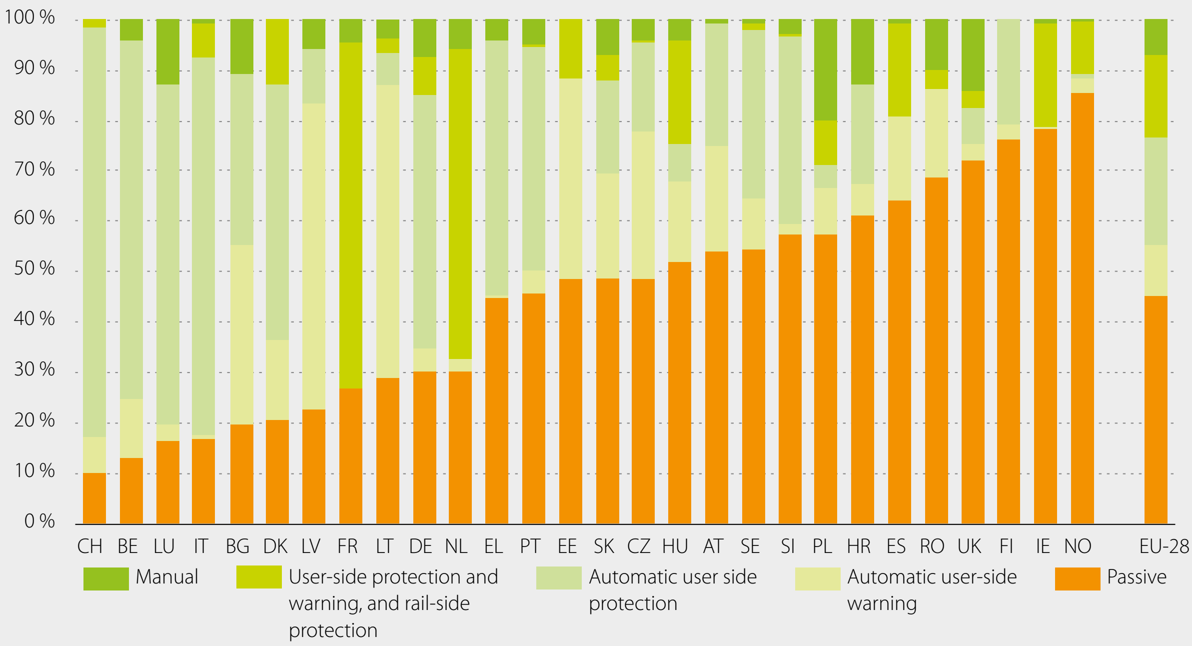
Figure A-35: Level crossings per type of protection (EU-28, 2010-18)



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

Figure A-36: Level crossings per type of protection per country (ERA countries, 2018)

Share among all level crossings



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

A-20 Safety certification

Purpose

The Railway Safety Directive requires the railway undertakings (RUs) to hold a safety certificate issued by the national safety authority (NSA) to access the railway infrastructure. 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's undertaking safety management system) and at least one Part B safety certificate (certification confirming acceptance of the provisions adopted by the railway undertaking to meet specific requirements necessary for the safe supply of its services on the relevant network). A single safety certificate is now gradually replacing the old scheme.

Indicators

The number of valid safety certificates valid at the end of 2019, per type of certificate and type of service.

Findings

There were a total of 1 705 valid safety certificates in ERA countries (783 Part A and 922 Part B certificates) issued in accordance with the RSD and valid on 31 December 2019, as shown by records in the ERADIS database. This figure includes all new, renewed or amended safety certificates. It shows that a relatively small number of RUs provide cross-border train operations in Europe. (However, there may be some RUs operating under the safety certificate of another RU). The international part B safety certificates remain rather rare for RUs operating passenger train services; they are more common for RUs operating freight transport services.

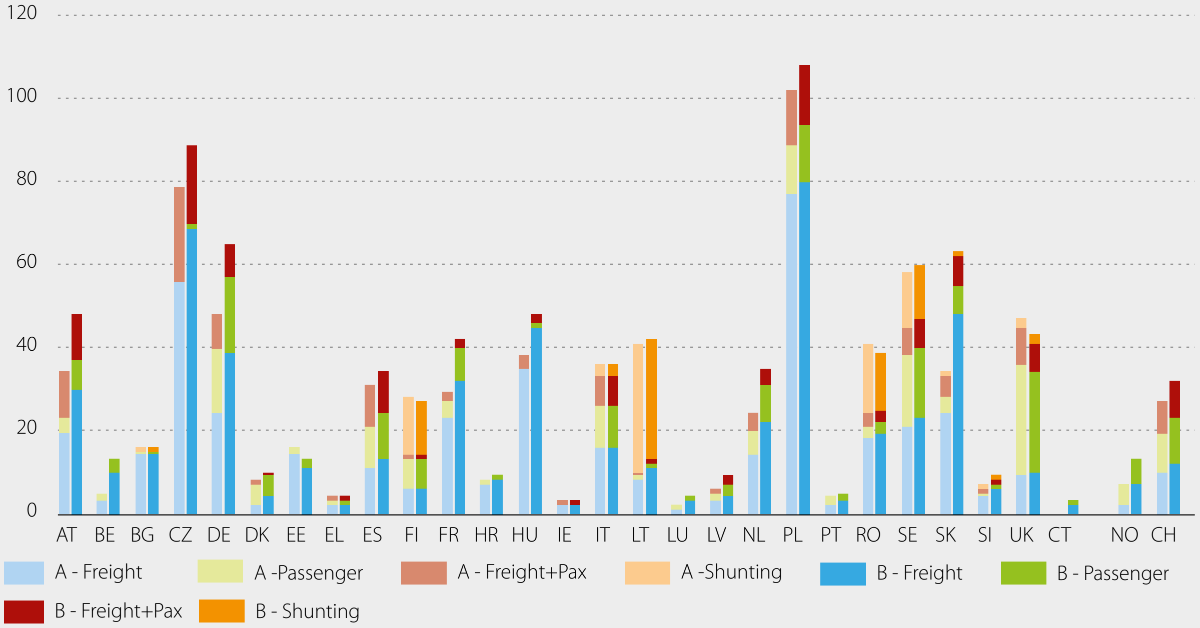
Altogether 13 single safety certificates have been awarded in 2019, of which three by the Agency. Six of them are for freight train services. Given the short time of application of the new scheme, it is too early to draw any conclusions from this data.

Meta-data

The certificates are published by NSAs in the ERADIS database. The quality of the data has been improving in recent years, but some inaccuracies may still exist. For example, a lower number of B certificates compared to A certificates for some Member States indicates that for some the B certificates had already expired and the notification of renewal has not yet been submitted to the Agency.

Figure A-37: Valid safety certificates (ERA countries, end 2019)

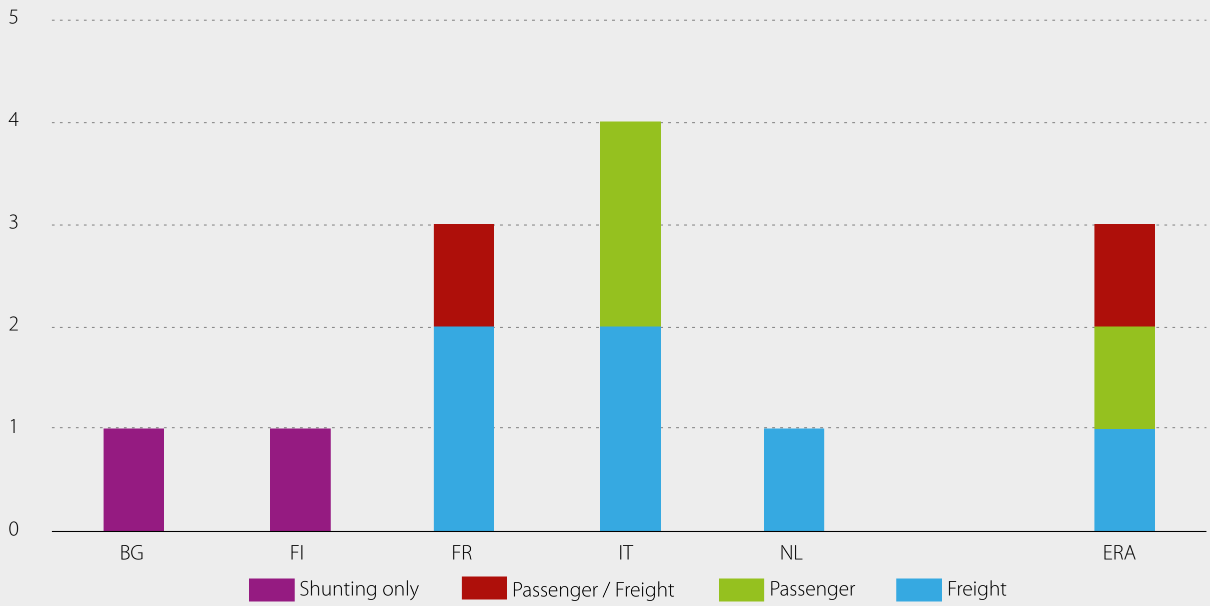
Part-A and part-B



Source: ERADIS (ERA)

Figure A-38: Issued single safety certificates (ERA countries, end 2019)

SSC per type of operation



Source: ERADIS (ERA)

B. Progress with Interoperability

Summary

The progress with interoperability of the Union railway system is unequal when looking at different areas: Solid progress has been achieved in aligning rules and procedures, whereas the improvements have been slow in the area of rolling stock and infrastructure, partly due to their long life nature. The progress in wide adoption of technical standards supporting information availability and exchange is also delayed across the Union, often resulting in parallel developments, which in turn reduces efficiency of investments.

Non-application of TSI requirements remains a common practice as visible from the number of derogations requests addressed to the EC. After their peak just before the implementation of the Fourth Railway Package, their numbers have stabilised and even decrease in some areas.

The "cleaning-up" of the national rules for vehicle authorisation has continued in the past years at a swift pace. The priority was the assessment of rules followed by their progressive publication in RDD. As of end 2019, rules had been published for 19 countries. No new safety rules were notified since 2016, confirming an advanced implementation of the common safety regulatory framework. Despite their overall reduction at the Union level, there is a great diversity in the extent of remaining safety and technical rules implementation among the EU Member States.

Progress has continued with the implementation of TAP and TAF TSIs: the degree of the implementation of single functions under TAP TSI by operators varies considerably among functions, but on average, it is now above 50 %. For the TAF TSI, the degree of the implementation of single functions by operators varies considerably among functions, while only two functions (company codes and rolling stock reference database) have yet been fully implemented by more than 70 % of respondents.

Availability of standardised information to support market entry and cross-border remains an issue. There is a delay in the implementations of European infrastructure and vehicle registers, which hamper on their overall efficiency. While new specification is now in place for infrastructure data, currently only about 86 % of the railway network is described and over 60 % of technical parameters available in the RINF.

At the EU level, less than 1 % of all stations are fully TSI-compliant, and less than 4 % are estimated to be partially TSI-compliant. At the same time, around an additional 40 % of all stations offer step-free access to platforms and are considered accessible under national legislation.

The proportion of train drivers licensed in line with the TDD requirements has been increasing steadily; it is estimated to be 84 % at the EU level as of end 2018 meaning approximately a two-year delay.

The effort in deploying ERTMS is insufficient and needs to be increased to keep up with the EU strategy. At the same time, the number of errors in ERTMS specification as well as the number of national rules decreased. The progress in ERTMS deployment seems to be partly related to high costs and immature market for ERTMS equipment.

As of end 2019, the Agency has issued 4 Type authorisations (3 first authorisations and 1 new authorisation) with average time elapsed of 112 days.

No harmonized and methodological mature indicators are available for the moment to measure the seamlessness of cross-border operation, the ultimate objective of the railway interoperability efforts. However the final outcome in terms of relative share of rail transport in Europe paints a mediocre picture with 6.7 % and 11.3 % share for passenger and freight respectively. These levels are too low in light of the EU climate policy ambitions. Besides, rail has not increased its market share in the last decade.

Overview of indicators and figures

Part B: Progress with interoperability

Indicator Nr	Figure Nr	Figure title	Category	Area
1		**Modal share of rail transport**	Outcomes	Final outcomes
	1	*Rail modal share - passenger transport (EU-28, 2001-18)*		
	2	*Rail modal share - freight transport (EU-28, 2001-18)*		
2		**National rules for train operation**	Outputs	Regulatory provisions
	3	*Notified national operating rules (EU-28, end 2019)*		
	4	*National operating rules per country (EU-28, end 2019)*		
3		**National rules for safety management**		
	5	*Notified national safety rules (EU-28, 2010-19)*		
	6	*National safety rules (EU28, end 2019)*		
4		**TAP TSI implementation**		Operating provisions
	7	*Degree of implementation of TAP functions (% of EU market, end 2019)*		
5		**TAF TSI implementation**		
	8	*Degree of implementation of TAF functions (% of EU market, end 2019)*		
	9	*Degree of implementation of Train Running Information function (EU-28, 2015-19)*		
6		**Train drivers with EU license**		Humans
	10	*Share of train drivers with EU license (EU-28, 2014-19)*		
	11	*Train drivers with a European license per country (EU-28, end 2018)*		
7		**Railway stations accessible to PRMs**		
	12	*Railway stations per type of PRM accessibility (EU-28, end 2019)*		
	13	*Railway stations accessible to persons with reduced mobility (EU-28, end 2018)*		
8		**Non-application of fixed installations-related TSIs**		Fixed installa-tions
	14	*Derogations from fixed installations-related TSIs (EU-28, end 2019)*		
	15	*Derogations from fixed installations-related TSIs (EU-28, 2007-19)*		
9		**ERTMS trackside deployment**		
	16	*Length of railway lines equipped with ETCS (ERA countries, end 2019)*		
	17	*Deployment of ERTMS on core network (ERA countries, end 2019)*		
10		**Non-application of TSIs related to rolling-stock**		Rolling stock
	18	*Derogations from rolling stock-related TSIs (EU-28, 2008-19)*		
	19	*Derogations from rolling stock-related TSIs per country (EU-28, 2008-19)*		
11		**Applicable national technical rules for vehicles**		
	20	*Progress with "cleaning up" of national rules for vehicle authorisation (ERA countries, end 2019)*		
	21	*National Rules for vehicle authorisation (ERA countries, 2016-19)*		
12		**Vehicle authorisations**		
	22	*Vehicles authorised in 2018: first authorisation (ERA countries)*		
	23	*Share of issued vehicle authorisation types (ERA countries, 2018)*		
13		**ERTMS on board deployment**		
	24	*Vehicles with ERTMS OBU in operation (ERA countries, end 2018)*		
	25	*Contracted ERTMS-equiped vehicles (ERA countries, 2008-19)*		
14		**RINF completeness**	Inputs	Enablers
	26	*RINF network description completeness (ERA countries, end February 2020)*		
	27	*RINF technical parameters completeness (ERA countries, end February 2020)*		
15		**ETCS trackside costs**		
	28	*ETCS-L2 trackside cost (EU-28, 2011-18)*		
	29	*ETCS-L1 trackside cost (EU-28, 2011-18)*		
16		**ETCS on-board costs**		
	30	*ETCS-OBU unit cost (EU-28, 2011-18)*		
	31	*ETCS-OBU cost, without prototype (EU-28, 2011-18)*		
17		**Maturity of ETCS specifications**		
	32	*ERTMS specification errors (ERA countries, 2009-19)*		
18		**Time to obtain EU authorisation, safety certificate and ERTMS trackside approval**		
	1*	*Applications and granted vehicle authorisatios as of end 2019 (EU-28)*		
	2*	*Single safety certificates granted by ERA (EU-28)*		
19		**New lines approved and lines excluded from EU Directives**		
	3*	*Lines authorized and excluded under IOP/SAF Directives in 2018 (ERA countries, end 2018)*		

*) Tables

B-1 Modal share of rail transport

Purpose

The relative share of people and goods transported by railways, as compared to all other modes of transport, reflects the competitive position of rail transport in terms of efficiency and performance. Seamless timely operation is one of the inherent advantages of the rail transport and one of the key performance parameters. It is further elevated by an interoperable railway system, which has been an overall objective of the EU policy agenda for several decades. Thus, the modal share of transport is an indirect measure of the impact of railway interoperability on actual transport performance.

Indicators

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

Findings

The relative share of rail transport in the EU is 6.7 % and 11.3 % for passenger and freight respectively. These levels are too low in light of the EU climate policy ambitions. Besides, rail has not increased its market share in the last decade.

The relative share of passenger rail transport stands at 6.7 percentage points and has been stable since 2012. A modest increase of 2.7 per mille was recorded in a short period 2009-2012 following the last financial crisis. The underlying passenger transport volume has seen an increasing trend since 2009, with an annual average increase of 1.6 %. This is in line with trends registered for other modes of transport.

The relative share of freight rail transport is just above 11 %, and it has been at this level for more than a decade. An increase in freight transported has been recorded in 2017 and 2018, possibly marking a change in the overall trend.

It is also noticeable that the share of rail transport carried out internationally has been stable for a decade now with around 6 % for passenger transport and 50 % freight transport carried out internationally.

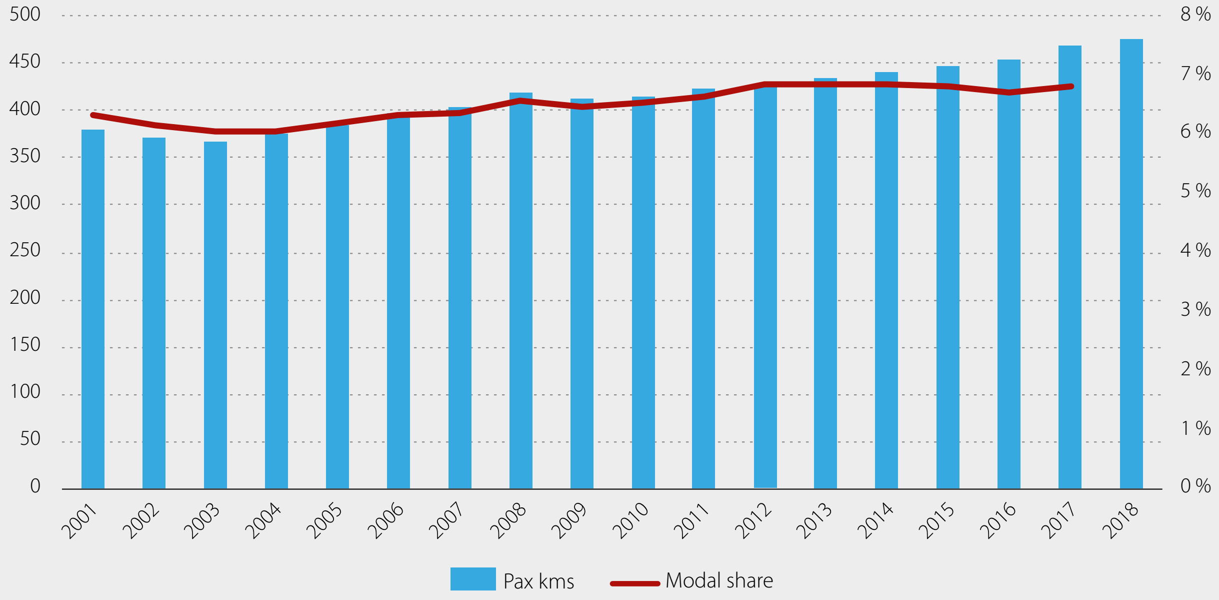
With its relatively low externalities, rail transport has traditionally been the preferred mode of transport for European policy makers. EU policy contains explicit goals on the increase of rail transport share and provide public support to reach those goals. These justify a close monitoring of the developments, including in-depth analyses of causes and effects.

Meta-data

The data on modal share has traditionally been compiled by EUROSTAT, relying on the inputs from national statistical offices. Eurostat has notably developed and applied methodologies allowing to territorialize the transport flows at MSs level and to avoid double-counting of transport flows on single territories (e.g. in road transport). The quality of these administrative data could be considered high, owning to the well-established data collection and data production practices.

Figure B-1: Rail modal share – passenger transport (EU-28, 2001-18)

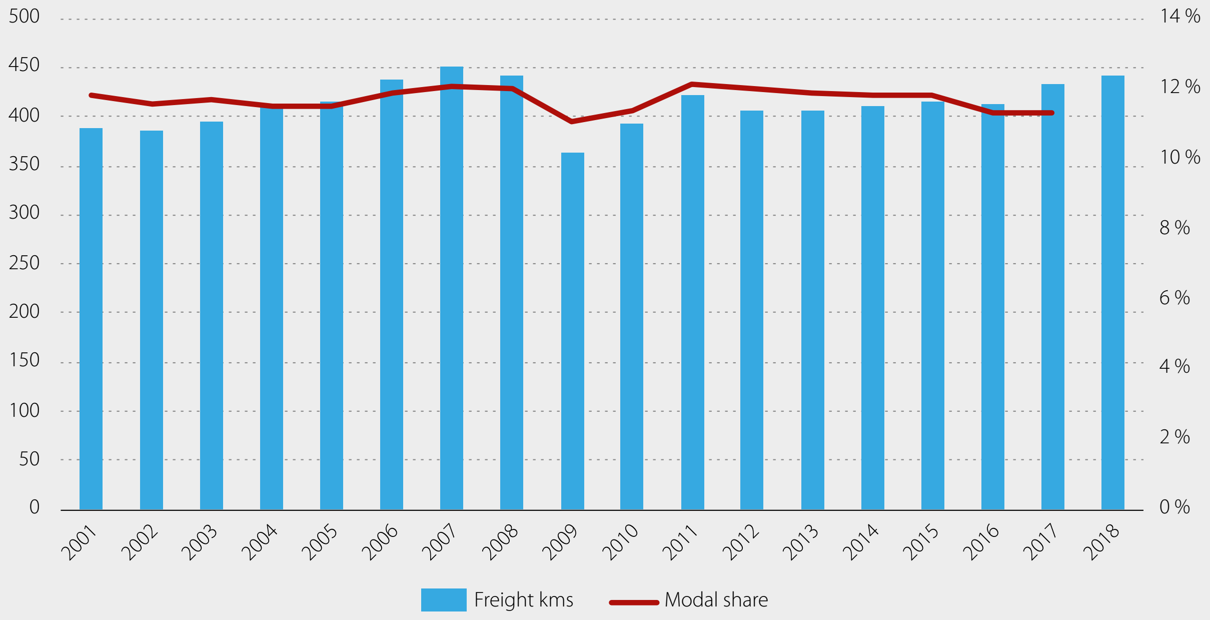
Passenger kilometers (billions) and their share in total movements (%)



Source: Eurostat (data nodes: rail_go_total, iww_go_atyo, road_go_ta_tott, road_go_ca_c, avia_tpgo)

Figure B-2: Rail modal share – freight transport (EU-28, 2001-18)

Tonne kilometers (billions) and their share (%) in total transport



Source: Eurostat

B-2 National rules for train operation

Purpose

National rules that relate to train operations are requirements on top of those contained in the Railway Interoperability Directive and the TSI for operations and traffic management. Member States have been asked to remove these rules as the TSI has been developed. However, a significant number of national rules remains in place hindering effective cross border traffic.

Indicators

Three types of rules related to the train operations are notified by national authorities: Common operating rules of the railway network that are not yet covered by TSIs, including rules relating to the signalling and traffic management system (type 3), Rules laying down requirements in respect of additional internal operating rules (company rules) that must be established by infrastructure managers and railway undertakings (type 4), Rules concerning requirements in respect of staff executing safety-critical tasks, including selection criteria, medical fitness and vocational training and certification, in so far as they are not yet covered by a TSI (type 5).

The metrics used for monitoring of the operation-related rules is the total number of rules in force and the notification of new safety rules, since the historical data is not available for the former metric.

Findings

As of end 2019, there were 431 type 3, 43 type 4 and 118 type 5 rules (totalling 592) in force in the EU-28. Regarding type 5 (operational staff), no rules were in force in three Member States.

It is also notable that there is no association between the overall number of rules on train operation and the overall number of rules on safety management at the level of countries.

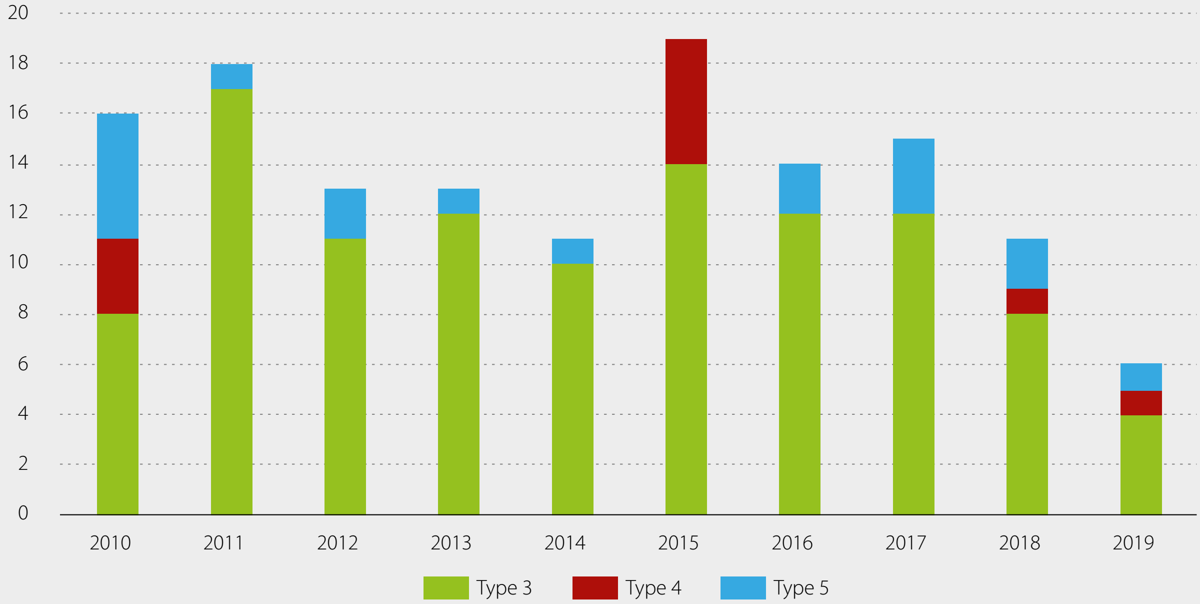
Until 2018, at least ten new rules were notified by MSs every year, with a slightly downward trend observable since 2010. The most recent development (past three years) shows a significant reduction in notified safety operational rules with type 3 remaining the prevalent type among type 3, 4 and 5 safety rules.

Meta-data

National rules are notified by NSAs into Notif-IT, originally hosted by the EC and then moved to the Agency. There is no guarantee that all relevant rules are notified. The quality of data is considered to be satisfactory.

Figure B-3: Notified national operating rules (EU-28, end 2019)

Type 3, 4 and 5 rules notified in Notif-IT

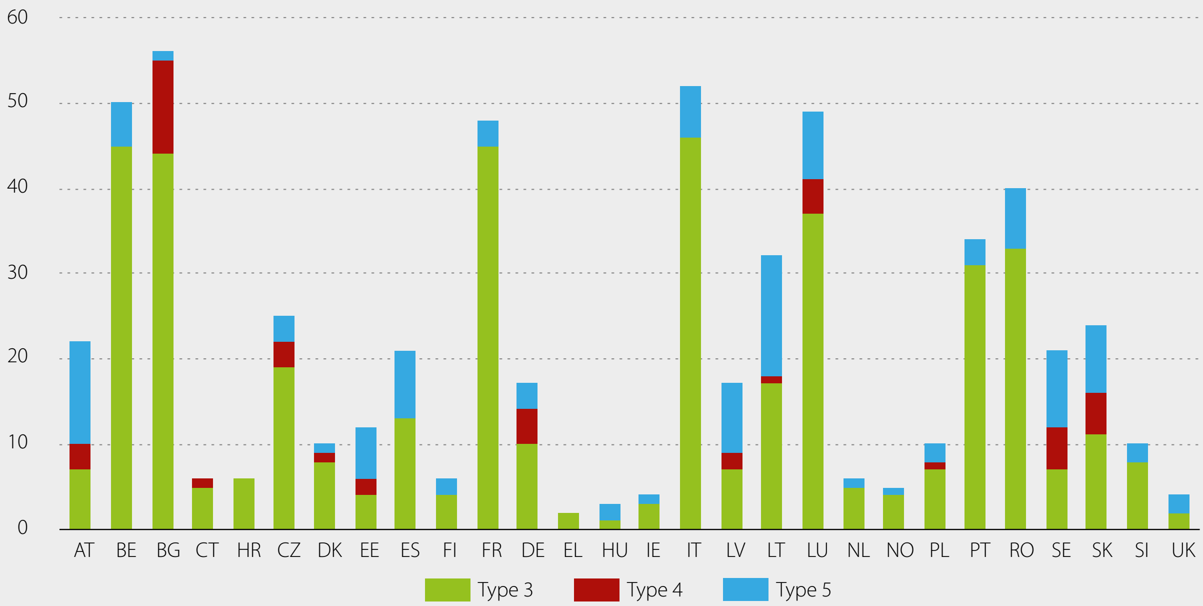


Notes: Type 3: Common operating rules, Type 4: Additional operating rules, Type 5: Rules on operational staff

Source: Notif-IT database

Figure B-4: National operating rules per country (EU-28, end 2019)

Type 3, 4 and 5 rules in force



Notes: Type 3: Common operating rules, Type 4: Additional operating rules, Type 5: Rules on operational staff

Source: Notif-IT database

B-3 National rules for safety management

Purpose

National safety rules are specific requirements that are permitted by the Railway Safety Directive. These NSRs were originally set out as transitional requirements from the national approaches in Member States to a more European interoperable approach. Member States have been asked to review and remove them as and when new EU legislation comes into force. However, the pace for this change has been slow and there remain inconsistencies with EU legislation that represent a hurdle to interoperable and efficient train operation. The ultimate objective is therefore their elimination now as they are no longer appropriate.

Indicators

Three types of rules related to the safety management are notified by national authorities: Rules concerning existing national safety targets and safety methods (type 1); Rules concerning requirements in respect of safety management systems and safety certification of railway (type 2); Rules concerning the investigation of accidents and incidents (type 6).

The indicators used for monitoring of the safety rules is the total number of rules in force and the notification of the new safety rules, since the historical data is not available for the former indicator.

Findings

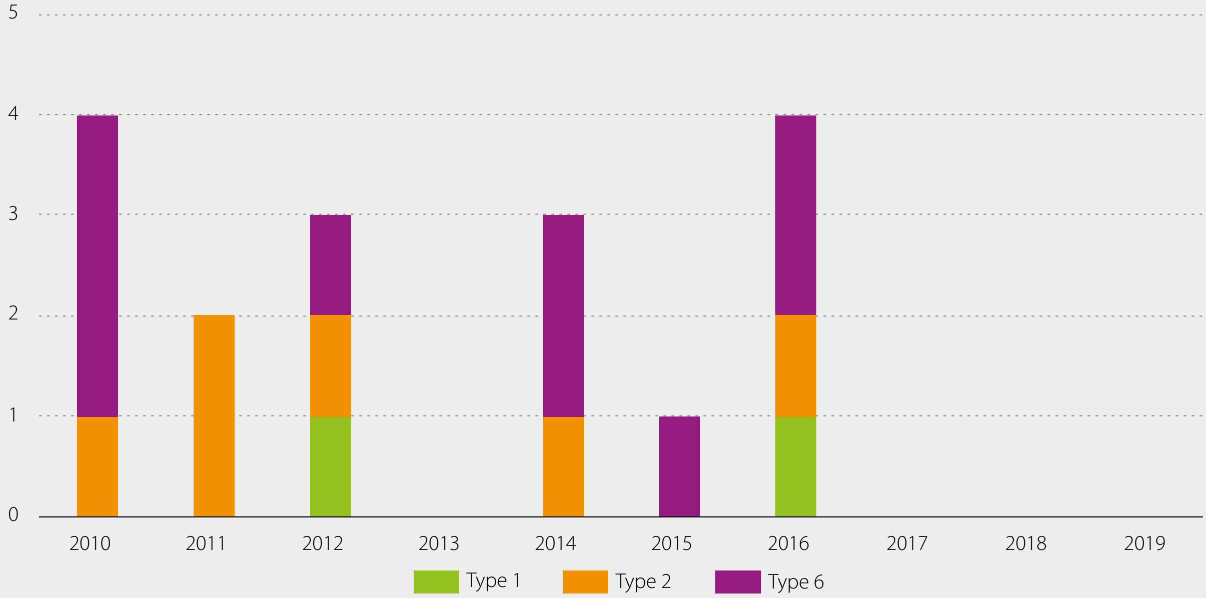
As of end 2019, there were 34 type 1, 52 type 2 and 67 type 3 rules (totalling 153) in force in the EU-28. No single rule was in force in five MSs: Belgium, Croatia, Denmark, Greece, Slovenia and the UK. Rules in force in three countries account for one third of all safety rules. This highlights substantial diversity in the extent to which national safety rules persist across the EU. No new national rules were notified since 2016; this provides a sound basis for the effective elimination of all unnecessary safety rules in force.

Meta-data

National rules are notified by NSAs into Notif-IT, originally hosted by the EC and then moved to the Agency. There is no guarantee that all relevant rules are notified.

Figure B-5: Notified national safety rules (EU-28, end 2019)

National safety rules Type 1,2 and 6 rules notified in Notif-IT

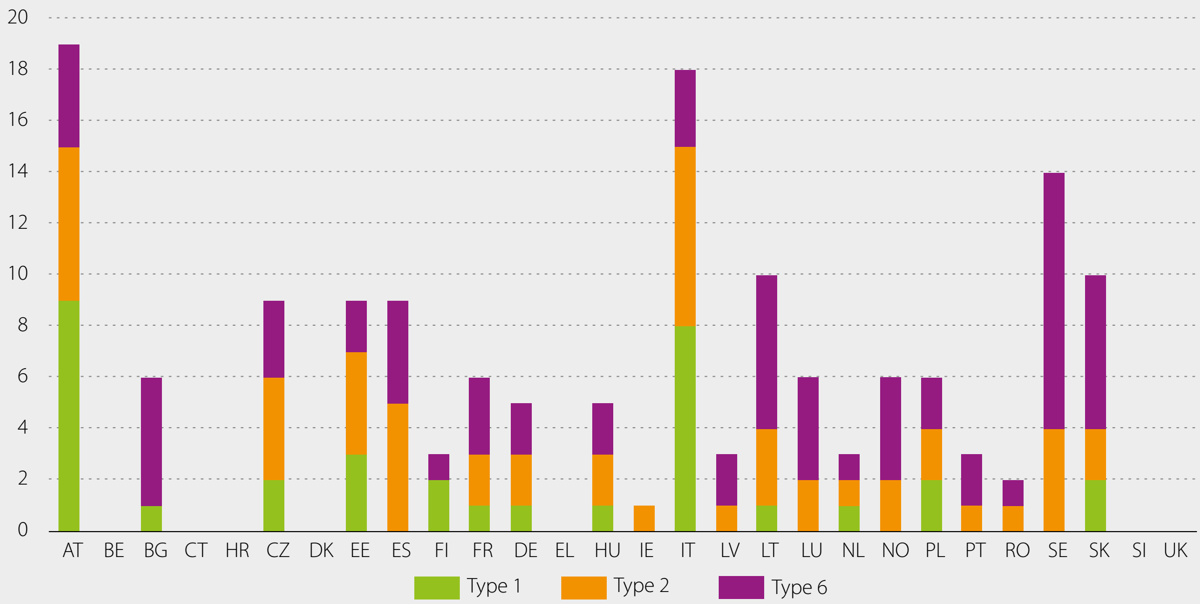


Notes: Type 1: National safety targets&methods, Type 2: Safety management&certification, Type 6: Accident investigation

Source: Notif-IT database

Figure B-6: National safety rules in force (EU-28, end 2019)

Type 1,2 and 6 rules in force, EU-28



Notes: Type 1: National safety targets&methods, Type 2: Safety management&certification, Type 6: Accident investigation

Source: Notif-IT database

B-4 TAP TSI implementation

Purpose

Telematics applications for passenger services (TAP) TSI were introduced to allow for the harmonisation/standardisation of procedures, data and messages to be exchanged between the computer systems of the railway companies and of the tickets vendors in order to provide reliable information to passengers and to issue tickets for a journey on the European Union railway network. Furthermore, the data exchange between the railway undertakings and infrastructure managers is standardised.

The implementation by the RUs and IMs has been underway in the EU. The railway operators have been gradually integrating TAP standards into their IT practices. 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 railway undertakings. The railway undertakings have implemented specific functions for retail as well for the communication between them and the IMs.

Indicators

The indicator used to monitor the progress on the implementation of TSI TAP specific functions by the railway sector is the share of operators that have implemented a certain TAP function in their IT systems, weighted by the train kilometres on European scale. The target value for the indicator is to have 100 % of the individual functions implemented as communicated in the Master Plan of the railway undertakings.

Findings

The degree of the implementation of single functions by operators varies considerably among functions, but now averages above 50 %. With the exception of the function providing for car carriage reservation requests and two specific tariff-related functions, all functions have already been implemented in more than 50 % of the market. The highest degree of implementation is for the acceptance of paper tickets in international and foreign sales (76 %) and for the timetable data provision (73 %).

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 TAP TSI Implementation Cooperation Group deploys a dedicated tool which allows the RUs and IMs to report twice a year on the degree of implementation of specific TAP TSI functions. Data provided by the RUs and IMs has a good degree of reliability. While analysing the trends in the deployment of the functions, attention should be paid to the fact that the population of respondents may not be the identical across various reporting periods.

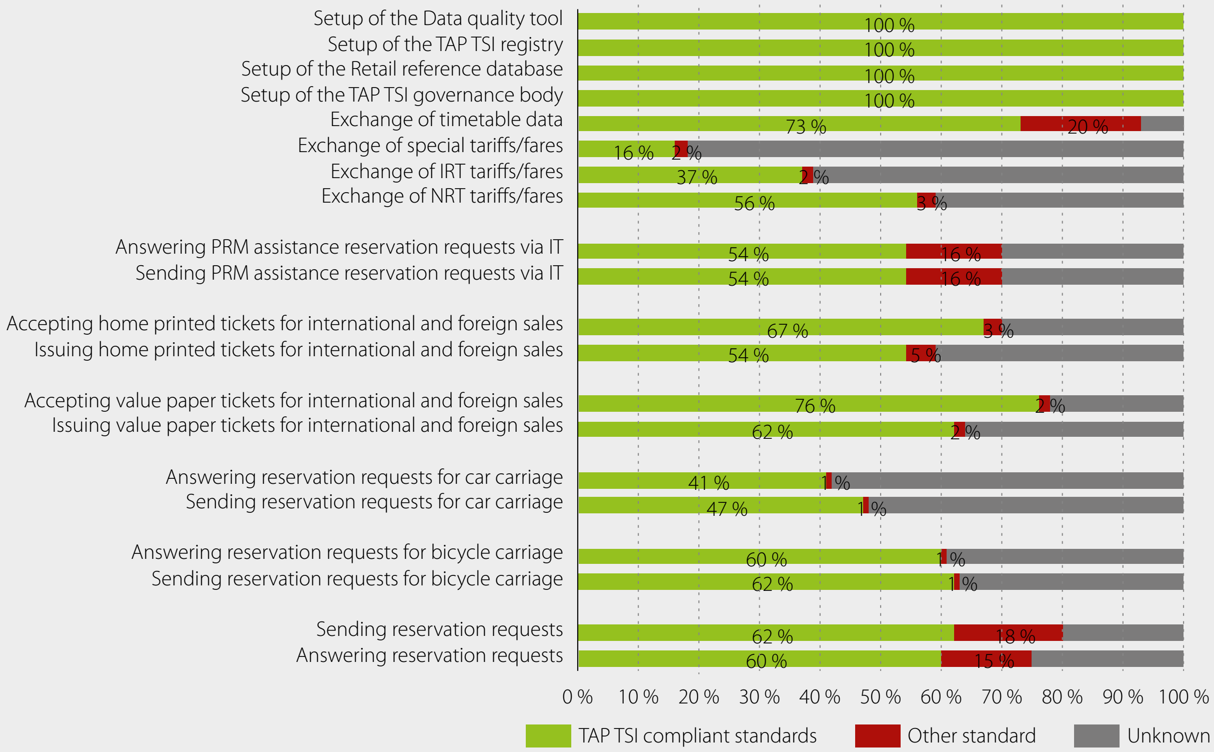
Overall it has to be considered, that the implementation of TAP TSI functions is mainly in place for the incumbent railway undertakings whereas for non-incumbent RUs, less progress have been achieved so far.

Meta-data

A regular survey of railway operators (RUs and IMs) is carried out in a coordinated way, using a stable methodology. Being a survey, the quality of statistical estimates depends on the response rate.

Figure B-7: Degree of implementation of TAP functions (% of EU market, end 2019)

Share of organizations by degree of implementation



Source: TAF surveys to RUs, WKs and IMs by the Implementation reporting group by the TAF Joint Sector Group

B-5 TAF TSI implementation

Purpose

Telematics applications for freight services (TAF) TSI sets the functional and technical standards for exchanging harmonised information between infrastructure managers, railway undertakings and other wagon keepers.

Following years of design and development, the implementation by the RUs and IMs is now underway. The railway operators have been gradually integrating TAF standards into their IT practices in line with the national implementation programmes.

Indicators

The indicator used to monitor the progress with the implementation of TSI TAF specific functions by the railway sector is the share of operators that have implemented the TAF functions, as per regular survey among the three type of organizations carried out by the implementation cooperation group.

Altogether 11 functions are to be implemented with various target dates that correspond to the end of the calendar year, although some functions may come in earlier. Two of them are to be implemented by both RUs and IMs. The target dates are based on the corresponding TAF TSI function to be implemented. 12 out of 13 specific functions have their target date before 2020.

Findings

The degree of the implementation of single functions by operators varies considerably among functions, while only two functions (company codes and rolling stock reference database) have yet been fully implemented by more than 70 % of respondents.

The higher implementation rate amongst IMs, combined with their potential to drive the TAF TSI implementation process forward, should foster RUs catching up in the near future. The deployment of IM specific functions at European rail freight corridor level is good for most of the corridors and corridor sections.

As an example, the TAF TSI function with the highest expected benefits to the sector, the train running information function, has seen a gradual implementation over time, with the implementation level above 80 % among IMs and above 50 % for the RUs. These fall short in respect to the target, but the trends hold the promise of eventual full implementation in the near future.

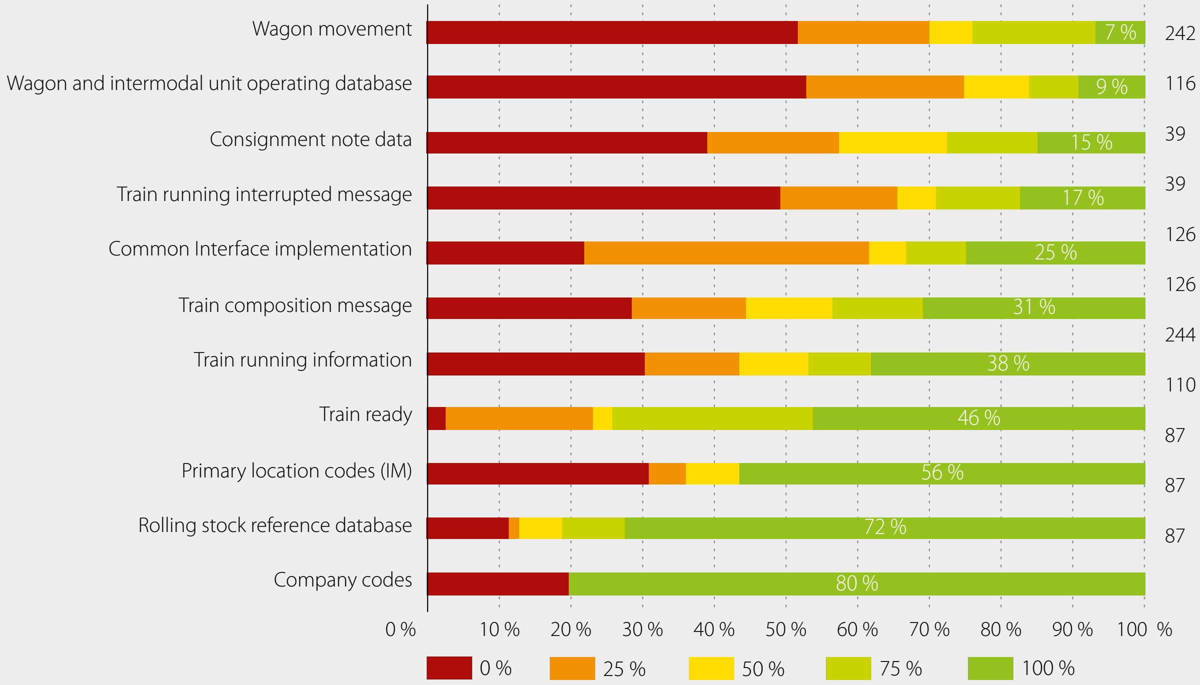
A revision of the TAF TSI is now underway with its publication anticipated by end 2020. The revised version should allow for the implementation by other means of compliance. This means that large incumbent RUs that are members of larger TAF user's communities would report 100 % implementation level. This would translate into a significant increase of implementation of some functions such as consignment note or wagon movement. Besides, the wagon and intermodal unit operating database should not be anymore mandatory in the aforementioned revised TAF TSI.

Meta-data

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 TAP TSI Implementation Cooperation Group deploys a dedicated tool which allows the RUs and IMs to report twice a year on the degree of implementation of specific TAP TSI functions. While the number of responding organizations is limited (actual figures shown per individual function), the degree of representativeness of the data sample is relatively high, as the responding organizations represent major players on the railway market. While 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. This is notable as it may explain the sudden drop seen in the first 2016 survey for the Train running information function.

Figure B-8: Degree of implementation of TAF functions (% EU market, end 2019)

Share of EU market by different type of standard



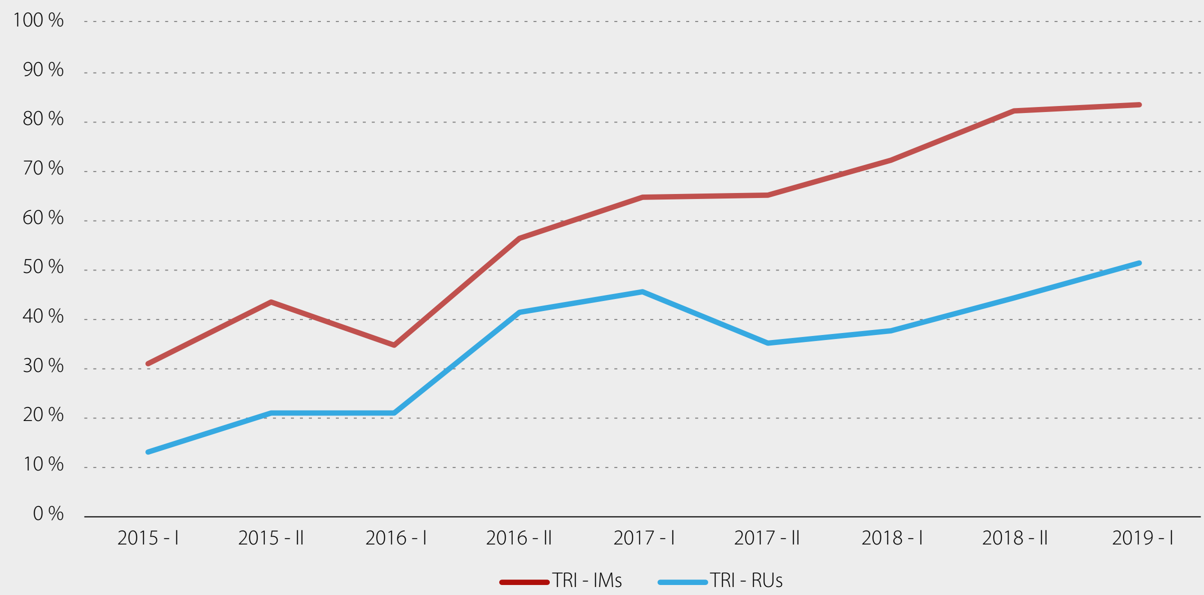
Notes: Share of market of RUs and IMs for which the information is available is showed

NRT= Non-Reservation-Integrated Tickets; IRT= Integrated Reservation Tickets; PRM=Persons of Reduced Mobility

Source: TAP surveys to RUs and IMs carried out by the Agency

Figure B-9: Degree of implementation of Train Running Information function (EU-28, 2015-19)

% of organisations that implemented TRI function among those surveyed



Source: Surveys by the TAF Joint Sector Group

B-6 Train drivers with EU licence

Purpose

The EU train driver license is a means to facilitate 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 safety directive. It has been introduced by the Train Drivers Directive (TDD), which foresaw its gradual implementation in EU Member States. All train drivers in Europe must, since October 2018, hold a license in conformity with the TDD. They also need to be certified by the RU for the rolling stock and infrastructure on which they can operate. This is part of the RUs' SMS.

Indicators

The indicator used to measure the implementation of the EU train driver license scheme is the proportion of train drivers with a valid EU license, compared to the total number of drivers. In addition, the number of licenses issued annually provides an indication of the scheme implementation progress over time.

Findings

The proportion of train drivers licensed in line with the TDD requirements has been increasing steadily; it is estimated to be 84 % at the EU level as of end 2018. This means that there was at least one a year delay in the implementation of the legal requirement. With the current annual average increase at around 10 % per year, all train driver licenses are likely to be conform to TDD by end 2020.

The underlying data available at MS level shows, that while all MSs have been implementing the scheme, there were still train drivers, not yet licensed under the EU scheme in at least eight MSs in 2019.

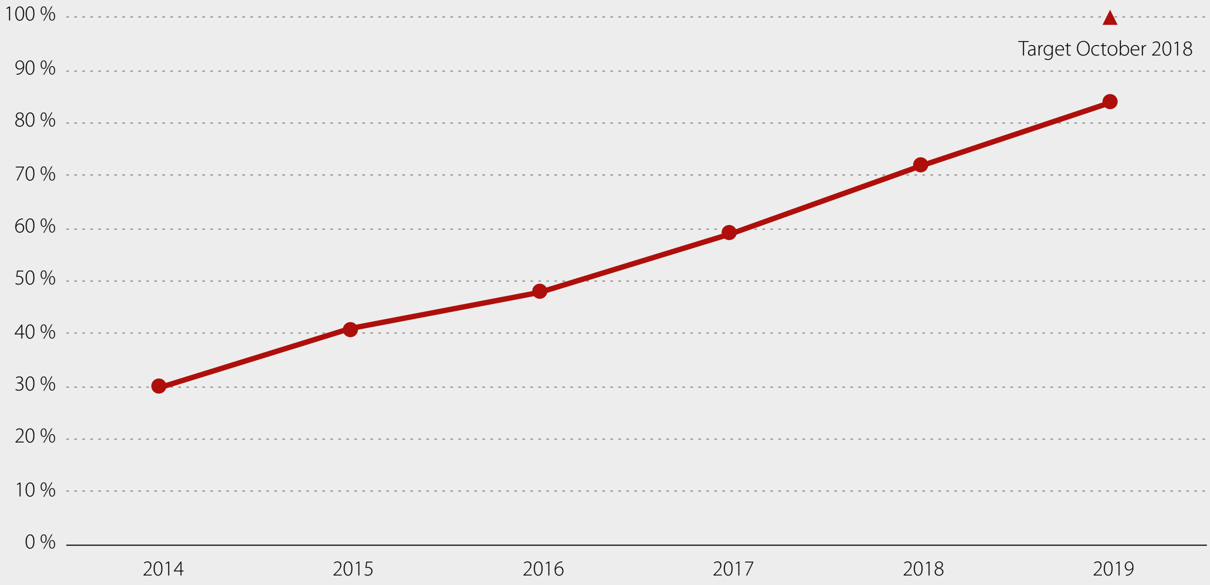
The data on the total number of EU licenses per MSs issued in different years suggest that practically all MSs issued EU licenses in 2018, whereas an increased effort took place in some of them to advance the implementation. To the knowledge of the Agency, as of end 2019, two MSs have not issued EU driver licenses yet.

Meta-data

The data on the total number of train drivers and total number of train drivers licensed according to the TDD are provided by the NSAs in each Member State, who are the licensing authority. The quality of these data could be considered as satisfactory. However, the indicator value had to be estimated, since the underlying data were not available in the case of three Member States.

■ **Figure B-10**: Share of train drivers with EU license (EU-28, 2014-19)

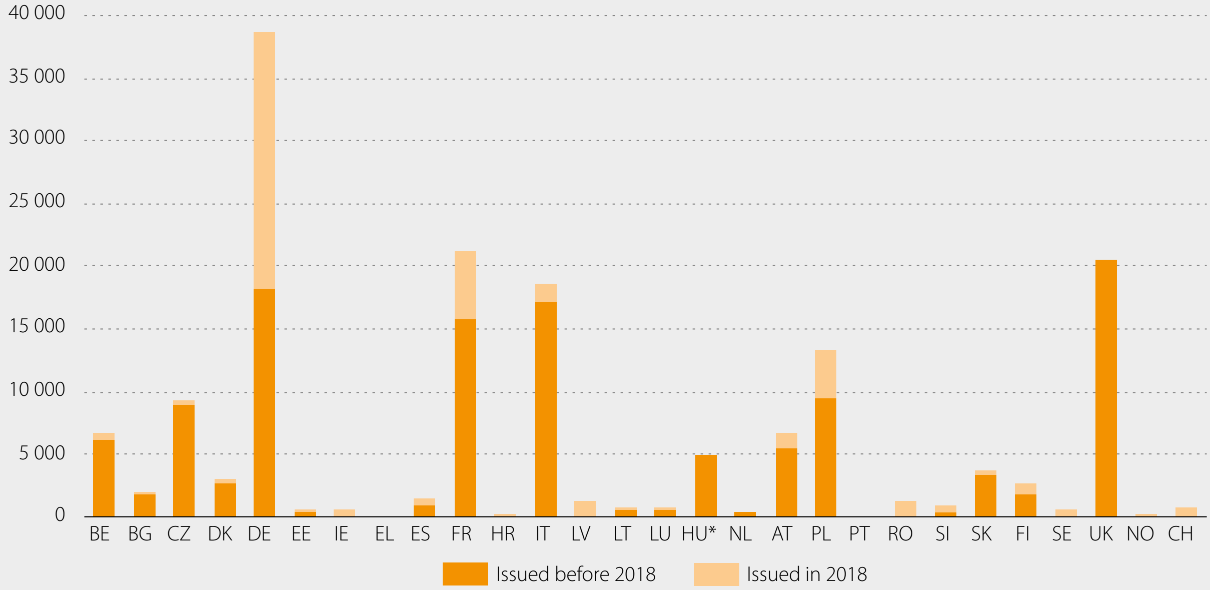
Drivers with EU license among licensed drivers, as of 31.12.



Source: ERA estimation based on data provided by NSAs.

■ **Figure B-11**: Train drivers with a European license per country (EU-28, end 2018)

As per 31.12.2018



Note: *) Data as of 1.1.2017

Source: Survey of NSAs in late 2019

B-7 Railway stations accessible to PRMs

Purpose

There are over 100 million persons with disabilities living in the European Union[3]. An additional 50 million Europeans have reduced mobility due to their disability, age, or pregnancy[4]. They would often avoid taking the train due to physical barriers that are present at the railway stations. The Technical Specifications for Interoperability for Persons with Reduced Mobility (PRM TSI) specifies that all European Union (EU) Member States should work towards improving the accessibility of their rail system for persons with disabilities and persons with reduced mobility. More specifically, all Member States are required to develop and endeavour to put into practice a National Implementation Plan (NIP) setting out how they will progressively eliminate all identified barriers to accessibility across the rail network. These plans were to be submitted to the European Commission by January 2017.

Indicators

There are almost 30 000 train stations in EU-28 Member States[2]. They have various degrees of accessibility to persons with reduced mobility. The indicator used to measure the degree of accessibility is the share of railway stations compliant with the PRM TSI requirements on the one hand and the share of accessible stations on the other hand, whereas full TSI compliance means full conformity with PRM TSI requirements, as demonstrated by the Notified Body (NoBo) certificate. Partial TSI compliance means conformity with some (but not all) PRM TSI requirements, as demonstrated with the NoBo certificate. An accessible station means a station considered accessible under national legislation. (No NoBo certificate available.)

Findings

According to the data supplied by the NSAs, there were, by end 2018, at least 110 stations with full TSI compliance, and 275 stations with partial TSI compliance. At the EU level, less than 1 % of all stations are fully TSI-compliant, and less than 4 % are estimated to be partially TSI-compliant. At the same time, around additional 40 % of all stations offer step-free access to platforms and are considered accessible under national legislation.

Meta-data

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

Substantial differences exist among MSs, whereas 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 the progress towards the goal of mobility for all.

For this report, the data were available for 16 EU Member States and this was complemented with data from National Implementation Plans recovered by a consultant for the Agency back in 2018. Their study further delivered the estimates of the total number of disabled persons and persons of reduced mobility and the reference number of railway stations in EU Member States, since these data are not subject to regulatory data collection.

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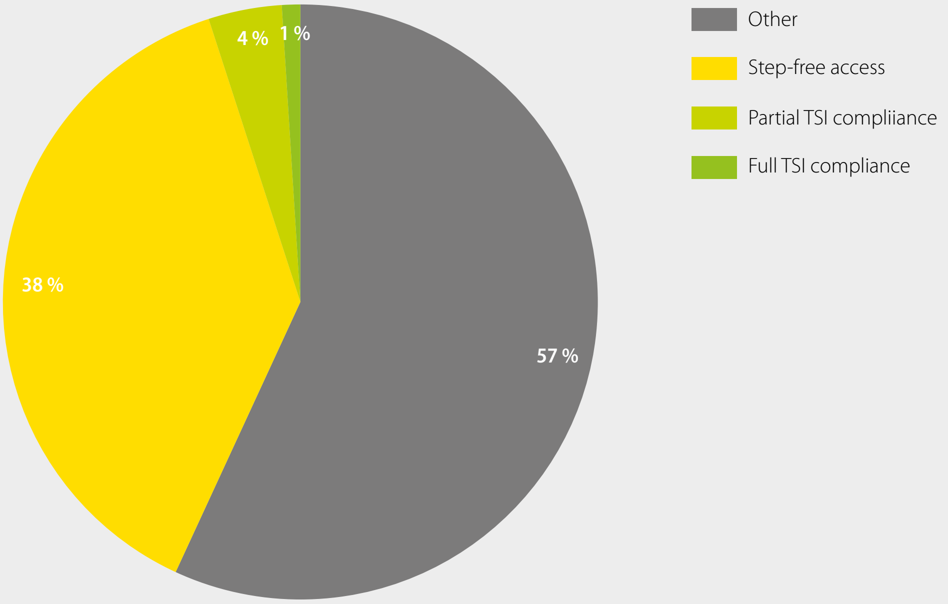
[3] Source: European disability forum, retrieved from http://www.edf-feph.org on 15/03/2020

[4] Study: Railway costs and benefits data collection (ERA 2017 38 RS), INECO-ECORYS

Figure B-12: Railway stations per type of PRM accessibility (EU-28, end 2018)

Percentage of stations

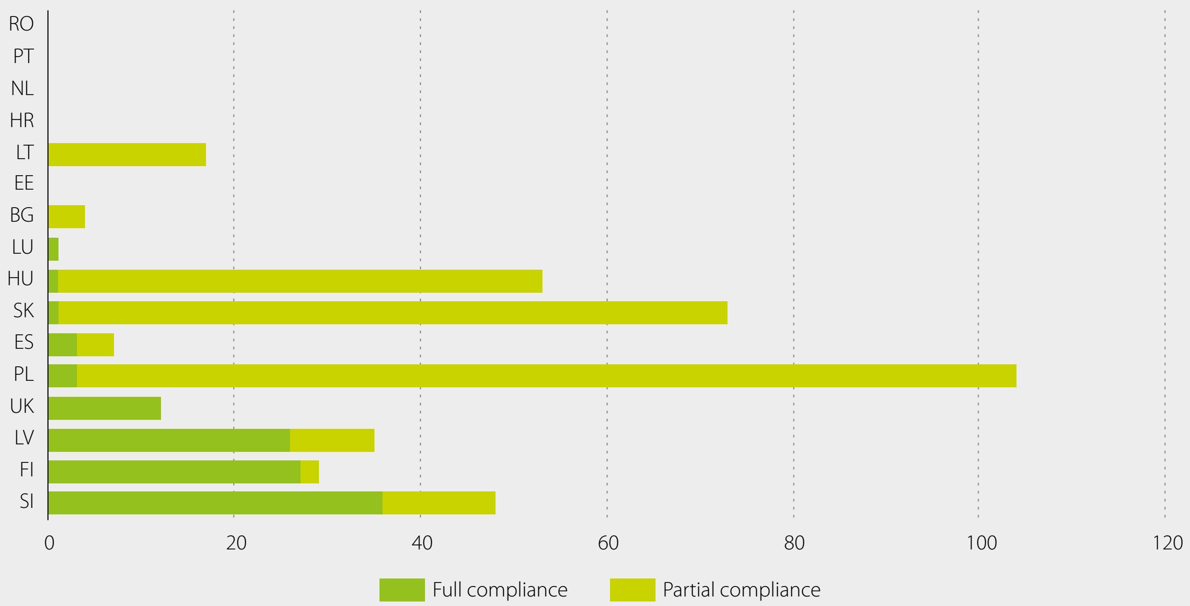


Notes: ERA estimates based on sampe data from 16 EU countries

Source: NSA survey, end 2019 and National Implementation Plans

Figure B-13: Railway stations accessible to persons with reduced mobility (EU-28, end 2018)

PRM-TSI compliant stations



Source: NSA survey end 2019

B-8 Non-application of fixed installations-related TSIs

Purpose

If the subsystem cannot fulfil some TSI requirements, there is a limited possibility to apply for a derogation from TSI requirements. This is normally only applicable for projects that were already in an advanced state when the TSI came into force. The TSIs specify transition rules and time limits. A project which has derogations that are inside the transition rules does not need derogations. Besides, the Interoperability Directive specifies that the European Commission may decide on a derogation for any proposed renewal, extension or upgrading of an existing subsystem, when the application of these TSIs would compromise the economic viability of the project. However the Commission has only accepted very few derogations of this type to date.

Indicators

The indicator used here is the number of derogation requests for the fixed installations related TSIs (INF, ENE, SRT and PRM), as submitted by Member states. All requests for derogations received by the EC are counted, except those which were rejected. These derogations refer to infrastructure projects in general and concern either a single railway line or even an area of a network depending on the geographical scope of the derogation. These derogations represent technical barriers for vehicles because vehicles have to be compliant with these derogations (additional national technical rules) in addition to the TSIs requirements. In general, the lower the number of derogation requests registered the higher the level of interoperability of the Union railway system is.

Findings

The TSI derogations most frequently concern the TSI CCS and refer to the requirements of the 2008 Interoperability Directive. It should also be noted here that several derogations to the TSI CCS since 2017 may concern OBU of rolling stock and not fixed installations.

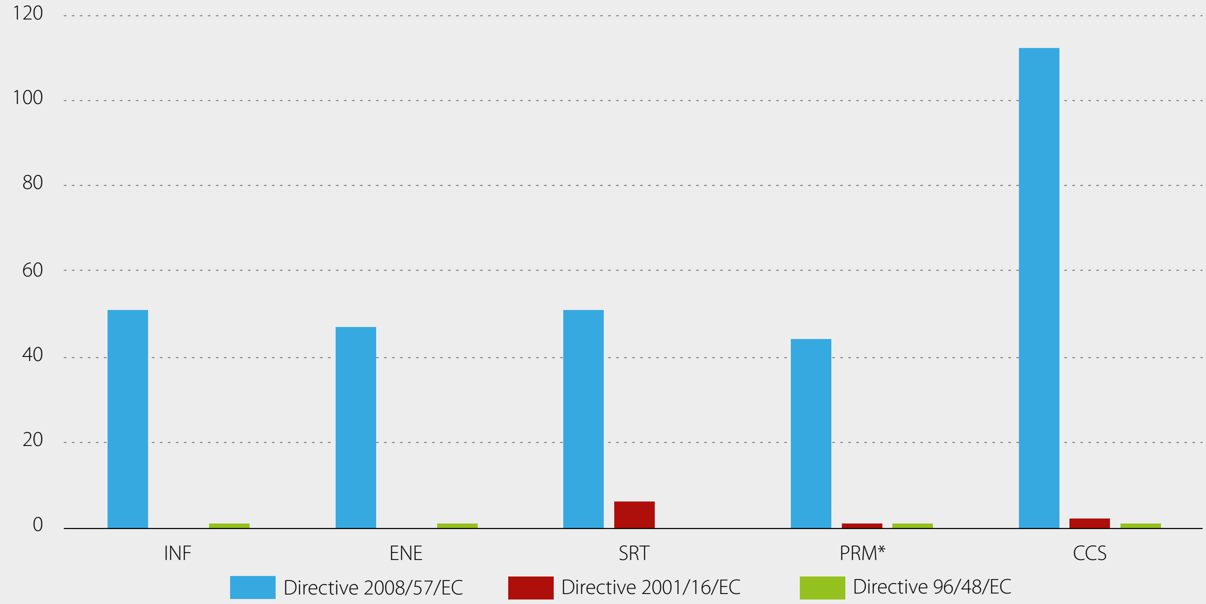
An annual average of 27 derogations were received since 2010. There was a substantial increase of derogation requests in 2017 most likely linked to the recast of the relevant TSIs. The annual number of requests started to decrease since then.

Meta-data

While not shown here, derogations submitted come from multiple MSs, but there are also cases of no derogation requests from some countries. This may point to possible underreporting of derogations to DG MOVE. The data is directly retrieved from an internal database of the EC (DG MOVE), where all submitted derogation requests are recorded. Its quality is considered satisfactory for the given purpose. Derogation data for two categories (PRM and CCS) should be considered as preliminary due to ongoing validation with Member States.

Figure B-14: Derogations from fixed installations-related TSIs per Directive (EU-28, end 2019)

TSI INF, ENE, SRT, PRM, EU-28

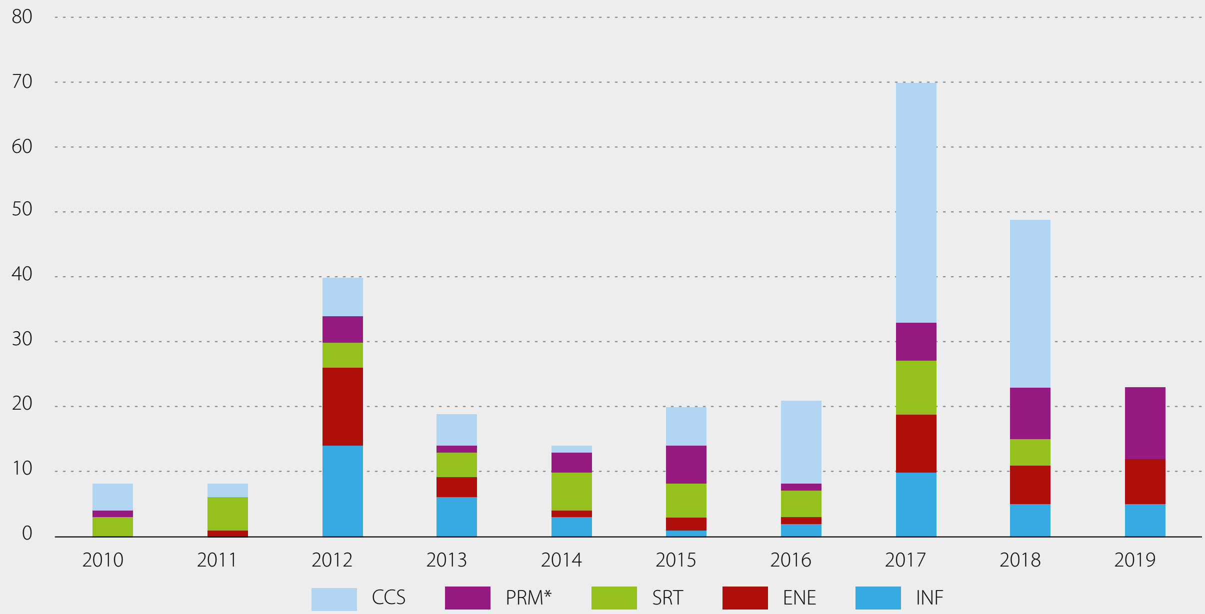


Note: *) preliminary data

Source: DG MOVE internal database

Figure B-15: Derogations from fixed installations-related TSIs per year (EU-28, 2010-19)

TSI INF, ENE, SRT, PRM



Notes: *) preliminary data

Source: DG MOVE internal database

B-9 ERTMS trackside deployment

Purpose

ERTMS stands for 'European Railway Traffic Management System', and is the European standard for the Automatic Train Protection (ATP). The ERTMS is meant to replace legacy train protection systems and is designed to replace the many incompatible safety systems currently used by European railways. As such it will allow an interoperable railway system in Europe, while providing additional benefits in terms of operational efficiency, increased capacity and safety. ERTMS deployment has been a key element of the European strategy for interoperable and safe railways for the past 15 years.

While ideally, the entire Union rail network would be equipped with the system, an emphasis has been put on nine core network corridors (CNC) with the view to ensure the highest efficiency of investments. The common long-term target adopted by the EC is to have all core network lines (representing a quarter of the Union rail network) equipped by 2030.

Indicators

The indicator used to measure the progress with the ERTMS deployment on the Union rail network is the share of lines equipped with ETCS and GSM-R, the two components of the ERTMS, on the whole network and on CNC only, in terms of length of lines with and without deployed component.

Findings

The deployment of ETCS on Union railway network has been slow so far; it currently stands at about 7 100 km of railway lines. It is 8 518 km when figures for Norway and Switzerland are considered in addition. The deployment varies considerably between countries, as they reflect national rail transport policy priorities. Given the size of their network, Luxembourg, Slovenia and Belgium have equipped most lines with ETCS component so far, with deployment on more than 20 % of their national network.

As regards ERTMS deployment on the CNC network, it has reached 11 % (ETCS) and 66 % (GSM-R) at the end of 2019. There has only been an increase of 2 % and 9 % respectively for ETCS and GSM-R from the 2017 deployment figures. However, with the realization of ETCS deployment projects under construction, the length of ETCS lines will double. Nevertheless, with 6 600 km of CNC lines equipped with ETCS by end 2019, a greater effort is needed to meet the European Deployment Plan (EDP) target of 51 000 by 2030.

The progress has been uneven among single corridors, with notable progress registered for the Rhine-Alpine corridor that now has 27 % of lines equipped with ETCS. The ETCS deployment on the other corridors ranges between 5 % and 16 % of the total length.

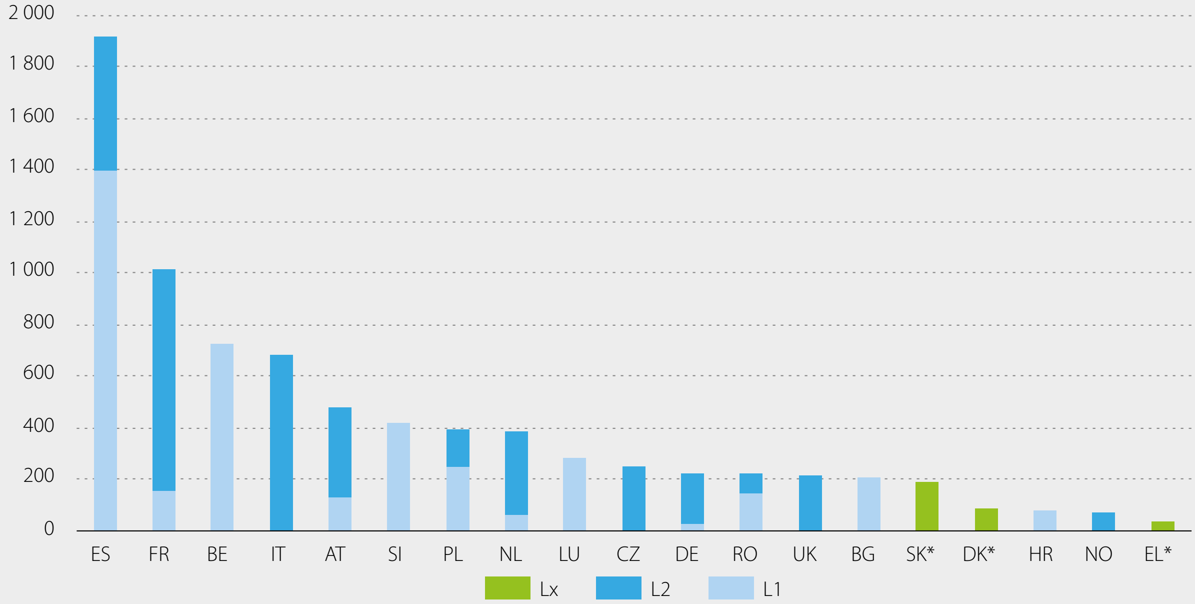
Meta-data

The underlying data are reported by MSs to Register of Railway Infrastructure (RINF) maintained by the Agency and to the TENtec database managed by DG MOVE respectively. Provision of ERTMS parameters in RINF has been mandatory since one year, while the data available in TENtec, for CNC, is provided by Member States under the EDP[5]. The quality of data is deemed satisfactory with minor accuracy problems for some countries.

[5] Commission Implementing Regulation (EU) 2017/6 on the European Rail Traffic Management System European deployment plan on 5 January 2017

Figure B-16: Length of railway lines equipped with ETCS (ERA countries, end 2019)

Length in kilometers per ETCS level

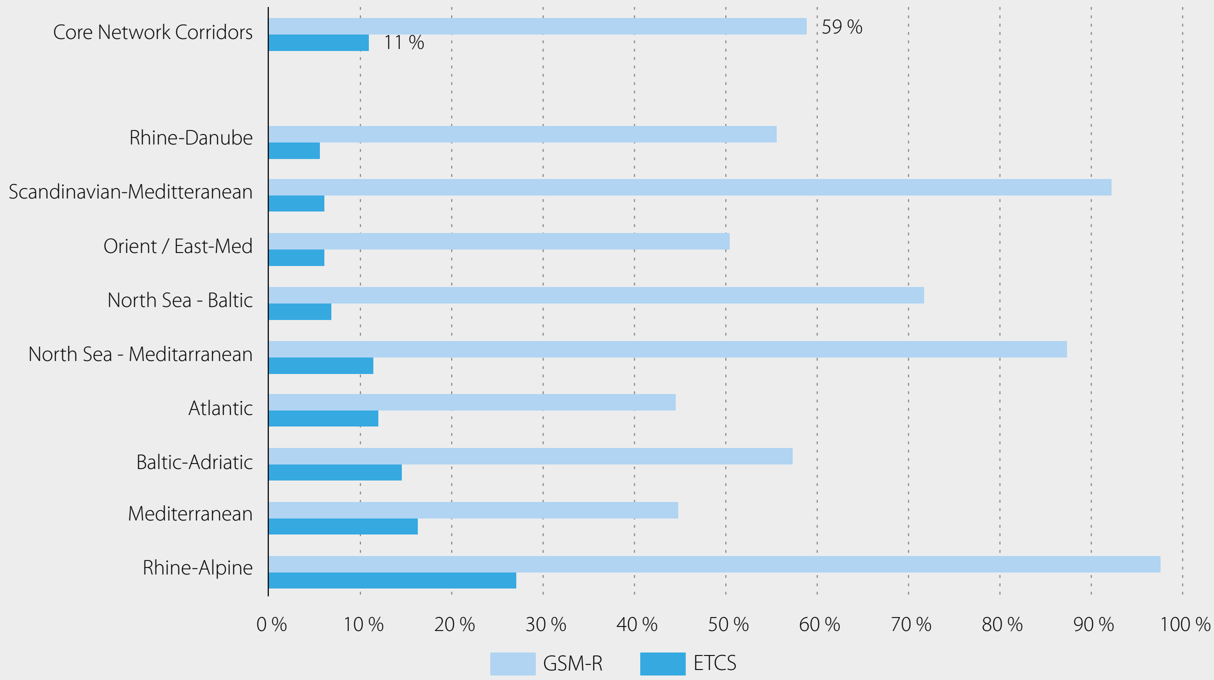


Note: Data for countries marked with * come from TENtec (ETCS data not available in RINF)

Source: Register of Infrastructure (RINF), TENtec

Figure B-17: Deployment of ERTMS on core network (ERA countries, end 2019)

ETCS and GSM-R equipped lines among core network corridor lines



Source: TENtec information system (DG MOVE)

B-10 Non application of TSIs related to rolling stock

Purpose

When a subsystem cannot fulfil TSI requirements, there is a limited possibility to request a derogation from TSI requirements. The limited cases are defined in article 7 of the Interoperability Directive and notably include advanced stage of development, safety concerns, economic viability and the operation on specific infrastructure. The Rolling Stock TSIs specifies transition rules and time limits. Projects that can benefit from transition phases do not need to request non-application of TSIs.

Indicators

The indicators used here is the number of non-application of TSI requests for the rolling stock related TSIs (LOC&PAS, WAG, PRM, SRT and NOI), as submitted by Member states. All requests for non-application of TSIs received by the EC are counted, except those which were rejected.

The indicators represents the non-application of TSIs under directive 2008/57/EC and directive (EU) 2016/796. These derogations represent technical barriers for vehicles because vehicles have to be compliant with these derogations (additional national technical rules) in addition to the TSIs requirements. In general, the lower the number of derogation requests, the higher the level of interoperability of the Union railway system.

Findings

There have been five non-applications per year on average, with a peak in 2019. This likely reflects the upcoming entry into force of relevant legal acts bringing more stringer requirements on rolling stock.

Altogether 57 non-application of TSIs were submitted to European Commission since 2008. About one third of them were justified by economic viability.

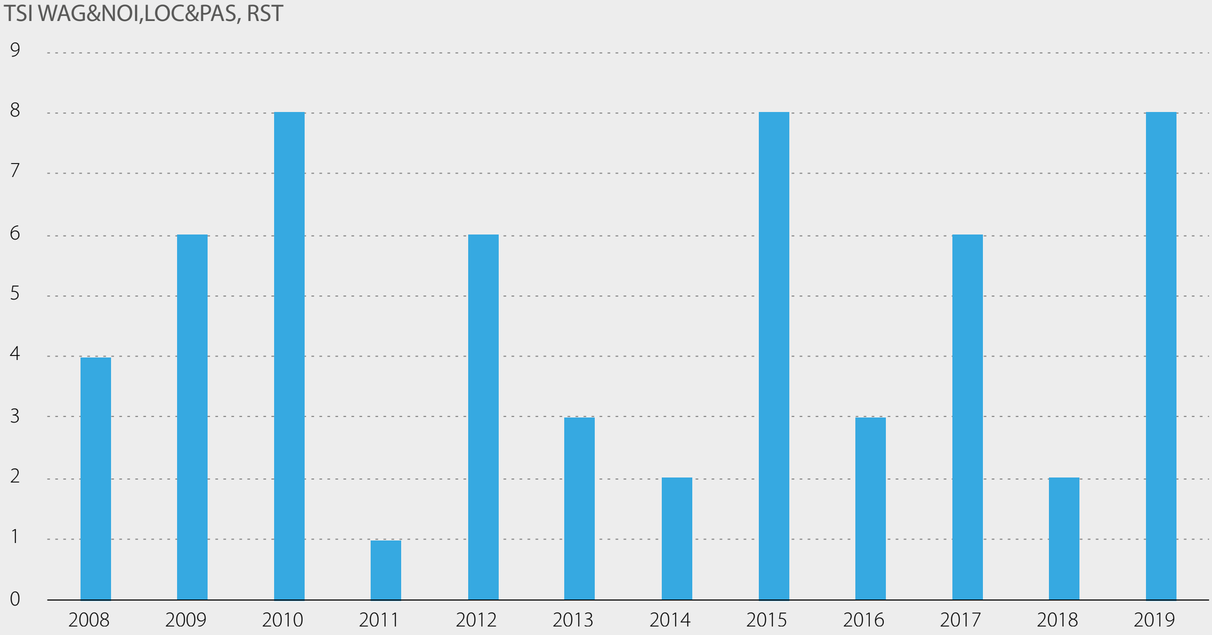
The number of the non-applications fluctuates from year to year, with peaks corresponding to the publication of new TSIs (e.g. in 2011 and 2014) and to the end of transition periods (e.g. 2017).

Given the amount of non-application requests per single MSs in light of the amount of new vehicle authorizations in these countries, the level of application of Article 9 of Directive 2008/57/EC or Article 7 of Directive (EU) 2016/796 by some MSs can be put in question.

Meta-data

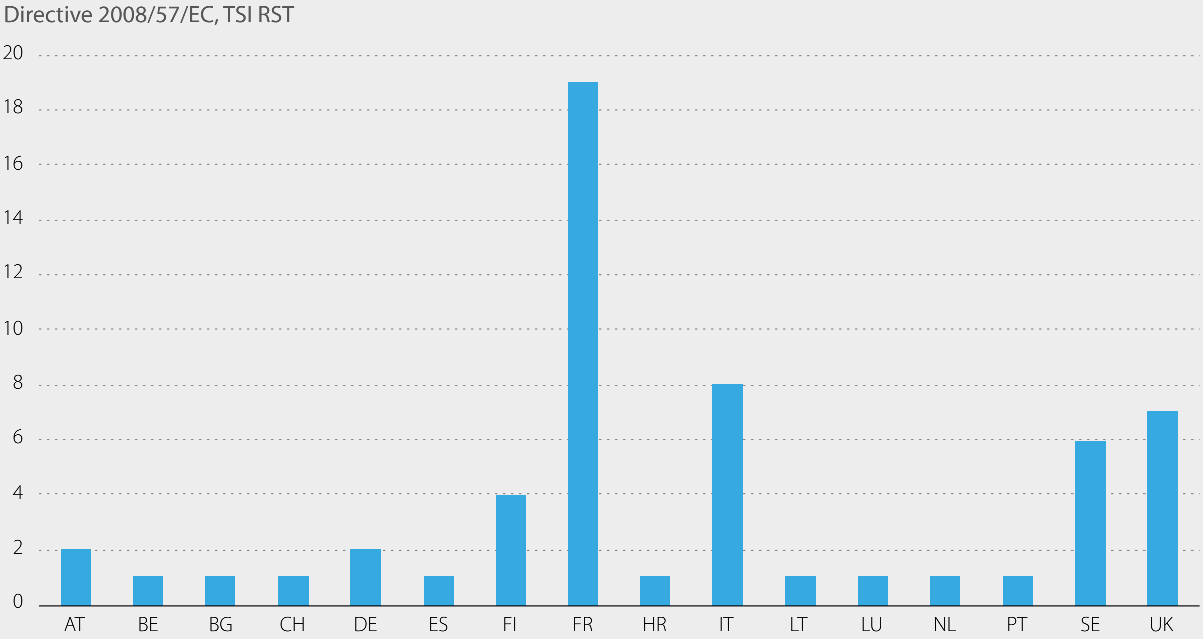
Derogations requests are received and processed by the EC (DG MOVE), which also keep track of them through an internal database file.

Figure B-18: Derogations from rolling stock - related TSIs (EU-28, 2008-19)



Source: DG MOVE internal database

Figure B-19: Derogations from rolling stock-related TSIs per country (EU-28, 2008-19)



Source: DG MOVE internal database

B-11 Applicable national technical rules for vehicles

Purpose

National technical rules represent technical barriers in the vehicle authorisation process because vehicles have to be compliant to these rules (usually in addition to harmonised Technical Specification for Interoperability (TSI) basic parameters).

Member States have to publish (notify to the European Commission) these national rules since either absence or non-transparency leads to unnecessary uncertainty, costs and safety risks. Before they are notified, a 'cleaning up' of rules is necessary. The remaining notified national technical rules may only cover Open Points in TSIs, Specific Cases in TSIs and issues of vehicle compatibility with the network (e.g. Class B signalling systems). The cleaning up process ensures, that only these relevant rules are published in Reference Document Database (RDD).

Indicators

The indicators used are the status of the process for 'cleaning up' of national technical rules and the remaining national rules in place in Member States. The objective is to have all 'cleaned up' national rules for vehicle authorisation published in RDD.

Findings

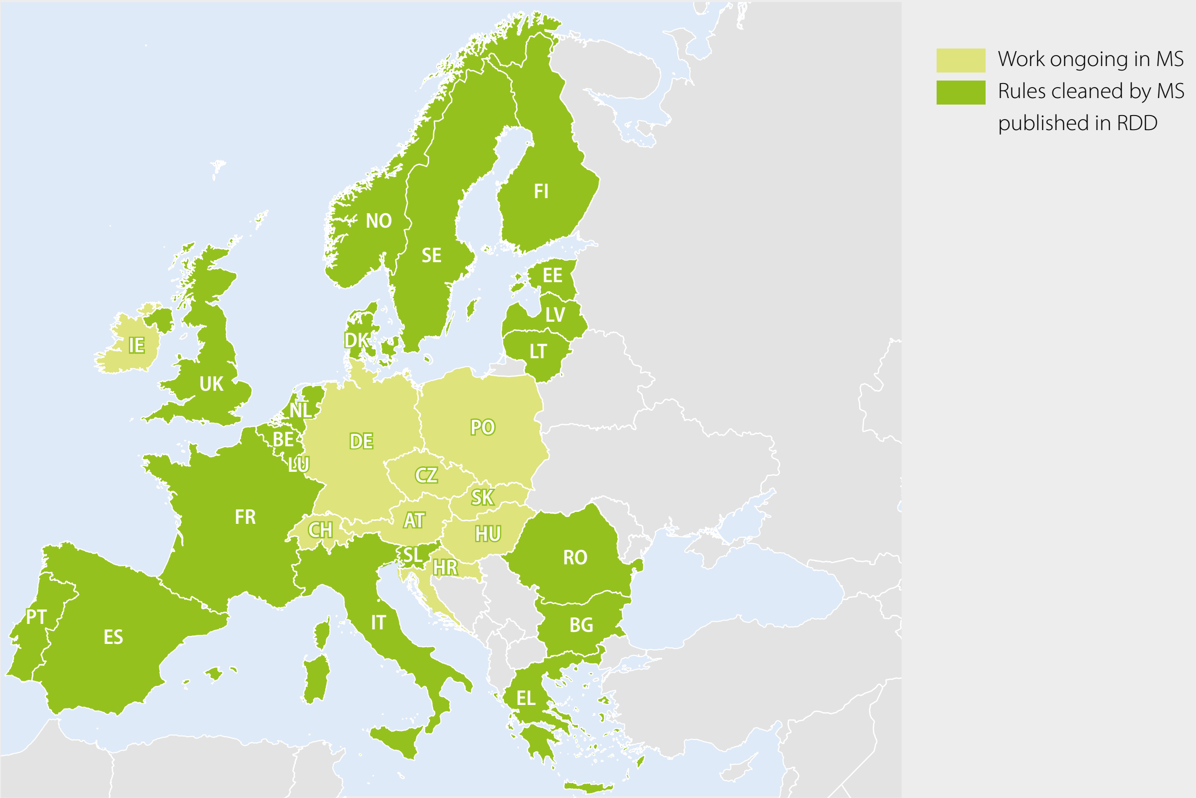
As of end 2019, rules had been published in RDD for 19 countries. All but one form a cluster situated in Central Europe. At the level of the EU+NO+CH, the total number of national rules for vehicle authorisation in addition to the latest TSIs in force, dropped from about 14 000 in January 2016 to 1 050 by end 2019. While the number of published rules has seen an impressive decrease over the past four years, it has flattened in 2019, as the potentially removable rules are becoming scarce and additional countries published their rules in RDD for the first time. A further reduction is nevertheless expected after further cleaning up or during the next revisions of the TSIs.

Once the process of cleaning up national rules is finalised in all countries, the Agency will focus on the progress in the reduction of the remaining notified national rules which will mainly depend on the progress of closing Open Points in TSIs and on the migration towards an interoperable infrastructure.

Meta-data

As the data is retrieved directly from the Agency's Reference Document Database (RDD) after being uploaded by the Member States, the reliability of the data depends on the extent to which there is up-to-date and complete information in the different Member States.

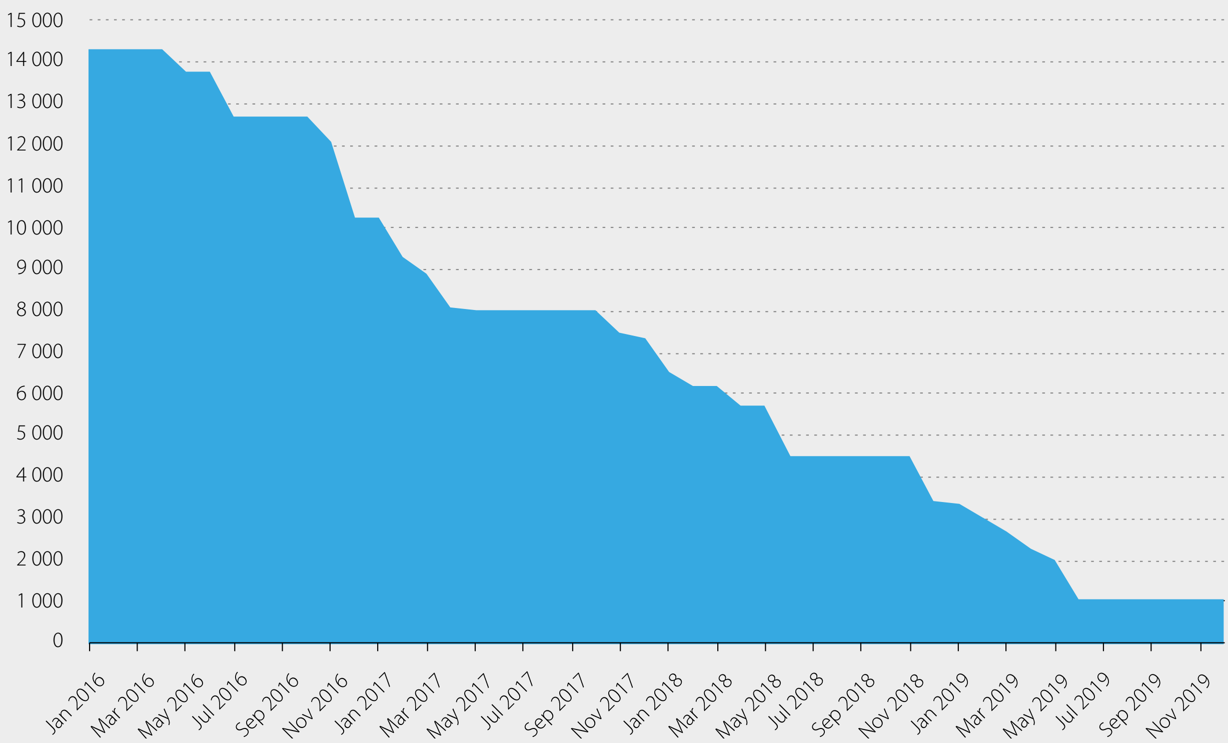
Figure B-20: Progress with "cleaning up" of national rules for vehicle authorisation (ERA countries, end 2019)



Source: Reference document database maintained by the Agency

Figure B-21: National Rules for vehicle authorisation (ERA countries, 2016-19)

Rules notified by Member States



Source: Reference document database (RDD) maintained by the Agency

B-12 Vehicle authorisations

Purpose

Before a new or modified railway vehicle is permitted to operate on the EU railway network it must be authorised. An authorisation is granted for a vehicle and/or vehicle type (vehicle type authorisation), or for individual vehicles that conform to an already authorised vehicle type (vehicle authorisation for placing on the market). 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), and may also be required if changes are made to an authorised vehicle and/or vehicle type (new authorisation). Authorisations are granted by NSAs and since mid-June 2019 also by the Agency. Tracking the number of issued authorisations, by their types, allows one to understand the impact of the new arrangements on the market and to monitor its evolution over time.

Indicators

The indicator used here is the number of authorisations issued in the calendar year (2018), per vehicle type and per type of authorisation. The focus is on the first authorisations per vehicle type most closely reflecting the underlying business and regulatory developments. Since the data on authorised vehicles in service are not publically available, only a limited insight is possible.

Findings

An estimated 9 000 first authorisations were granted in EU-28 Members States in 2018. The majority (75 %) concerned wagons, followed by hauled passenger vehicles (19 %) and fixed or predefined formation (15 %). Locomotives represented 8 % of vehicles authorised. First authorisations represent two thirds of all authorisations; type authorisations issued in 2018 represented a mere 3 % of all authorisations. A relatively high number of authorisations granted after upgrade or renewal (over 2 000 in 2018) reflects preferences of many RUs for continuous use of existing rolling stock over their replacement. An estimated 400 type authorisations were issued in single year 2018 by NSAs, while the number of type authorisations issued by the Agency in a few months of 2019 (since 16 June) was just four.

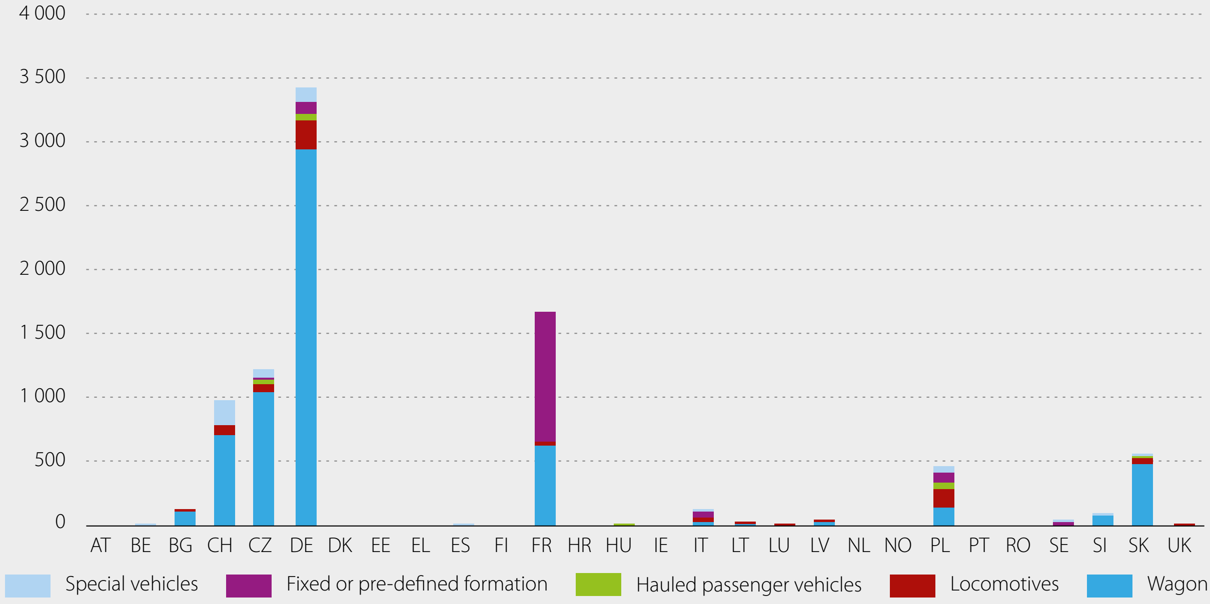
Meta-data

The data used to produce the indicator above comes from a survey of NSAs. The data were provided by all but two EU Member States. The application of the Fourth Railway Package legislation implies a new categorization and definitions for vehicle types. This change may impact the quality of reported data.

Authorisation applies to vehicles and to vehicle types. A vehicle authorisation for placing on the market will always result in a vehicle type authorisation granted at the same time. A vehicle type authorisation (i.e. the design) does not necessarily require that a vehicle conforming to that type is authorised

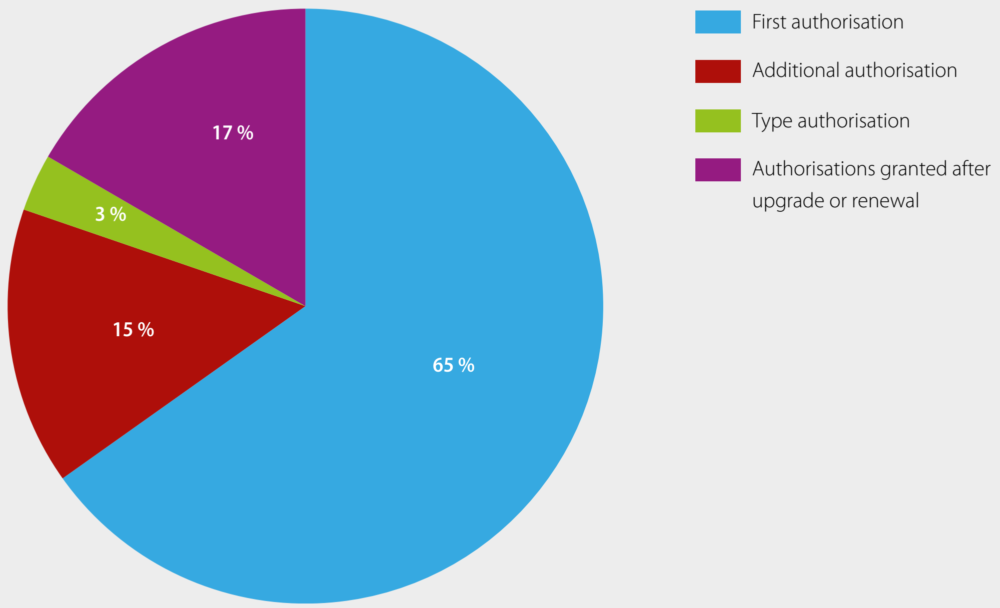
A new vehicle type and/or vehicle must always be authorised. Where changes are made to the vehicle type and/or the vehicle, be it a change to the applicable rules sufficient to require a renewed type authorisation, a change to the design (dependent on the scale of the change) or a change to the area of use, there is a need to apply for an authorisation.

Figure B-22: Vehicles authorised in 2018: first authorisation (ERA countries)



Source: NSA survey end 2019

Figure B-23: Share of issued vehicle authorisation types (ERA countries, 2018)



Note: No data available for FI and NO

Source: NSA survey, end 2019

B-13 ERTMS on-board deployment

Purpose

Deployment of ERTMS on board equipment in tractive vehicles is a prerequisite for ERTMS compatible train operation. It is realized either through new vehicle acquisition or through the retrofitting of existing rolling stock.

Indicators

The indicators used to measure the extent of the ERTMS on-board deployment are the share of tractive rolling stock authorised by EU member states for the operation on the Union railway network and the number of ERTMS-equipped vehicles contracted in EU Member States.

Findings

Between 3 880 and 4 337 ERTMS on-board units have been completed and/or are in operation in Europe, which, as some trains need two on-board units, can be translated into estimated 3 600 vehicles equipped in Europe[6]. At the same time, the number of contracted vehicles contracted has seen a steadily increasing trend, with over 9 500 vehicles contracted in EU MSs (over 11 250 in EU+28+NO+CH) by end 2019. However, the time lag between contracting vehicles with ERTMS and their operation is important: the median value for nine EU countries for which detailed data are available is about five years.

Among 1 000 tractive vehicles approved annually for the operation on the Union railway network, less than 200 of the new vehicles are equipped with ERTMS as most of them were subject to some derogations or were exempted from the requirement to fit ERTMS (for example because of use for regional services only). Almost 300 existing vehicles are then equipped with ERTMS on-board unit each year.

However, to meet the objective of the On-board strategy target for 2030, about 2 650 vehicles with ERTMS OBU need to be added to the fleet each year. This represents a true challenge for not only the owners of the rolling stock, but also for the manufactures, as there might not be the necessary capacity available for both manufacturing and retrofitting at the moment. It is also notable that even though ERTMS is a system, which could yield important benefits for all stakeholders, there are still important financing gaps especially for railway undertakings and rolling stock owners.

In conclusion, the effort in deploying OBU in the tractive vehicle fleet is insufficient and needs to be increased to keep up with the EU strategy.

Meta-data

The underlying data are not readily available, and have to be compiled from various sources. The first source is the survey among NSAs conducted by the Agency on vehicles in service, the other source is the survey of UNIFE among their members on contracted vehicles. In case of national data supplied by NSAs, the data are not available for 10 Member States. In the case of UNIFE data, the data are deemed accurate enough.

Methodological notes: Number of operated tractive vehicles: owned, leased, and rented minus rented-out vehicles equipped with ETCS. Vehicles without power units are excluded. Multiple units are counted once. Included are only vehicles which are operated to transport freight or passengers. Vehicles under pilot operations are not counted. Yellow fleet and other IM vehicles are not included. Includes only vehicles which are registered in the country of main business activities of RUs.

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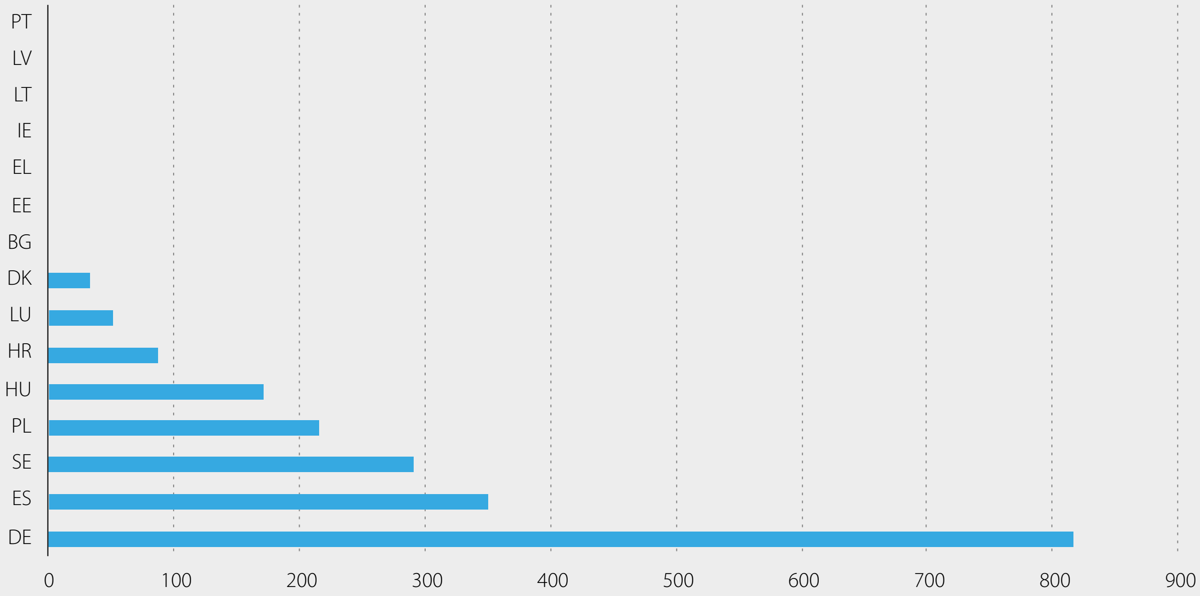
[6] According to UNISIG and in line with sample data obtained through ERA NSA survey for end 2018.

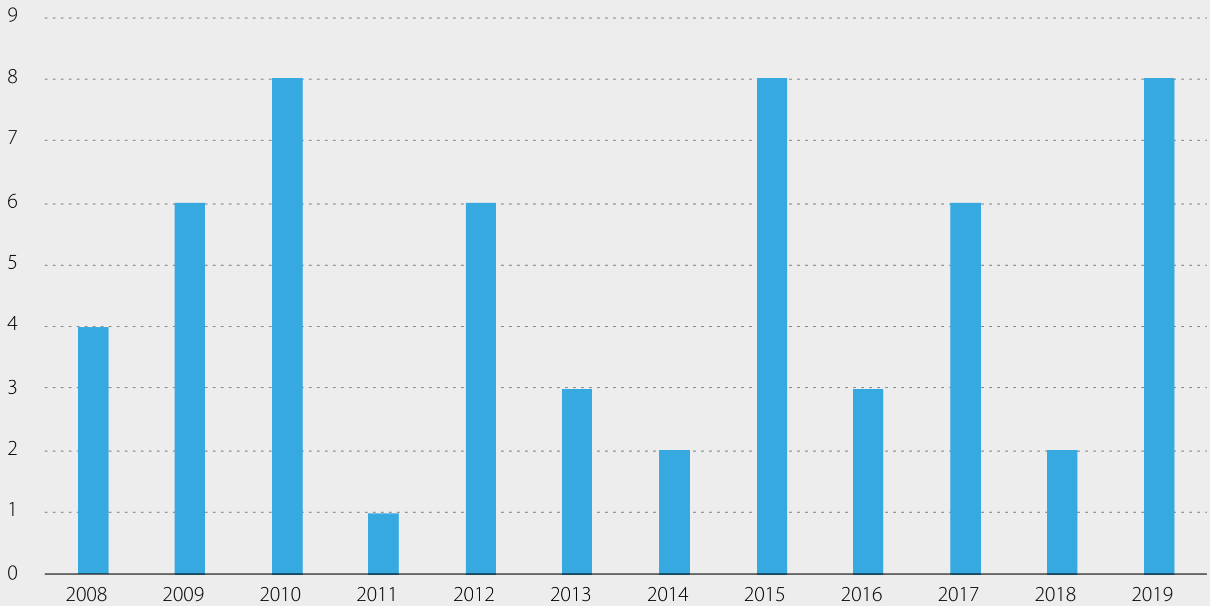
Figure B-24: Vehicles with ERTMS OBU in operation (ERA countries, end 2018)

New and retrofitted vehicles



Source: Survey among NSAs carried out by the Agency in late 2019

Figure B-25: Contracted ERTMS-equipped vehicles (ERA countries, 2008-19)



Source: UNIFE - regular survey among members and other sources

B-14 RINF completeness

Purpose

The Register of Railway Infrastructure (RINF) is a common European Register hosted by the Agency 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 notably provide seamless access to static infrastructure data to railway undertakings for their planning and preparing railway services within the Union, whereas the main benefits are expected from the possibility to carry out vehicle-route technical compatibility checks before vehicle design and service planning.

The implementation of the RINF has been underway since 2016, with countries gradually providing the first set of mandatory data, for which the legal deadline of 16 March 2019 applied. The data availability in the register 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 used to assess the usefulness of the register: Network description completeness and Technical parameters completeness. The former refers to the percentage of the national railway network (main lines) for which geometrical description is available. The latter refers to the technical parameters provided for the railway network described in the register.

Findings

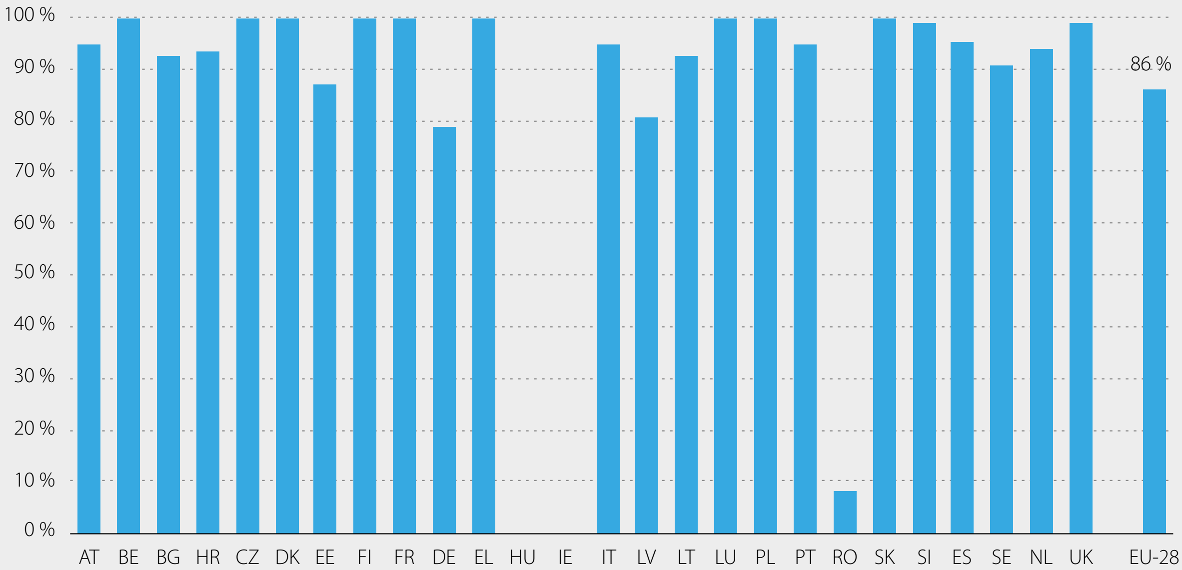
As of end February 2020, about 86 % of the Union railway network has been described in the RINF through Sections of Lines (SoLs) and Operational Points (OPs). Two national networks are still not described while one network is barely described. The availability of values for mandatory technical parameters for those introduced SoL/OP varies greatly between countries. In respect to the parameters mandatory since 16 January 2020, 78 % of parameters for SoLs and 79 % of parameters for OPs are currently available in the RINF. The data for basic descriptive and reference parameters are often complete, while particular technical parameters have a lower availibility. This represents a major hurdle for the effective use of the Register data and minimize the return on investments made so far. The latest RINF regulation foresees further development of the RINF, including integration of new functions. This brings about a challenge in managing this evolution in such a manner that benefits linked to the original functions could be harvested at the same time.

Meta data

The statistics are produced at the level of (main) railway lines, whereas the reference length of the national network is taken from Eurostat (2017 data) and the length of lines in RINF is established from data available as of end February 2020. As for the technical parameters, the estimates are produced for all SoLs/OPs in the RINF, across single parameters mandatory as of 16 January 2020.

Figure B-26: RINF network description completeness (ERA countries, end February 2020)

Estimated share of railway lines decribed in RINF

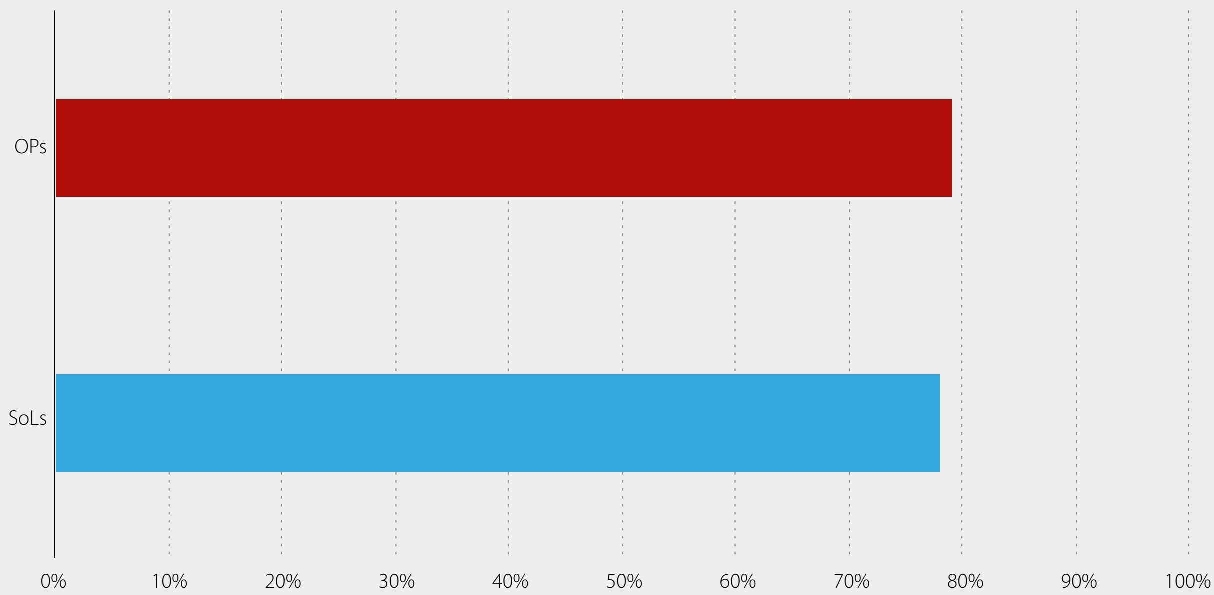


Note: Physical description of the tracks of the lines and not attributes counts

Source: RINF, Eurostat as of end February 2020

Figure B-27: RINF technical parameters (ERA countries, end February 2020)

Share of SoL/OPs with encoded technical parameters



Note: Weighted average of data completeness across 102 parameters for Section of Lines (SoL) and 51 parameters for Operational Points (OPs) mandatory as of 16 March 2019, as retrieved from RINF end February 2020

B-15 ETCS trackside costs

Purpose

ETCS deployment is a mean to reach technical interoperability in train control and signalling in Europe. However, its progress has been limited due to high costs. A mature technical specification, richer experience of the sector, increased competition and economies of scale should normally drive the unit costs down, over time. Whereas the unit costs are primarily driven by market forces, the Agency expects the unit costs for the new ETCS trackside installations to be below 100 k€. This estimate covers customised design (particular line), cabling, balises, LEUs, testing and sub-system verification, excluding additional costs for the interlocking or radio communication parts.

Indicators

The indicator used for monitoring the ETCS trackside costs is the weighted average cost for ETCS trackside installation on one kilometre of a double-tracks line equivalent (standard two tracks line). This is based on application files for ERTMS projects submitted to Connected Europe Facility (CEF) Calls for Proposals organised by the Innovation and Networks Executive Agency (INEA).

Findings

The indicator is adjusted for inflation as to smooth the effects of the increase in construction prices. There have been no new ERTMS level 1 trackside projects since 2016, when the weighted average unit cost was 190 k€ per line km (double track line equivalent). A certain drop is visible for ERTMS level 2 trackside installation costs since 2015, oscillating currently around 100 k€ per line km. Overall, the number of projects and line km to be equipped has seen a decrease in the past two years, partly owning to approaching the end of the financing period and to the budget available for the most recent calls.

The decent decrease in unit costs that has been observed for level 2 construction projects is only partly satisfactory, as the average costs do not remain below the targeted 100 k€ per line km.

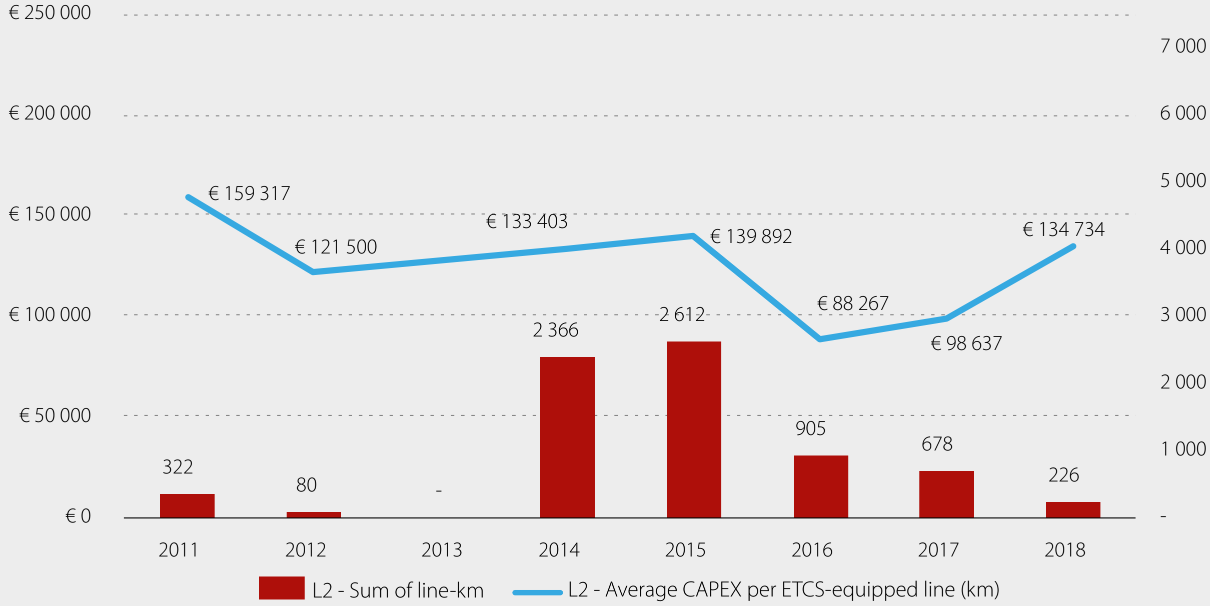
An increase in competition among ERTMS trackside suppliers as well as their capacity may help to drive the unit costs further down. A preference of CEF Call applicants for level 2 installations over level 1 installations is clearly visible.

Meta-data

Whereas the quality of the data is estimated to be high, the accuracy of the indicator is limited due to a limited number of projects in general and the number of projects for which comparable data are available, in particular. The costs are adjusted for producer prices in the industry, with the base year 2010, using the total output price index published by Eurostat.

Figure B-28: ETCS-L2 trackside cost (EU-28, 2011-18)

Unit costs for double track line equivalent

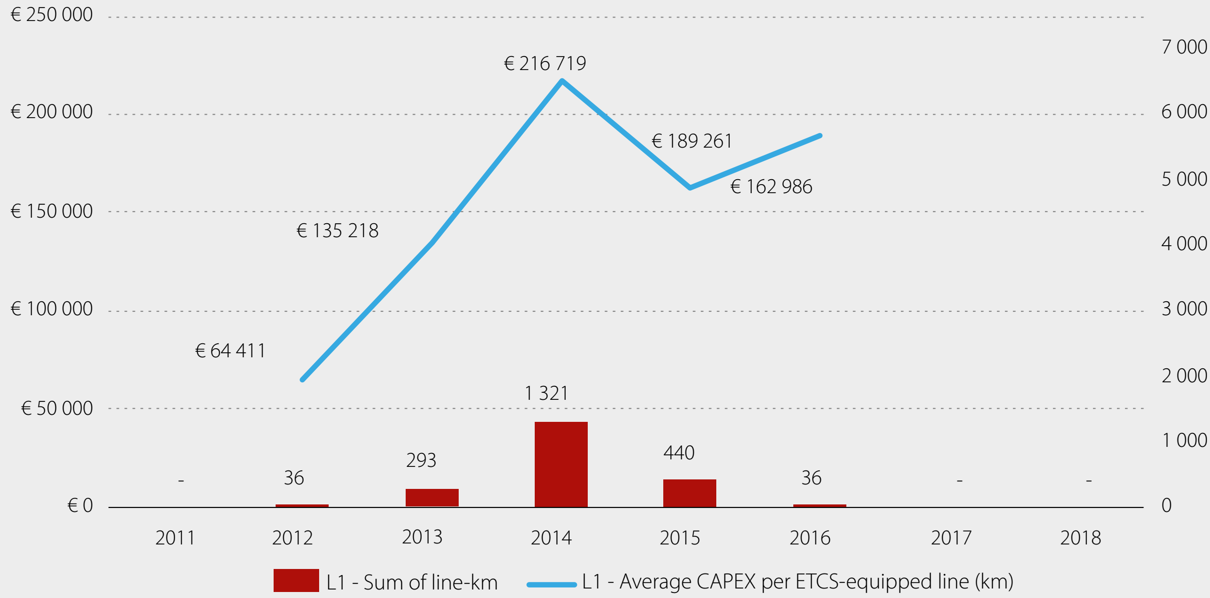


Notes: Unit cost derived as weighted average

Source: CEF calls application files

Figure B-29: ETCS-L1 trackside costs (EU-28, 2011-18)

Unit costs for double track line equivalent



Notes: Unit cost derived as weighted average

Source: CEF calls application files

B-16 ETCS on-board costs

Purpose

ETCS-on-board deployment follows on from the trackside deployment in assuring technical interoperability in train control and signalling in Europe. Similar to trackside, the progress in equipping the vehicles providing traction has been limited due to high costs. A mature technical specification, richer experience of the sector, increased competition and economies of scale should normally drive the unit costs down, over time.

Whereas the unit costs are primarily driven by market forces, the Agency expects the unit costs for the new ERTMS on-board retrofit (deployment of ERTMS on an existing vehicle) to be below 85 k€ per on-board unit [OBU]. Given the ongoing development of the market for ETCS OBU, a decreasing trend in costs is expected.

Indicators

The indicator used for measuring the costs for ETCS on-board deployment is the investment costs needed for retrofitting (on-board unit installation on existing rolling stock).

Findings

The data on ETCS on-board serial retrofitting costs demonstrates a stable trend for ETCS on-board deployment with an average cost of approximately 250 [k€/OBU L2], which is above the intermediate target value of 85 [k€/OBU]. **The unit costs for ETCS on-board unit thus remains far higher than desirable.**

Specific actions such as those linked to the Fourth Railway Package (single authorisation) are expected to reduce the fixed costs of multiple authorisations. The stability of the ETCS specifications (Baseline 3 Release 2 voted in February 2016) should contribute in the coming years to a downward trend in ETCS on-board costs. The future deployment of "ETCS only" vehicles compared to vehicles with ETCS and other Class-B systems simultaneously on-board is also expected to reduce the costs for ETCS on-board products.

Meta-data

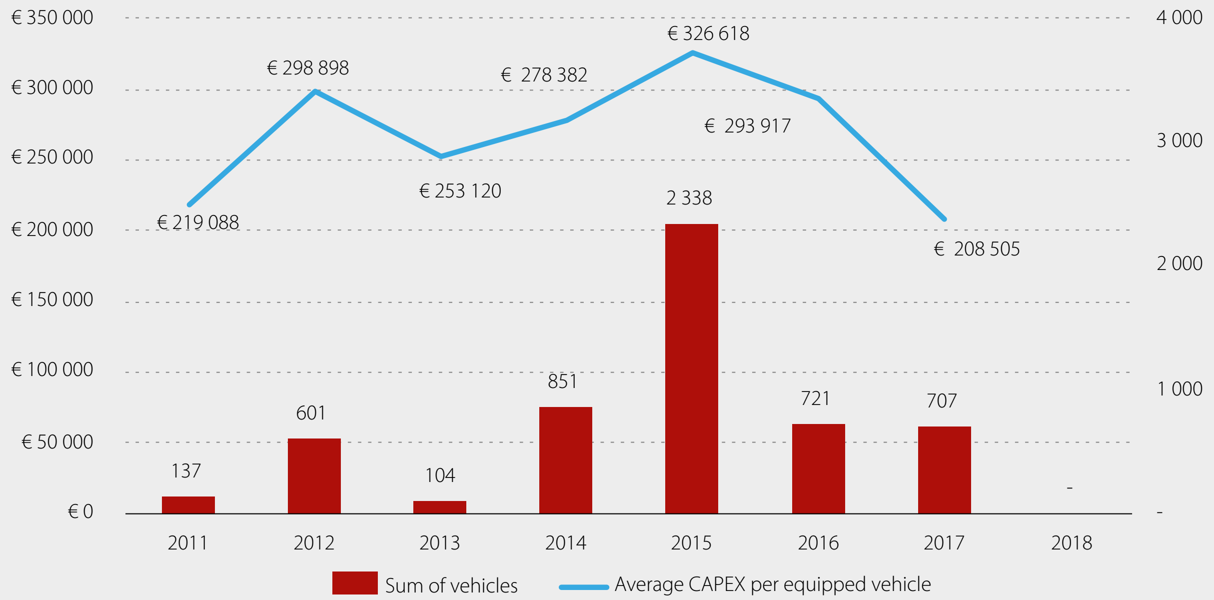
The data are retrieved from application files for ERTMS projects submitted to CEF Calls for Proposals organised by the Innovation and Networks Executive Agency (INEA). The metric focuses only on the serial retrofitting costs by excluding prototyping (first in class). Whereas the quality of the data is estimated to be high, the accuracy of the metric is limited due to a limited number of project for which comparable data are available.

The costs are adjusted for producer prices in the industry, with the base year 2010, using the Total output price index published by Eurostat.

The design of the CEF call impacts the unit costs in various ways. Two issues in particular emerge: 1) The maximum eligible costs of the OBU has been capped within ERTMS dedicated calls with a ceiling of 150 k€ (TEN-T) and 250 k€ per OBU (1) and 2) Lack of a homogeneous approach to eligibility of a prototype costs. Within certain calls they were accepted in full, when justified, and in others they were capped by the OBU ceiling (2).

Figure B-30: ETCS-OBU unit cost (EU-28, 2011-18)

Unit cost per vehicle

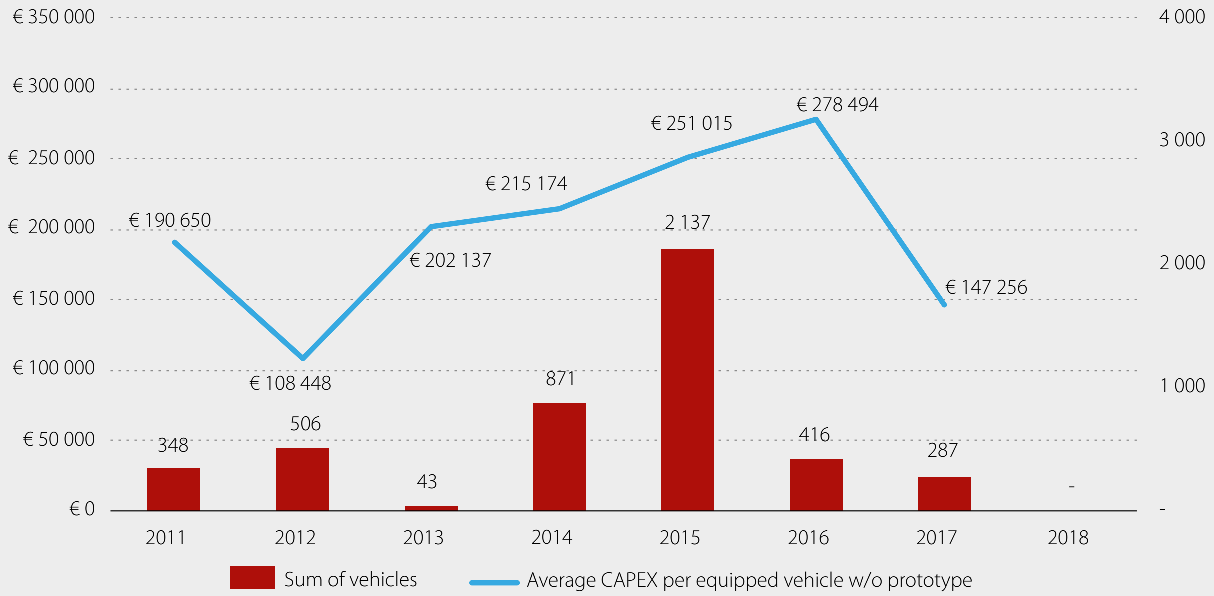


Notes: Unit cost derived as weighted average

Source: CEF calls application files

Figure B-31: ETCS-OBU unit cost, without prototype (EU-28, 2011-18)

Unit costs per vehicle, EU-28



Notes: Unit cost derived as weighted average

Source: CEF calls application files

B-17 Maturity of ETCS specifications

Purpose

The maturity of ETCS specification is hereby measured by the number of remaining errors in the European Rail Traffic Management System (ERTMS) specifications over time. A low number of errors is a sign of a mature specification and thus stable ERTMS specification contributing to interoperability. The target value for the remaining errors in this indicator is zero for stability reasons, in particular for errors impacting the normal service. Besides the errors in the specifications, there are national technical rules affecting the ERTMS products.

Indicators

The number of remaining errors in the ERTMS specification and the number of national technical rules affecting the ERTMS specification.

Findings

A major effort was done between 2016 and now to solve all errors having an impact on the normal service. Although the remaining errors are about 29, the remaining errors having an impact on normal service are below five. **The ETCS specification has matured significantly over time.** However, persisting errors negatively affect the operation. The next ERTMS legal release is not planned to be introduced before 2022. This long period of stability (between 2022 and the current legal release B3R2 voted in 2016) should allow the further stabilisation of the set of specifications.

Currently, there are approximately 25 NTRs that are affecting the SRS 3.6.0 products announced/known. The majority is already available and discussed, whereas some of the known ones are still under review.

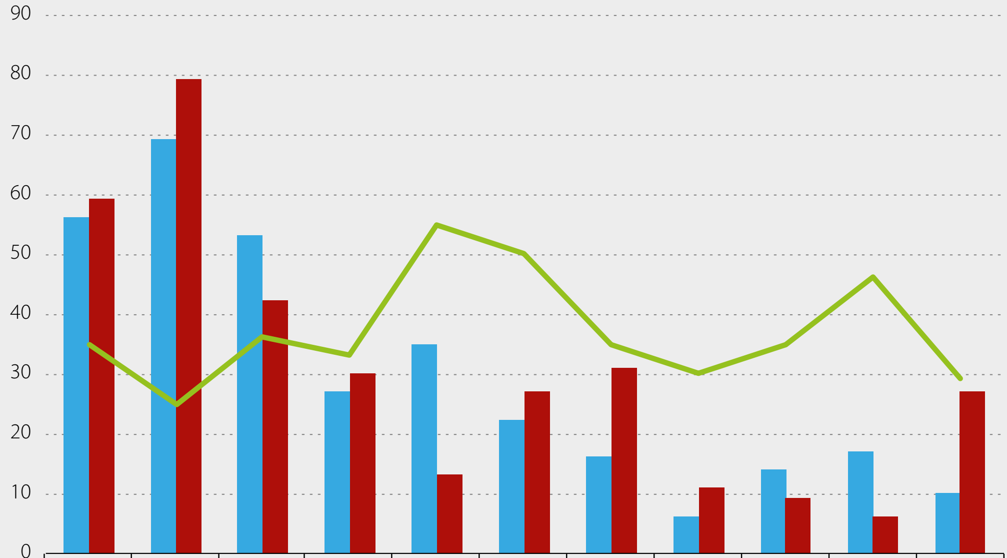
30 % of the NTRs are based on open points and mainly options (infill), 40 % are marked as exported constraints and therefore rejected by the Agency. MSs are still, in dialogue with the Agency, cleaning up their national rules. Concerning ETCS set of specification 3 (SRS 3.6.0), it has to be noted that several MSs actually have no B3 infrastructure in operation, so it can be assumed that additional NTRs will be notified when migration to ETCS B3 takes place. Concerning the open point (RAM) only a few MSs have actually notified a rule, additional notifications are expected in this field too.

Meta-data

The records on ERTMS specification errors are available in the Agency's ERTMS Change Control Management (CCM) Database. Data can be considered to be highly reliable.

Figure B-32: ERTMS specification errors (ERA countries, 2009-19)

Errors notified in ERTMS CCM during calendar year



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
New errors	56	69	53	27	35	22	16	6	14	17	10
Solved errors	59	79	42	30	13	27	31	11	9	6	27
Remaining errors	35	25	36	33	55	50	35	30	35	46	29

Source: Change control management database managed by the Agency

B-18 Time to obtain EU authorisation, safety certificate and ERTMS trackside approval

The Fourth Railway Package has introduced a scheme for a single EU vehicle authorisation, single safety certification of railway undertakings and for ERTMS trackside approval as a mean to enhance interoperability and improve efficiency of the railway sector. In particular, the reduction of the time needed to obtain formal regulatory documents needed for train operation was the key promise of the technical pillar of the Fourth Railway Package, the time directly translates into costs to the railway sector.

Time to obtain vehicle authorisation

Purpose

Railway vehicles authorised under the Railway Interoperability Directive offer the highest possible degree of interoperability with the TSI compliant fixed installations. Authorisations granted without unnecessary delay and valid for multiple areas of use means the highest possible efficiency for railway operators. They also contribute to increased competition on railways.

Indicators

The metric used to monitor the time to obtain a railway vehicle authorisation is the time elapsed between the submission of the application for vehicle authorisation via the One Stop Shop (OSS) and the issuance of the authorisation. EU legislation provides a cap of five months for this task to the Agency (respectively 1 month for authorisations in conformity to an authorised type).

Findings

As of end 2019, the Agency has issued 4 Type authorisations (3 First authorisations and 1 New authorisation) with average time elapsed of 112 days. This is well under the legally required 5 months. Besides the type authorisations, the Agency has also issued 307 authorisations in conformity to type and these in two weeks on average (well under the legal timeframe of 1 month).

Moreover, nine 'pre-engagement' applications out of 23 received in 2019 were delivered in the same period, whereas they are optional for the applicant but mandatory for the authorising entity and/or the NSAs concerned with the area of use, on request of the applicant. The 'pre-engagement' covers all prior formal exchanges of information between the applicant, the authorising entity, the concerned NSAs and other interested parties, before the actual submission of the application for authorisation. This allows the applicant to obtain an opinion from the authorising entity concerning the approach proposed by the applicant at an early stage of the process.

Meta-data

As the data used for the metric above is directly taken from the OSS underlying database and since the OSS has had excellent operational availability records since its launch, the data can be considered as fully reliable.

Table B-1: Applications and granted vehicle authorisations as of end 2019 (EU-28)

Type of application	Number of opinions/ authorisations issued in 2019	Time to deliver (in calendar days)
Authorisations in Conformity to an authorised type	307	13
Pre-engagement opinions	9	92
Vehicle type authorisations	4	112

Time to issue safety certificate

Purpose

Access to the railway infrastructure is granted only to railway undertakings that hold a valid safety certificate (SC) that gives evidence that the railway undertaking has established its safety management system and is able to comply with its legal obligations. Replacing part-A and part-B historic safety certificates, a single safety certificate is valid for a given area of operation, i.e. a network or networks within one or more Member States where the railway undertaking intends to operate and thus simplifies the railway operations in multiple countries.

Single safety certificates have been issued in countries that transposed the Fourth Railway Package legislation and by the Agency since 16 June 2019. The safety certification body (NSA or Agency) is required to carry out a completeness check of the application within one month, and to make a decision no later than four months after acknowledging the file is complete.

Indicators

Average time to obtain a single safety certificate (SSC): time elapsed between the submission of the application via the One Stop Shop (OSS) and the issuance of the certificate.

Findings

Altogether 26 applications for SSC were received in 2019, of which 11 were submitted to the Agency. As of end 2019, the Agency delivered five SSC with the average duration for delivery of 96 days.

As there were about 800 valid safety certificate (part A) in EU-28 in recent years and the safety certificate must be renewed every five years, one would expect around 160 applications per year. Besides reflecting the limited extent of transposition, the relatively low number of SSC applications further reflects a decreasing trend in newly issued certificates, which seemed to peak in 2017.

Meta-data

As the data used for the metric above is directly taken from the OSS underlying database and the OSS has had excellent operational availability records since its launch, the data can be considered as fully reliable.

Time to issue ERTMS trackside approval

In 2019, the Agency has received three applications for ERTMS trackside approval. As of end 2019, they were still in "Submission and verification of completeness" phase and due to the lack of completeness and the long process to obtain the complete applications decisions on approvals, decisions are planned for end of June 2021 for two of them and October 2023 for the other. The rest of the approval processes are still in the initial engagement phase that is before submission.

Table B-2: Single safety certificates granted by the ERA until end 2019 (EU-28)

Type of application	Number of certificates issued in 2019	Time to obtain (in calendar days)
Single Safety Certificate	5	96

B-19 New lines approved and lines excluded from EU Directives

Unless benefiting from Derogations to TSIs requirements, the railway lines newly authorised by NSAs represent fully TSI compliant railway infrastructure with the highest degree of interoperability. On the other hand, the lines excluded from the scope of Interoperability and Safety Directives potentially represent an obstacle to those goals. Data reported by NSAs for 2018 indicates that a mere 1.5 % of railway lines in the EU are excluded from the scope of application of the Interoperability Directive.

Table B3: New lines approved and lines excluded from EU Directives (ERA countries, end 2018)

	Lines excluded from the scope of IOP/SAF Directive (end 2018)		Length of new lines authorised by NSA in 2018
	Length of lines excluded from the scope of application of the IOP Directive [km]	Length of lines excluded from the scope of application of the SAF Directive [km]	Total length of lines [km]
AT	-	-	-
BE	-	-	-
BG	153	0	0
CH*	>1 400	0	0
CZ	0	0	0
DE	-	-	8
DK	-	-	-
EE	2 141	2 141	0
EL	-	-	0
ES	-	-	108
FI	17	17	0
FR	-	-	0
HR	0	0	-
HU	0	0	0
IE	0	0	0
IT	-	-	-
LT	0	0	0
LU	0	0	0
LV	75	613.32	10.3
NL	32	32	0
NO	-	-	-
PL	64.405	64.405	233.286
PT	112.536	0	0
RO	99.37	99.37	0
SE**	571	571	
SI	0	0	0
SK	45.096	0	0
UK	-	-	0

*) 1400 km corresponds to "narrow" railway network in Switzerland

**) Track length provided instead of line length

Annexes

Annex I: Methodological information

Progress with Safety

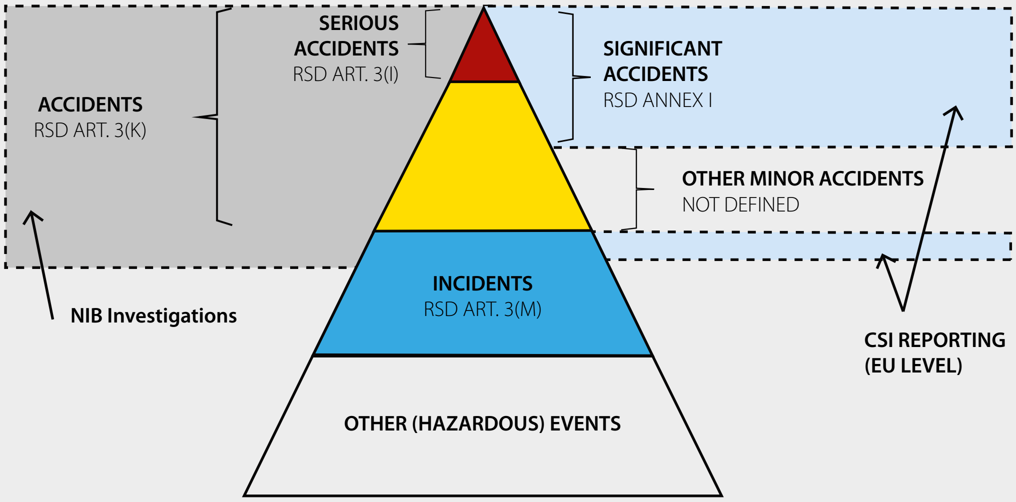
The report is mainly based on the common safety indicators (CSIs) data reported to the and available in ERAIL database end December 2019. Any changes after that date have not been taken into account. Information presented on serious accidents and their investigations is based on reports available to the ERA on 31 December 2019. Any event occurring after that day 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 report to ERA. The term significant accident covers a wider range of events than serious accidents. The Railway Safety Directive (Directive 2016/798) provides the following definitions and ways of reporting for these two groups of accident:

Significant accident	Serious accident
Any accident involving at least one rail vehicle in motion, resulting in at least one killed or seriously injured person, or in significant damage to stock, track, other installations or environment, or extensive disruptions to traffic. Accidents in workshops, warehouses and depots are excluded. 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. The reporting is often limited to significant accidents and a selection of incidents (precursors to accidents). At Member State level, the information on incidents are not necessarily collected by RUs/IMs and the NSAs do usually rely on accident data when planning their supervision activities. This absence may represent an obstacle to efficient learning and early identification of recurring safety issues in the EU railway system.

This reports also uses an accident category "major accidents" to facilitate the long-term monitoring of railway safety. Major accidents include not only the train collisions and derailments with five or more fatalities, but also the major level-crossing accidents, train fires and accidents involving groups of people struck by rolling stock in motion.



Progress with Interoperability

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

The report makes use of various sources of data: databases and registers hosted by the Agency, databases of the Commission and other Agencies and databases of representative bodies and international organizations. A regular biennial survey was run among NSAs in late 2019 to gather specific data that are only available at the national level. For the first time, this survey was integrated into the recommended template for the Annual safety report, and several NSAs provided the interoperabilty data on a voluntary basis as part of this statutory report. In early 2020, a 100 % response rate to this survey was reached; however data were not always available for all topics. Therefore, in some instatnces, assumptions had to be made to produce EU-wide estimates.

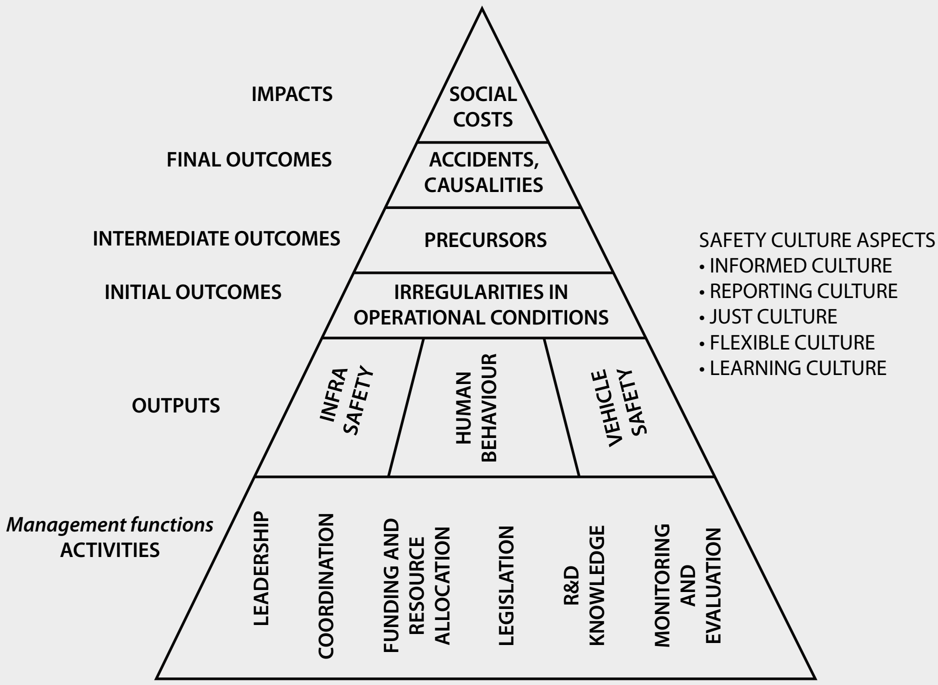
The standard reference date for this report is end 2018 or end 2019, depending on the data source (NSA survey or database/register). The data available for EU-28 Member States, Norway, Switzerland and Channel Tunnel are included. The EU aggregate is representative for the EU-28 Member States (as of end 2019, thus including the UK as well).

Annex II: Methodological framework for monitoring of 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 emphasized, 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 toward the ultimate objectives through measuring the achievement of outputs, outcomes, and impacts at different intervals of time. 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 for data gathering to ensure that the results framework is actually populated with data, updated with information at key points during program/project implementation, and used in decision making.

Methodological framework for safety monitoring

In the framework for safety monitoring, the impact refers to evidence on whether outcomes are actually changing beneficiary longer-term conditions of importance from a societal perspective (e.g. healthy population, more efficient transport), the final outcomes consist of long-term lasting desired results, here accidents and resulting casualties. Intermediate outcomes are indications of unsafe operational conditions, whereas the accident precursors represent the closest directly available measurements. Initial outcomes may then be represented by specific irregularities in operational conditions. As for the outputs, the conditions and performance of infrastructure, vehicle and humans can be distinguished. As for the activities, they can be grouped in a number of ways. Six areas, which can also be viewed as system management functions are proposed.

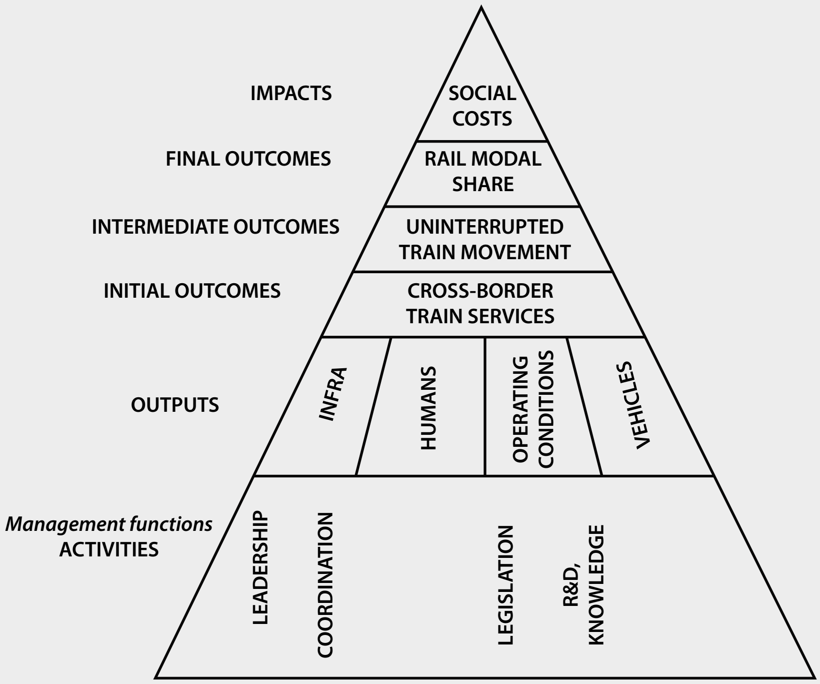


The Common Safety Indicators include indicators at the three top levels and a few at the level of outputs (infrastructure – level crossings per types of protection and vehicles – train protection system level). For human and their behaviour, an underlying safety culture is of a crucial importance, but no common indicators exist currently at the EU level. The measurements at the level of activities is crucial for a complete understanding of the full chain and notably of the contribution of organizational, 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 due to a not-so-well understood cause-effects underlying relations.

Methodological framework for interoperability monitoring

In the proposed framework for interoperability performance monitoring, the impacts refers to evidence on whether outcomes are actually changing beneficiary longer-term conditions of interest (in this case reduced economic costs of transport / improved economic prosperity and reduced environmental impacts) the final outcomes consist of long-term lasting desired results, in this case rail modal share. Intermediate outcomes are indications of seamless train operation, related notably to unnecessary train stops at the national borders. Initial outcomes may be represented by cross-border operating services. As for the outputs, the conditions and performance of infrastructure, vehicles, humans alongside with the overall operating conditions can be distinguished. As for the activities, they 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, the Agency has, been looking exclusively at the outputs level. The higher-level outcomes and impacts have not yet been systematically assessed.



Annex III: Overview of TSIs

Table IIIa. Structural TSIs and their amendments, by year (DoA-date of application, EiF-entry into force)

Year	INF		ENE		TSI SRT	TSI PRM	RST				CCS		Year
	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		**1999**
2000													**2000**
2001											Decision 2001/260 on basic parameters		**2001**
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)		**2002**
2003													**2003**
2004									Decision 2004/446 (on basic parameters)	Decision 2004/446 (on basic parameters) (CR only)	Decision 2004/447 (amendment Annex A)	Decision 2004/447 (on basic parameters)	**2004**
2005													**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	**2006**
2007											Decision 2007/153 (amendment Ann. A) DoA: 6/3/2007	Decision 2007/153 (amendment Ann. A) DoA: 7/3/2007	**2007**
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 Ann. A) DoA: 1/6/2008	Decision 2008/386 (amendment Ann. A) DoA: 1/6/2008	**2008**

Table IIIa. Structural TSIs and their amendments, by year (DoA-date of application, EiF-entry into force)

Year	INF		ENE		TSI SRT	TSI PRM	RST				CCS		Year
	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	
2009									Decision 2009/107 (amendment) DoA: 1/7/2009			Decision 2009/561 (amendment ch.7) DoA: 1/9/2009	**2009**
2010											Decision 2010/79 (amendment Ann. A) DoA: 1/4/2010	Decision 2010/79 (amendment Ann. A) DoA: 1/4/2010	**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)**			**2011**
2012	Decision 2012/462 (Amendment of Decision 2002/732 etc.) DoA: 24/1/2013		Decision 2012/462 (Amendment of Decision 2002/733 etc.) DoA: 24/1/2013				Decision 2012/462 (Amendment of Decision 2002/735 etc.) DoA: 24/1/2013			Decision 2012/462 (Amendment of Decision 2006/66 etc.) DoA: 24/1/2013	Decision 2012/88 **(1st merged CCS TSI)** DoA: 1/1/2013 Decisions 2012/462 and 2012/463 (amendment) DoA: 24/1/2013	Decision 2012/463 amendment DoA: 24/1/2013	**2012**
	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 2012/696 (amendment annexes A and G) DoA: 1/1/2013		
2013									Regulation 321/2013 **(2nd WAG TSI)** EiF: 13/4/2013 DoA: 1/1/2014 Regulation 1236/2013 amendment EiF: 4/12/2013 DoA: 1/1/2014				
2014	Regulation 1299/2014 **(1st merged INF TSI)** EiF/DoA: 1/1/2015		Regulation 1301/2014 **(1st merged ENE TSI)** EiF/DoA: 1/1/2015		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			Regulation 1304/2014 **(3rd NOI TSI)** EiF/DoA: 1/1/2015			**2014**
2015									Regulation 2015/924 amendment DoA: 01/07/2015		Decision (EU) 2015/14 (amendment) DoA: 1/7/2015		**2015**

Year	INF		ENE		TSI SRT	TSI PRM	RST				CCS		Year
	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	
2016					Amended (EU) 2016/912 EiF/DoA: 9/6/2016		Amended (EU) 2016/919 EiF/DoA: 27/05/2016				COMMISSION REGULATION (EU) 2016/919 (Recast) EiF: 05/07/2016		**2016**
2017													**2017**
2018			Amended (EU) 2018/868 EiF/DoA: 13/06/2018				Amended (EU) 2018/868 EiF/DoA: 13/06/2018						**2018**
2019	Amended (EU) 2019/776 EiF/DoA: 16/06/2019		Amended (EU) 2019/776 EiF/DoA: 16/06/2019		Amended (EU) 2019/776 EiF/DoA: 16/5/2019	Amended (EU) 2019/772 EiF/DoA: 16/5/2019	Amended (EU) 2019/776 EiF/DoA: 16/06/2019			Amended (EU) 2019/774 EiF: 16/05/2019 DoA: 8/12/2024	Amended (EU) 2019/776 EiF/DoA: 16/06/2019		**2019**

Table IIIb. Functional TSIs and their amendments, by year (DoA-date of application, EiF-entry into force)

<table>
<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>
<tr><td>2002</td><td rowspan="6">Decision 2002/734
(1st HS OPE TSI)
DoA: 12/3/2003</td><td></td><td></td><td></td></tr>
<tr><td>2003</td><td></td><td></td><td></td></tr>
<tr><td>2004</td><td></td><td rowspan="2">Decision 2004/446
on basic parameters</td><td></td></tr>
<tr><td>2005</td><td></td><td></td></tr>
<tr><td>2006</td><td rowspan="3">Decision 2006/920
(1st CR OPE TSI)
DoA: 18/05/2007</td><td rowspan="6">Regulation 62/2006
(1st TAF TSI)
EiF: 19/1/2006</td><td></td></tr>
<tr><td>2007</td><td></td></tr>
<tr><td>2008</td><td rowspan="2">Decision 2008/231
(2nd HS OPE TSI)
DoA: 1/9/2008</td><td></td></tr>
<tr><td>2009</td><td>Decision 2009/107
(amendment)
DoA: 1/7/2009</td><td></td></tr>
<tr><td>2010</td><td rowspan="2">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><td></td></tr>
<tr><td>2011</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
amending Decisions 2008/231/EC and 2011/314/EU etc.</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="3">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
Decision 2013/710
OPE:2012:A1:2013
(amendment appendix A)
DoA: 1/1/2014</td></tr>
<tr><td>2015</td><td colspan="2">Regulation 2015/995
amending Decision 2012/757/EU
EIF/DoA:
20/07/2015</td><td>Regulation 1305/2014
(2nd TAF TSI)
EiF/DoA: 1/1/2015</td></tr>
</table>

Year	TSI OPE		TA	
	HS TSI OPE	CR TSI OPE	CR TSI TAF	TSI TAP
2016				Regulation 1273/2013 (amendment) EiF: 8/12/2013
2017				
2018			Amended (EU) 2018/278 EIF/DoA: 24/2/2018	
2019	COMMISSION IMPLEMENTING REGULATION (EU) 2019/773EIF/DoA: Staggered implementation from 16/06/20 to 16/06/24		Amended (EU) 2019/778 EIF/DoA: 16/5/2019	

** DoA 1/1/2014 is only for point 6 of Annex I and point 5 of Annex II

*** Appendices P and Pa have different dates of application, i.e. Appendix P applies from 1/1/2012 until 31/12/2013; Appendix Pa applies from 1/1/2014.

Notes

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Publications Office

Print ISBN 978-92-9205-803-6 ISSN 2467-3730 doi:10.2821/469518 TR-AF-19-001-EN-C
PDF ISBN 978-92-9205-802-9 ISSN 2467-3749 doi:10.2821/30980 TR-AF-19-001-EN-N