**Railway Safety Report
The Swedish Transport Agency’s 2017 Annual Report**

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Road and Railway Department

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# Preface

The 2017 Safety Report sets out the level and development of Swedish railway safety during the year. The report describes the outcome of the number of accidents and risk events in the railway system and the safety activities carried out by private and public operators. The report is based on the accident and near-accident reports submitted to the Swedish Transport Agency on a regular basis by telephone, together with the written safety reports submitted from railway undertakings and infrastructure managers annually to the regulator. Where an operator’s own follow-up, investigations or research can be used to provide a clearer picture of the level of safety, these are also used.

The content of the report complies with the requirements set out in Regulation (EU) 2016/798 of the European Parliament and of the Council. The report is to be submitted to the Government and the European Union Agency for Railways (ERA) by 30 September each year.

Norrköping, September 2018

Jonas Bjelfvenstam

Director-General

# Summary

There continues to be a high level of safety within the Swedish railway system. This is the assessment of the Swedish Transport Agency based on Sweden meeting the targets in 2017 laid down by the European Commission for measuring railway safety, according to our own preliminary calculation. The targets are measured and followed up via an injury index calculated in respect of the following risk groups: society, unauthorised persons, level crossing users, passengers, employees and others. In addition to follow-up through official injury indices and national official statistics, supplementary indicators can be used to provide a more comprehensive and detailed picture of safety trends. We make an overall assessment of safety trends based on safety indicators, reported safety measures, oversight and available investigations; see table below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Risk category** | **European safety targets** | **Compliance rate (2017 outcomes)** | **Supplementary indicators (number)** | **Assessment of safety trends** |
| **Society** | Injury index (= Number of deaths caused by accidents + (0.1 x Number of serious injuries resulting from accidents) | Yes(15.2) |   | Some indication of improvement. |
| Must be below 25.7 for the entire railway system |
| **Unauthorised persons on railway premises** | The injury index in respect of unauthorised persons present in the railway area must be below 14.4 | Yes(10.2) | Suicide and attempted suicide (Swedish Transport Agency) | Some indication of improvement in respect of suicide and attempted suicide. |
| Near misses and accidents from taking shortcuts (Swedish Transport Agency) |
| Delay hours due to unauthorised access on track (Swedish Transport Administration) |
| **Level crossing users** | Injury index in respect of level crossing users must be below 9.7 | Yes(4.6) | Near misses and accidents at level crossings | No indication of change. |
| Level crossings according to common safety indicators (CSI) |
| **Passengers** | Injury index in respect of train passengers must be below 0.5 | Yes(0.0) | Train collisions and near misses (Swedish Transport Agency) | Some indication of improvement in respect of train derailments. No indication of change in train collisions. |
| Train derailments (Swedish Transport Agency) |
| Unauthorised SPAD (signal passed at danger) (CSI) |
| Unauthorised SPAD type A (National SPAD Group) |
| Track geometry and broken rail (CSI) |
| Fires and emissions (Swedish Transport Agency) |
| **Employees** | Injury index in respect of employees and contractors must be below 0.5 | Yes(0.2) | Collisions with persons and near misses when working in a rail environment (Swedish Transport Agency) | No indication of change. |
| Shunting accidents and near misses (Swedish Transport Agency) |
| Accidents at work that have resulted in sick leave (Swedish Work Environment Authority) |
| **Others** | Injury index in respect of other persons must be below 2.2 | Yes(0.2) |   | No assessment is made for this category. |
|

Although Sweden achieved all the targets, we recognise there is room for improvement. Unauthorised track access and level crossing accidents continue to account for the largest share of deaths from railway accidents. We note here that some other European countries have made more progress than Sweden in reducing injuries. While rail remains safe compared to road transport, we also recognise that the gap – in terms of the number of deaths measured in kilometres travelled – has narrowed between these modes of transport over the past 15 years. Another area where improvement is possible is accidents in connection with work on the tracks. Here, we see scope for reducing the number of near misses through better planning and correct execution of safeguarding and using train lookouts.

One area Sweden has chosen to focus on in reducing the number of deaths is prevention of track suicides. The number of successful suicide attempts fell sharply in 2017 compared to the previous two years. This is a positive outcome, but at this stage it is unclear whether this is the result of safety measures or for other reasons. Data spanning a number of years will be needed to see whether it is possible to rule out the reduction being due to a general reduction or environmental factors.

Besides reducing the total number of injuries, the railway system should be designed to prevent catastrophic accidents. No such accidents involving injuries to multiple passengers were reported in 2017. Also with regard to near misses, we recognise that, from a longer-range perspective, there has been a reduction in the number of serious train derailments, from a low to an even lower level. This could be related to the fact that we have also seen a decrease in track geometry errors identified during inspections from 2014 to 2017 (both years inclusive).

In 2017, cooperation continued between the industry and the Swedish Transport Administration to reduce the risk of train collisions by having analysed and prevented signals passed at danger (SPADs). Nevertheless, data received by the Swedish Transport Agency from operators, and the industry’s own compilation, do not show any general decrease in the number of SPADs in 2017 compared to 2016. In this context, it should be mentioned that it is difficult to analyse trends in this area due to variations in the quality of the data year on year. For that reason, we take the view that the jury is still out as regards the effect of ongoing collision risk mitigation efforts.

Safety culture continues to feature in our activities in 2017. Railway accident investigations published during the year by the Swedish Accident Investigation Authority show that serious accidents are often preceded by a degree of uncertainty at the level of operational staff, with staff facing a decision to notify, suspend operation or make more restrictive operational choices. The Swedish Transport Agency interprets opportunity and support for staff always to put safety first as a key component of safety culture when faced with a choice between extra prudence or efficiency. With this in mind, we carried out inspections and conducted conferences on the topic of safety culture in 2017. Industry feedback was positive.

Analysis of the number of accidents and near misses is very much focused on operational aspects such as skills, technology and organisation, but the analysis of these aspects must be interpreted through the eyes of prevailing societal conditions. Particular societal changes that may prove challenging in terms of railway safety in the years ahead may be expected to include continuing growth in train traffic, concurrent with more intensive work on the tracks. Even though Sweden has not witnessed major rail disasters during 2017 – or for a number of years prior – we cannot take this for granted, because the prerequisites for disaster risk can change rapidly.

# Summary

The level of safety in the Swedish railway system remains high. The Swedish Transport Agency makes that assessment based on the fact that every safety target set for 2017 was met. The safety targets are quantified in terms of a weighted injury index which is calculated per the following categories: *Society, Unauthorized people on track, Level crossing users, Passengers, Employees and Others*. On top of the safety indices used in common safety targets, supplementary measures can be used to give a more complete and detailed view of the safety development. The Swedish Transport Agency makes the assessments regarding the total development of railway safety based on all mentioned indices, as well as supervisions, reported safety activities and available reports. Please see table below for figures.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Risk groups** | **Common safety targets** | **Target met(Outcome 2017)** | **Supplementary indices(Common Safety Indicators, CSI)** | **Assessment of change in safety level** |
| **Society** | Injury index = Count of deaths due to accidents + (0,1\*serious injuries due to accidents) should be lower than 25,7. | Yes (15,2) |   | No indication of improvement |
|
| **Unauthorized people on tracks** | Injury index for unauthorized people should be lower than 14,4. | Yes (10,2) | – Count of suicide and suicide attempts (Swedish Transport Agency) | Some indication of improvement |
| – Count of accidents and deviations reported regarding unauthorized on track (Swedish Transport Agency) |
| – Hours of delay caused by trespassers on track (Swedish Transport Administration) |
| **Level crossing users** | Injury index for level crossing users should be lower than 9,7. | Yes (4,6) | – Count of accidents and deviations reported regarding level crossings (Swedish Transport Agency) | No indication of improvement |
| -Number and types of level crossings (CSI) |
| **Passengers** | Injury index for passengers should be lower than 0,5 | Yes (0,0) | – Count of accidents and deviation regarding train collisions (Swedish Transport Agency) | Some indication of improvement regarding train derailments, no indication of improvement regarding train collisions |
| – Count of accidents and deviation regarding train derailment (Swedish Transport Agency) |
| – Count of reported signal passed at danger, SPAD (CSI) |
| – Count of reported SPAD (National SPAD group) |
| – Count of track buckles (CSI) |
| – Count of fires in or by rolling stock (Swedish Transport Agency) |
| **Employees** | Injury index for railway employees should be lower than 0,5 | Yes (0,2) | – Count of accidents and deviations regarding employees on track (Swedish Transport Agency) | No indication of improvement. |
| – Count of accidents and deviations regarding shunting (Swedish Transport Agency) |
| – Count of work place accidents resulting in sick leave (Arbetsmiljöverket) |
| **Others** | Injury index for other groups of people should be lower than 2,2 | Yes (0,2) |   | No assessment is made for this group. |
|

While the Swedish railway system fulfils all safety target for the year, the Swedish Transport Agency observes that there are still improvements to be made. Unauthorized people on tracks and incidents in level crossings continue to be the main causes of deadly accidents in the railway system. Regarding these types of incidents we see that several countries in Europe has progressed more than Sweden in reducing the number of casualties. A comparison between modes of land transport also shows that the number of casualties due to railway accidents has not decreased at the same pace as that of casualties due to road accidents in the last 15 years. Another area in which we see potential for improvement is in reducing accidents with employees on track, given that asignificant portion of the deviations reported in this category could have been avoided through proper planning and different safety measures.

Another key area in reducing railway casualties is the reduction of the number of train related suicides. Here we see that the number of suicide incidents for 2017 is lower compared to previous years. While the outcome is positive, we cannot yet draw any clear conclusions whether this decrease stems from changes in railway safety or if it is caused by other changes in society.

Apart from reducing casualties in the railway system, a safe system should also prevent catastrophic events from occurring. No such incident, in which several train passengers are injured, has been reported in 2017. Regarding precursor to such catastrophic events, we can note that the number of train derailment appears to have decreased in the last four years. We also see a significant decrease of reported track buckles since 2014.

In 2017 there has been a continuous cooperation between the railway undertakers and the Swedish Transport Administration, in reducing SPADs. The causes of SPADs have been systematically analysed, and signal visibility has been increased in SPAD-prone areas. However, the data available to the Swedish Transport Agency does not show any decrease in the actual number of reported SPADs for 2017 compared to 2016. It is, nonetheless, difficult to assess the change in system safety based on the indices since the reporting degree may also have changed. We therefore conclude that it is too early to evaluate the effect of the initiatives.

During 2017 the Swedish Transport Agency has continued to focus on the concept of safety culture. The importance of safety culture is highlighted by the accident reports released in 2017 by the Swedish Accident Investigation Authority. A recurring situation shown in the investigations is that serious accidents are often preceded by moments where the operative personnel has an opportunity to make restrictive choices or abort operations in order to avoid accidents. The degree to which operative personnel feel they are allowed and encouraged to make careful choices, and to stop certain operation when in doubt, are particular aspects in which safety culture can influence accident occurrence. Through supervision and information sessions the Swedish Transport Agency has continued to put emphasis on safety culture during the year.

While an analysis of accidents and precursors often lead to focus on operative aspects such as human factors, technology and organization, it should be important to stress that these factors do not exist in isolation from the conditions of society in large. The density of trains traveling in the Swedish railway systems has dramatically increased in recent years, and is expected to rise even more in the near future. Simultaneously, major maintenance and investment projects are also expected to be initiated. All together, this implies that the Swedish railway system will be put under heavy strain in the coming years. To maintain safety barriers, and to secure sufficient amount of competent staff, should therefore be a continued area of focus.

# DEFINITION OF TERMS

|  |  |
| --- | --- |
| **Term** | **Explanation** |
| Significant accident | Any accident involving at least one rail vehicle in motion, resulting in at least one killed or seriously injured person, or in significant damage to railway vehicles, railway infrastructure, the environment or property that was not being transported by the railway vehicle that is equivalent to EUR 150 000 or more, or the suspension of train services for 6 hours or more.  |
| Seriously injured persons | Any injured person who was hospitalised for more than 24 hours as a result of an accident, according to the police. |
| Deaths | Any person dying within 30 days as a result of an accident, according to the police.  |
| Traffic on track | All rail-bound traffic, which includes traffic on state-owned rail networks, independent railways, tram and metro networks. |
| Fire | An accident involving fire or smoke accumulation in railway vehicles, track vehicles, railway infrastructure, track installations or other property as a result of railway or rail traffic. |
| CSM-RA | Common Safety Method for Risk Assessment – risk analysis according to the standardised method in Regulation (EU) No 402/2013. |
| ECM | Entity in Charge of Maintenance |
| ERA | European Union Agency for Railways |
| IM | Infrastructure Manager |
| Railway System | State railway system and the connecting tracks. |
| Collision | Accident involving collision between railway vehicles or between track vehicles. |
| Accident | An unwanted or unintended sudden event, or a specific chain of such events, which have harmful consequences. With the exception of suicides. See Directive (EU) 2016/798.  |
| SPAD | Signal passed at danger – a vehicle passed a red signal (stop signal) on the track without permission. |
| Passive level crossing | A level crossing without any form of warning system |
| Passenger-kilometre | A passenger-kilometre means the transport of a person by one kilometre. |
| Accident to persons | Accident resulting in a person’s death (including suicide unless otherwise stated) or injury but not involving fire, collision, a level crossing accident, collision with persons, derailment, emissions or a road traffic accident. |
| Level crossing accident | Accident involving an impact between a railway vehicle and a road vehicle, between a track vehicle and a road vehicle or another road user at an organised level crossing. |
| Collision with persons | Accident to person involving collision between a railway vehicle and another object or between a track vehicle and another object, but which is not a level crossing accident or a road traffic accident. |
| RU | Railway Undertaking |
| SHK | Swedish Accident Investigation Authority *(Statens haverikommission)*  |
| Track geometry fault | Fault relating to track continuity and track geometry, requiring the track to be taken out of service or an immediate reduction in the permissible speed. |
| Safety culture | Swedish Transport Agency definition: Safety culture is about an organisation’s mutual way of thinking and acting in relation to risks and safety, in other words how an organisation prioritises and actually works on risks and safety relating to its operations. Safety culture includes the following: |
| * Safety commitment
 |
| * Communication
 |
| * Systematic safety work
 |
| * Resources, skills and prerequisites
 |
| * Learning culture
 |
| * Reporting culture
 |
| * Fair culture
 |
| Precursor | Events that did not result in injury but where there was a significant risk of an accident. |
| Train kilometre | Unit of measure representing the movement of a train over one kilometre. |
| Derailment | An accident in which at least one wheel of a railway vehicle or track vehicle leaves the rails. |
| Emissions | An accident in which dangerous goods or other dangerous substances are released. |
| Road traffic accident | Collision in tram traffic in a street environment between a tram and a road vehicle. |

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# Introduction and structure

This report sets out the trends in railway safety in 2017. The follow-up of injuries and other safety indicators is presented in Chapters 2 and 3. The basis for the follow-up is mainly based on the European safety indicators submitted annually by railway undertakings and infrastructure managers to the Swedish Transport Agency (for all values, see Annex A). Where the official indicators can be supplemented by external data, such as the Swedish Transport Agency’s register of railway traffic near misses and accidents, direct follow-up by the Swedish Transport Administration and the railway industry, or other research and investigations, these are used in the evaluation of the safety trend.

Chapter 4 presents the safety measures and investigations of railway operators reported during the year. Chapter 5 presents some global factors that possibly have, or will have, an impact on safety over the next few years. Finally, we discuss the safety situation based on the material we presented in Chapter 6.

Unless otherwise stated, for the purposes of this report, ‘railway system’ refers to the public railway system and the connecting tracks, while ‘rail traffic’ refers to the entire system of public railways, independent railway networks, metros and trams. The report mainly relates to the safety of the railway system. This is to facilitate comparison with safety reports submitted by other EU Member States to the European Union Agency for Railways (ERA).

The classification of event types used as indicators is not always mutually exclusive, and some events may therefore be covered by multiple indicators.

# Deaths and serious injuries resulting from rail accidents

## Total deaths

In 2017, 64 people died on the state railway system, down from 82 deaths in 2016; see Figure 1. Compared to 2015 when 102 people lost their lives, the outcome for 2017 is a reduction of 37% over over two years. Approximately 80% of deaths on the railway system each year are intentional acts in the form of suicides.

The national safety target for railways falls within the scope of the transport policy objective. The target has been set to gradually reduce the number of rail traffic deaths, and the current interpretation of this is that the number of deaths should be reduced by at least one person per year (Transport Analysis, 2018d). As shown in Figure 1, the deaths outcome for 2017 is on a par with the necessary trend for the national target.

Figure 1. Deaths on the state railway system and rail traffic in relation to national rail safety targets, 2006-2017



## Deaths and serious injuries resulting from accidents

Deaths and serious injuries in railway accidents, i.e. non-intentional acts, are shown in Figure 2. In 2017, 14 people lost their lives in railway accidents, while 12 were injured seriously enough to be admitted to hospital for more than 24 hours. Deaths and injuries both rose slightly in 2017 compared to 2016.

Figure 2. Deaths, seriously injured persons and weighted number of injuries in railway accidents, 2006-2017.

According to ERA safety targets, each Member State must maintain or improve on its 2004-2009 baseline safety position. The target is monitored by following up on the weighted number of injured persons (total of the number of persons seriously injured in accidents divided by 10 plus the number of deaths), in relation to volume of traffic. Figure 2 shows the provisionally calculated weighted injury outcome for Sweden in relation to the target defined by ERA. The target increases for the period, contingent on the total increase in the volume of train services. We note that the weighted 2017 injury outcome is well below the target; according to the Swedish Transport Agency’s preliminary calculation, this shows that Sweden’s safety level is acceptable in relation to the target.

Out of the 14 deaths caused by rail accidents, 10 were unauthorised persons on the tracks, while 4 were level crossing users; see Figure 3. This implies some increase in the number of unauthorised person deaths and a slight decrease in deaths among level crossing users from 2016. Unauthorised persons on the tracks and level crossing users together accounted for slightly more than 94% of all deaths for the entire period 2006-2017. No passengers have died on the railways since 2010.

Figure 3. Number of deaths caused by railway accidents, by person

Among the 12 seriously injured persons, 6 were level crossing users, 2 were employees working on the tracks, 2 were unauthorised persons and another 2 were people standing near passing trains (see Figure 4). The number of seriously injured level crossing users was slightly higher in 2017 compared to 2016, while the number of injured unauthorised persons was slightly lower.

Figure 4. Number of people seriously injured in railway accidents, by category of person

In the same way as the European target is calculated based on the total number of deaths and serious injuries in relation to the volume of traffic, grouped target values are also calculated based on weighted injuries per category of persons. Figure 5 shows the weighted outcome for injuries each year compared to the target set by ERA. We note that the target was met in respect of all categories of persons for 2017.

Figure 5. Weighted outcome of injuries per category of persons in relation to the European target 2011-2017

##  Comparison of countries and types of traffic

Compared to other European countries, Sweden enjoys a relatively high level of railway safety. Figure 6 shows the number of serious accidents per million train-kilometres in Sweden in 2017, compared to other European countries in 2016 (ERA, 2018a).

Figure 6. The number of serious accidents by type of accident per million train kilometres in Sweden in 2017, and the rest of Europe in 2016

The number of accidents in relation to traffic volume in Sweden can be considered to be at an average level among the top-performing countries in Europe. A degree of caution may be necessary in interpreting inter-country comparisons, however, as there may be differences in reporting practices.

A comparison of the railways with the safety of other types of traffic in Sweden shows a consistent general trend across all types of land transport. Figure 7 shows the number of deaths caused by accidents involving passenger transport vehicles per billion kilometres travelled by each type of vehicle per year. We see that the number of deaths on buses and railways in relation to the volume of traffic has decreased, but that both the relative and absolute differences in deaths between these and private car traffic have also decreased (Transport Analysis, 2018c).

Figure 7. Number of deaths caused by accidents involving passenger transport vehicles per billion kilometres travelled, by vehicle type (Transport Analysis, 2018b and Transport Analysis, 2018c)

For people travelling in vehicles, the outcome of the number of deaths according to traffic volume shows a different picture; see Figure 8. Seven passengers have died on the railways during the period 2003-2017, while the corresponding figure is 47 for those travelling by bus and 3 024 for those travelling in cars. Viewed in relation to passenger traffic volume over the last ten years, slightly more than six times more people die on buses than on trains, and a further nine times more die in a car compared to on a bus.

Figure 8. Deaths of passengers in passenger transport vehicles per billion kilometres travelled (Transport Analysis, 2018b and Transport Analysis, 2018c)

As regards freight traffic safety, relatively minor changes are observed between the years. Figure 9 shows the number of deaths caused by accidents involving freight trains and heavy goods vehicles in traffic per billion tonne-kilometres. There was a greater reduction in the number of accidents involving heavy vehicles from 2008 to 2010, but this may be due to the fact that suicides were not excluded from official road traffic injury statistics until 2010.

Figure 9. Deaths caused by accidents involving freight vehicles per billion tonne-kilometres (Transport Analysis, 2018b and Transport Analysis, 2018c)

# Safety by categories of persons

This chapter looks at safety for the various categories of persons by reviewing safety-related indicators and available knowledge relating to the categories of persons.

##  Unauthorised persons on the tracks

Accidents and suicides involving unauthorised persons on the tracks have historically been responsible for around 80% of deaths on the railway system. 2017 was no exception, and 55 of the 64 deaths happened during unauthorised access to the tracks.

### Suicide and attempted suicide

Of the 55 deaths among unauthorised persons, 45 were suicides. Five more took their lives at level crossings, making a total of 50 suicides on the railway system in 2017. Eight people were also seriously injured as a result of attempted suicide, but survived. The number of deaths involving suicide decreased substantially for two consecutive years from 2015; see Figure 10.

Efforts to reduce suicides on the railway system have been driven in part by the Swedish Transport Administration (see Chapter 4). Effects of fencing, barriers and speed reductions can be difficult to distinguish from other factors potentially influencing suicide propensity in the population. Figure 10 also shows deaths reported as suicide in the National Board of Health and Welfare Cause of Death Register using data from 2006 to 2016 (National Board of Health and Welfare, 2018). We note also that the total number of suicides in society fell, to some degree, from 2013 to 2016.

Figure 10. Number of deaths and suicide-related serious injuries on the railway system and for society as a whole.

### Unintentional shortcuts

Besides suicide-related events, ten unauthorised persons died on the railway system and two were seriously injured as a result of accidents. While the number of deaths showed a slight increase, the number of accidents and near misses involving unauthorised persons on the tracks fell from 2015 to 2017; see Figure 11.

Figure 11. Number of near misses and accidents resulting from collisions with unauthorised persons on the tracks reported by the operator to the Swedish Transport Agency.

Delay hours due to unauthorised persons on the tracks have increased dramatically in the period from 2013 to 2016, however, and here we note that the outcome for 2017 shows a reversal of the trend; see Figure 12 (Swedish Transport Administration, 2018b). The increase in hours of delay does not necessarily indicate an increase in the risk of collisions with unauthorised persons; this could more likely be due to earlier knowledge of unauthorised persons, with resultant adjustment of speed. The rail industry interoperability association has not yet found any single explanation for the significant increase in delay hours from 2013 to 2016 (Swedish Transport Administration, 2018b).

Figure 12. Number of delay hours due to unauthorised persons on the tracks; Source: *Tillsammans för Tåg i Tid* [Together for trains on time], 2018 Progress Report

## Level crossing users

In 2017, four level crossing users died, while six level crossing users were seriously injured. A total of 17 accidents and 36 near misses involving collisions at level crossings were reported to the Swedish Transport Agency in 2017; see Figure 13. This is a reduction in the number of events compared to 2015 and 2016.

Figure 13. Number of near misses involving collisions at level crossings reported by the operator to the Swedish Transport Agency

The type of road user usually involved in level-crossing accidents and near misses are motorists and pedestrians. Figure 14 shows the number of events at level crossings, by road traffic elements. In 2017, seven events involving heavy vehicles were reported, including two that involved buses.

Figure 14. Number of near misses and accidents resulting from collisions at level crossings, analysed by road user involved, reported by the operator to the Swedish Transport Agency

Figure 15 shows the number of events, analysed by safety device, at level crossings for all accidents and near misses, 2015 to 2017. We note that approximately one-half of level crossing accidents during the period were at passive level crossings, and the remainder were at level crossings with automatic protection or warning. The number of near misses compared to accidents is somewhat higher for level crossings with automatic protection than for passive level crossings. The relationship between the number of events and the type of protection is affected by the fact that most of the level crossings with dense traffic have better protection. Even taking the volume of traffic into account, however, barriers most likely do have a tangible effect on accident reduction (VTI, 2017).

Figure 15. Number of accidents and near misses at level crossings, analysed by safety device; data from 2015 to 2017.

The number of level crossings is mostly unchanged in 2017 compared to the two previous years. Figure 16 shows the number of level crossings, analysed by type of protection, reported in annual follow-ups by infrastructure managers to the Swedish Transport Agency. The Swedish Transport Administration reported approximately 150 more passive and 200 more active level crossings than in the previous year. The explanation is that, as of 2017, some platform crossings now count as level crossings. In other respects, no major changes are noted.

Figure 16. Number of level crossings, analysed by safety device, reported to the Swedish Transport Agency for annual compilation by infrastructure managers, 2015-2017.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **2015** |  |  |  | **2016** |  |  | **2017** |  |  |
| **Level crossings** | **Swedish TransportAdministration** | **Others** | **Total** |  | **Swedish Transport Administration** | **Others** | **Total** | **Swedish Transport Administration** | **Others** | **Total** |
| Passive safety devices | 2 783 | 796 | **3 579** |  | 2 771 | 808 | **3 579** | 2 961 | 772 | **3 733** |
| Active safety devices, manual | 7 | 62 | **69** |  | 7 | 66 | **73** | 7 | 53 | **60** |
| Active safety devices, automatic user-side warning signals | 638 | 114 | **752** |  | 570 | 132 | **702** | 581 | 147 | **728** |
| Active safety devices, automatic protection and warning signals | 2 061 | 85 | **2 146** |  | 2 092 | 81 | **2 173** | 2 209 | 101 | **2 310** |
| Active safety devices, rail-side protection, automatic protection and warning signals | 81 | 3 | **84** |  | 80 | 2 | **82** | 81 | 2 | **83** |
| **Total number of level crossings** | 5 570 | 1 060 | **6 630** |  | 5 520 | 1 089 | **6 609** | 5 839 | 1 075 | **6 914** |

##  Passengers

No passengers were killed or seriously injured in 2017. The fact that the zero rate of serious injuries among train passengers has been maintained for several years is a great achievement for the railway system, but in order to maintain this outcome, indicators relating to several types of potential catastrophic events need to be followed up. This sub-chapter reports on indicators relatingto train collisions, train derailment and fire. Although the subheading is ‘passengers’, safety indicators relating to the non-passenger trains are included in the report to complete the picture of safety trends.

### Train collisions

The number of serious train collisions was zero in 2017. On the other hand, there were two near-miss train collisions at Kolbäck and Karlstad Central. The number of train collisions per year has historically been low, and only two have been classified as ‘serious’ in the last four years; see Figure 17. Besides two ascertained serious train collisions, three train collisions were reported that were initially expected to have serious consequences. For one of these events, detailed information on consequential injuries is unavailable due to bankruptcy of the operator. Out of five reported accidents for the period, six train manoeuvres were involved. Five of these were freight trains and one was a passenger train.

Figure 17. Reported train collisions and near-miss train collisions 2014-2017

Due to the fact that collisions and near misses most often occur as a result of a SPAD, the number of SPADs is also an indicator of risk to passengers. Figure 18 shows the number of SPADs reported by railway undertakings. In 2017, there were 254 SPADs when not passing a danger point, while 24 SPADs passing a danger point were reported. The strong increase in events from 2015 to 2016 is likely due to the increase in reporting.

Figure 18. Number of SPADs reported by railway undertakings in annual safety reporting 2015-2017

SPADs passing a danger point

The number of SPADs reported to the Swedish Transport Agency do not provide a completely reliable picture of the overall safety situation. The Swedish Transport Administration and several railway undertakings jointly operate a working group to identify, analyse and minimise SPADs (Swedish Transport Administration, 2018a). Their group reported 338 SPADs of type A, which is an increase from 2016, when 300 events were reported.

In terms of train kilometres, the trend is for SPAD-A to be three times higher for freight trains than for passenger trains (Swedish Transport Administration, 2018a). The detailed classification of SPAD-A shows that approximately one-half of events during 2017 involved drivers not observing stop signals, or observing them too late, and approximately nine per cent of these events involved impaired or poor stopping capacity; see Figure 19.

Figure 19. Number of SPAD-A reported in the national SPAD group with a breakdown by sub-categories, 2016 and 2017. Source: National SPAD group (Swedish Transport Administration, 2018a), Swedish Transport Administration, BTO

### Train derailments

There were four serious train derailments in 2017, one more than in 2016; see Figure 20. Compared to the period 2012-2014, however, we note that the number of train derailments has decreased. One of the accidents in 2017 was a notable derailment causing substantial material damage, and occurred in Ludvika on 12 October. A public accident investigation of this event is ongoing at the time of writing.

Figure 20. Number of serious derailments in connection with train manoeuvres, together with reported infrastructure faults that resulted in reduced speed or stops in traffic

Overall, it can be said that the number of serious train derailments is low, as people are rarely seriously injured and material damage is rarely extensive. In 2016, three relatively serious near-derailments were reported where sink-holes, fallen trees and failure to reduce speed in high traffic volume sections with major track geometry faults could all have resulted in serious occurrences. No near-misses were reported in 2017.

The number of reported faults that resulted in reduced speed or traffic stops decreased in 2017. The outcome is on a par with the continuing trend from 2014, with the number of track geometry faults having virtually halved in four years. The Swedish Transport Administration explains that this reduction could be due to the fact that it has been working with a subcontractor in a proactive approach to track maintenance. The total number of delay hours due to infrastructure faults has decreased from 2014 (Swedish Transport Administration, 2018b).

### Fire and emissions

One serious rolling stock fire was reported in 2017, the same number as in 2016. Most fires on the railway system are not classed as serious due to the fact that no one is injured and the material costs of the damage rarely exceed SEK 1.5 billion, which is the definition of a major accident.

Each year, the Swedish Transport Agency receives considerably more reports of fires than the number reported in major accident statistics. Figure 21 shows the number of reported fires according to a rough estimate of the extent of the fire. A small fire is a fire that can be extinguished by staff using fire extinguishers or can be easily put out by search and rescue services. A major fire is a fire that may require some intervention by search and rescue services, whereas a major conflagration requires an extensive extinguishing operation. We note that the majority of fires do not progress beyond small fires, or do so only with smoke accumulation.

Figure 21. Number of railway fires reported to the Swedish Transport Agency, analysed by the extent of the fire

Regarding the site of a fire, most major fires begin in a locomotive, freight wagon, track installation or other track-side property; see Figure 22.

Figure 22. Number of fires, analysed by extent and location of fires, 2014-2017

## Employees and subcontractors

No railway employees lost their lives in 2017, although two railway employees were seriously injured. The number of employees killed has varied between one and zero in recent years. The European target for this category implies a zero tolerance for deaths among employees on the Swedish railway system.

### Track-side works

In connection with track-side works, no accidents were reported in 2017; see Figure 23. On the other hand, there were reports of 12 near misses, 2 of which involved incorrect management of protection, and the rest were near-collisions with persons, without protection.

Figure 23. Number of accidents and near-miss accidents involving persons in connection with track-side works.

Reporting of near-collisions with track workers was mainly based on information provided by train drivers. In most cases, drivers perceive that track workers do not notice the train approaching or notice it too late. As track workers themselves rarely report to the Swedish Transport Agency, information about these events could be inadequate. It is not always clear if it is actually rail workers who are involved in the event or if it is unauthorised persons performing other duties and wearing high-visibility clothing in the track area.

Figure 24 shows an attempt to categorise these events by event description. The circumstances remain unclear for the majority of accidents and near misses involving workers on the tracks in the period 2014-2017. Most often, train drivers see people wearing high-visibility clothing on or near the tracks, but, after contact with traffic management, they are unable to specify who these people are or why they have been so close to tracks in use.

Figure 24. All accidents and near misses involving workers on the tracks, analysed by cause, interpreted from the event description, 2014-2017

In the majority of events in which it is possible to identify the workers, the majority of events involve working without protection. Often, there is no train lookout, people are not fully aware of the approaching vehicle or visibility is too poor. In isolated cases, a train lookout may warn of an approaching train on one track, so the track workers move to an adjacent track, and a hazardous situation then arises when another train approaches on the other track.

###  Shunting accidents

Two employees and one level crossing user were seriously injured in shunting accidents in 2017. One employee was injured in a derailment accident and the other employee was injured by slipping when alighting from the carriage. The number of injured persons is higher in 2017 than in the previous year; however, viewed in terms of accidents and near misses, there are no major differences in shunting events compared to previous years; see Figure 25.

Figure 25. Number of deaths, serious injuries, accidents, near misses and other reported faults in connection with shunting, 2014-2017. May include events on infrastructure intended for own freight.

With regard to event types, variations in types of accidents and near misses can occur during shunting. Figure 26 shows all accidents and near misses reported in 2014-2017 analysed by event type. The events are relatively evenly distributed among collisions, level crossing accidents, collisions with persons, and other accidents involving persons. The latter type of event often refers to the fact that the shunter is trapped between vehicles or falls from a footboard. Derailment, often in the context of trailed points, can result in accidents.

Figure 26. Event types for shunting accidents and near misses, 2014-2017



### Other occupational accidents

As regards the safety of employees, this can also be reflected in the Work Environment Authority’s statistics on accidents at work. Figure 27 shows the number of reported accidents that have resulted in sick leave in the 'Land transport – rail' sector (Work Environment Authority, 2018). The total number of accidents has not changed particularly in the period 2013-2017. By contrast, accidents involving intimidation, violence or shock are down from 2014. This causation group includes events in which staff witness shocking events such as collisions with persons. In the case of accidents involving falling, losing one’s footing and vehicle collisions, the number increased from 2014 to 2016, and then decreased somewhat in 2017.

Figure 27. Number of reported occupational accidents in the railway sector analysed by causation; combination of causes; years with fewer than five events are excluded; extract from the Swedish Work Environment Authority’s statistics portal, 11 July 2018.

# Safety measures

This chapter presents some of the safety measures employed by railway players in 2017. Sub-chapter 4.1 deals with accident investigations published during the year. Sub-chapter 4.2 describes the activities of the Swedish Transport Agency on the basis of the annual compilation by the Agency. Finally, sub-chapter 4.3 presents the activities reported by railway undertakings and infrastructure managers to the Swedish Transport Agency in the context of the annual activity report.

Some figures will be presented in this chapter, but the basis is neither comprehensive nor a reliable indicator of actual improvements implemented in the system. It is not possible to analyse the effect of such measures. The purpose of this chapter is to explain what issues have been raised and brought to the attention of the players during 2017. A list of substantive measures and sectoral cooperation cooperation is presented in Annex C, Table 2.

## Public accident investigations

The Swedish Accident Investigation Authority is responsible for public investigations of accidents of special interest. During 2017, the Swedish Accident Investigation Authority reported five investigations of railway accidents. Four of these deal with train collisions and near misses, while one relates to an accident during railway operations (see Annex C, Table 3).

Among the human factors affecting accidents, culture and routine are particularly noteworthy. In at least two of the investigations, it emerges that working methods that have probably become routine present high risks and deviations from the regulatory framework. In two more of these cases, it is suspected that the inexperience of the operational staff in a specific operation, together with a desire to get the job done, resulted in the staff opting to provide less restrictive operational measures than were necessary. One common factor behind these may be shortcomings in the safety culture of the organisation.

Technical considerations raised include the interaction of humans and technology. One of the investigations noted that a collision nearly happened because the driver passed a stop signal when the signal was difficult to detect in an environment with multiple visual impressions. Another area highlighted is how traffic management should deal with situations where their tools provide insufficient or unclear information on the current traffic situation.

## Activities of the Swedish Transport Agency

### Issuing authorisation

Since 2013, applications for authorisation have taken place electronically on the Swedish Transport Agency’s website. The system for applications contains guidance on what is to be completed and attached (Swedish Transport Agency, 2018b). During 2017, the Swedish Transport Agency received an accumulation of applications for the renewal of safety authorisations, and this was prioritised. Authorisations are valid for five years, after which time they must be renewed.

A lack of understanding of the regulatory framework has been an obstacle for new players to obtain a certificate (Swedish Transport Agency, 2017c). This has led to repeated additions being required before the authorisation was granted, which in turn resulted in players hiring consultants for documentation and design of the safety management systems. The Swedish Transport Agency has observed that this is problematic, as understanding and implementation of safety management cannot be guaranteed by such a solution.

The role of a licensing authority requires cooperation with other European authorities to verify the safety of cross-border activities. Two Swedish railway undertakings operating outside Sweden renewed their safety certificates in 2017: one company with cross-border traffic to Norway and one company operating to Norway, Denmark and Germany. There have already been ongoing contacts with the safety authorities in Norway and Denmark. As a Swedish railway undertaking operates in Germany, the Swedish Transport Agency needs to expand its contacts to include the safety authority there.

The Swedish Transport Agency did not receive any appeal cases concerning the operation of issuing safety authorisations during 2017.

### Supervision

The Swedish Transport Agency is the supervisory authority for the railway undertakings and infrastructure managers who have been issued with safety certificates or safety authorisations. Oversight is for the purpose of maintaining or improving safety in Sweden in the light of the agreed EU common safety objectives.

The vast majority of oversight in the railway takes place at system level. This means inspecting infrastructure managers’ and railway undertakings’ safety management systems and the safety provisions required in order to ensure safe operation.

Besides railway undertakings and infrastructure managers, oversight is also necessary of authorisation holders for training and examining train drivers and authorisation holders for train driver health inspections. Oversight is also exercised in relation to maintenance management units for freight wagons certified by the Swedish Transport Agency. Special oversight for the transportation of hazardous goods also comes up, often in collaboration with other authorities.

Swedish railways vary in the scope and type of activities carried out by each operator; accordingly, the allocation of resources for oversight has been based on the principle of risk-based oversight (Swedish Transport Agency, 2014). The principle consists of carrying out oversight of the authorisation holders, the area or the subsystems deemed to benefit most in terms of safety. Transposition of the principle of risk-based oversight is a work in progress for the authority.

In addition to points-based risk factors gathered, the following qualitative channels are used as contributions to plans and strategies:

* Information regarding accidents that have occurred and serious near-accidents and the investigations carried out by the Swedish Accident Investigation Authority.
* Information from the results of previous oversight activities.
* New, amended or removed rules and regulations (both national and international).
* Changes to oversight objects of such magnitude that they are notified to the Swedish Transport Agency (e.g. reorganisations and changes of ownership).
* Results of oversight from other authorities applicable to players in the railway system. A quality failure in one aspect of an operation can also indicate increased risk as regards operational safety failings.
* Market surveillance and market oversight information that can indicate a risk of safety being impacted by financial considerations.
* Information from international cooperation.
* Notifications from the public, the industry or the media.

Towards the end of 2017, the number of staff tasked with oversight was 21, and a total of 15,819 hours were spent on oversight; see Figure 28. The figures differ from 2016 mainly because staff qualified to carry out supervision have changed jobs or employers.

Figure 28. Resources and hours spent on oversight, the Swedish Transport Agency, 2016-2017



|  |  |
| --- | --- |
| Tillsynstyp | Type of oversight |
| Antal spenderade timmar 2016 | Number of hours spent, 2016 |
| Antal anställda 2016 med tillsyn som arbetsuppgift | Number of employees in 2016 tasked with oversight |
| Antal spenderade timmar 2017 | Number of hours spent, 2017 |
| Antal anställda 2017 med tillsyn som arbetsuppgift | Number of employees in 2017 tasked with oversight |
| Systemtillsyn – Järnvägsföretag | Systems oversight – Railway undertakings |
| Systemtillsyn – Infrastruktur-förvaltare | Systems oversight – Infrastructure managers |
| Riktad tillsyn – Farlig gods | Targeted supervision – Hazardous goods |
| Tematillsyn – Säkerhetskultur | Thematic oversight – Safety culture |
| Trafikmedicinsk tillsyn | Oversight of traffic medicine |
| Examinatorer och utbildningsorganisationer | Examiners and training organisations |

The introduction into Swedish law of the fourth railway package means that more people qualified as inspectors are performing other duties instead; for example, some are 100% occupied with international and national regulations. Some work 25% on safeguarding the European One-Stop-Shop system, used inter alia for applying for future ‘single safety certificates’. Some work 25% on identifying new and modified work procedures that the authority will need internally. As already stated, safety authorisation renewals have also required a lot of resources. The authority has recruited staff for oversight, but the learning period is at least 1 year with guidance.

Some inspections are required by recommendations resulting from public accident investigations (see Annex C Table 2). During 2017, the Swedish Accident Investigation Authority (Statens haverikommission, SHK) made a recommendation (SHK, 2018c) to the Swedish Transport Agency: 'within the framework of its oversight to examine how the Swedish Transport Administration could use its its safety management system to learn lessons from experiences regarding understanding, providing training in, the functionality of and follow-up of the STEG planning and documentation system and its application in relation to forms and other systems highlighted in this report.' This activity concerns the safety management systems with respect to understanding of training in, functionality of and follow-up of new technical systems that impact traffic safety. Oversight is scheduled for autumn 2018.

Safety culture was a major theme for oversight in 2016 (Swedish Transport Agency, 2017b). This area continued to be a special focus of oversight in 2017, but in relation to the number of hours available, scope for oversight has decreased.

### Granted exemptions from the Ordinance regarding appointing an entity in charge of maintenance

During 2017, the Swedish Transport Agency did not receive any applications for an exemption from the rule designating an entity in charge before a vehicle is put into service in accordance pursuant to Article 15 of Directive (EU) 2016/798.

### Other safety activities

In November 2017, the Safety Conference was held for the first time under the auspices of the Swedish Transport Agency. The theme of the conference was safety culture. Some 250 participants gathered for the conference in Örebro to find inspiration and learn the lessons of experience with regard to railway safety work.

The conference was launched by the Director-General of the Swedish Transport Agency, who noted that safety culture is essential for the creation of a safe, accessible and sustainable railway system. Participants were given access to how organisations work to raise the bar of safety culture, and also to hear how oversight of an undertaking’s safety culture works in practice, and how those being inspected view this. The conference was generally appreciated and was regarded as a learning experience, according to the evaluations submitted by the participants.

The conference was also of value to the Swedish Transport Agency, serving to promote understanding of the situation and challenges faced by operators. Here are some sample reflections from the Conference as noted in the evaluations:

*– it doesn’t matter how well organised your safety management documents are if the company doesn’t have the right attitudes to safety.*

*– it appears most companies face the same difficulties in getting their management to understand needs and requirements, and that it’s mainly safety departments that deal with the questions.*

*– it’s important to work systematically and, above all, for everyone to participate, from the top management to the individual member of staff.*

The day before the conference, the Swedish Transport Agency had had called about fifty railway undertakings for a briefing and discussion about Commission Regulation (EU) No 1078/2012 of 16 November 2012 on a common safety method for monitoring. The Swedish Transport Agency gave a presentation on how the provisions in the Regulation can be applied in the undertaking and how implementation can be facilitated if the safety management system is structured as processes.

Responses after the meeting showed that the organisations have varying levels of knowledge. Some participants found the information and the discussion too basic, while other participants appreciated the level this was pitched at.

A previous focus area for the Swedish Transport Agency was to ensure that managers of small rail infrastructure, such as municipalities, industries and ports, have sufficient knowledge of their areas of responsibility. Accordingly, during 2017, additional briefings were organised from Luleå in the north of Sweden, to Malmö in the south. Approximately 100 participants from eight different towns and cities involved in the management of minor railway infrastructure received information about licensing, oversight and regulatory frameworks. The focus at the meetings was to explain clearly what it means to be the infrastructure manager, and the appurtenant obligations and responsibilities. The response was very positive, and several respondents called for more activities of this nature.

## Operator safety activities and safety objectives

### Swedish Transport Administration

Each year, the Swedish Transport Administration and other infrastructure managers submit a report on safety activities and safety management. Safety is followed up at the level of the overall railway system, safety of track infrastructure, the controller and safety of works for which they carry the responsibility as the developer.

Safety of the railway system is followed up by a specific halving target guiding the priority between traffic safety measures to reduce the expected number of deaths. The trend in the number of deaths is on a par with the Swedish Transport Administration’s objective of annually reducing the number of deaths in the railway system by an average of 6.6% from the 2010 level. While the actual number of deaths is decreasing at the expected rate, the calculated effect of traffic safety measures is somewhat lower (4 fewer deaths) compared to the initial target (5.4 fewer deaths; the Swedish Transport Administration, 2018c). Within the framework of this work, preventive work is ongoing in relation to unauthorised track access, requiring both physical measures and analyses of events. One specific example is the testing of barriers to unauthorised access in the form of rubber mats that are difficult to pass. Data from these tests indicates that the rubber barriers are an inexpensive and effective way of preventing people from running along the tracks in certain places (the Swedish Transport Administration, 2017b). The ‘Sluta genast gena’ (‘stop taking shortcuts now!’) information campaign came under the heading of preventing people from running along the tracks (the Swedish Transport Administration, 2017c).

In our opinion, the safe use of track infrastructure is developing in a positive direction. The number of derailments of moving trains due to infrastructure failures at the Swedish Transport Administration’s installations declined sharply in 2017 compared to the baseline year, 2014. Possible explanations are proactive maintenance, early identification of problems and suitable speed reductions.

Workplace safety is included in Swedish Transport Administration targets under maintenance, investment and major projects. Safety in this respect is a broader concept than rail safety, as it can include accidents without the involvement of track vehicles. Follow-up of indicators such as the number of accidents, sick leave records and observations from workplace inspections shows an inconsistent picture of the safety trend. In the matter of investment, safety measures are required in order to improve regulatory compliance when working with heavy work vehicles. Measures must also be put in place to improve documentation of start-up meetings for railway projects.

In addition to these objectives, the Swedish Transport Administration is working to improve safety throughout the organisation by means of a new action plan to boost safety work (the Swedish Transport Administration, 2017d). Among the measures implemented, several focus on safety culture and skills development when it comes to handling deviations.

### Other infrastructure managers

Track managers other than the Swedish Transport Administration are also required to implement safety management systems and report on these to the Swedish Transport Agency. Altogether, 96 infrastructure managers reported their 2017 safety objectives and activities. With the exception of Inlandsbanan and Arlandabanan, most of the reporting agents are managers of tracks covering between a few hundred metres and a few kilometres, with a maximum permitted speed of below 50 km/h.

Figure 29. Safety activities by capacity type, with a view to improvement, infrastructure managers



|  |  |
| --- | --- |
| Person | Person |
| Delsystem | Sub-system |
| Analys | Analysis |
| Arbetsmoment | Work phase |

The majority of infrastructure managers have reported safety objectives relating to zero accidents or near misses on their installations; see Figure 29. In certain cases, the objective can be combined with a vision of zero tolerance for accidents in the manager’s other operations, such as industry and non-track transport. Some infrastructure managers have also set targets for regulatory compliance, track barriers, derailments and level crossing safety.

Some safety measures are designed to increase physical safety on the installation. Several of these relate to maintenance, such as snow clearance, clearing of shrubbery and replacement of sleepers. Installation of signs, cameras and barriers has also been reported.

Among activities designed to increase analysis and management capacity, several relate to increased reporting of near misses, the introduction of indicators and establishing routine meetings to discuss results and risks.

Safety activities relating to operations are of a variety of types. Several activities relate to procedures and regulatory compliance with regard to working in specific situations such as ports and freight terminals. Several activities also relate to response and dealing with operational staff in the case of alerts and accidents.

### Railway undertakings

For 2017, 55 railway undertakings reported their safety management to the Swedish Transport Agency for the annual summary for its annual compilation. Essentially, that includes all railway undertakings that have a safety certificate. Several companies with only national safety authorisations have also reported on their activities to the Swedish Transport Agency. Just as with the infrastructure managers, the scope of activities of the railway undertakings also varies. Besides freight and passenger traffic, several railway undertakings mainly deal with switching, maintenance or museum traffic.

Figure 30. Number of safety targets reported by railway undertaking for the operational year 2017, analysed by type of accident/type of near miss

For safety objectives, railway undertakings select different levels of detail to follow up on. The most common type of safety objective stated is to reduce accidents, injuries and near misses in the undertaking; see Figure 30. Undertakings with minor activities often set a target of zero tolerance for injuries and accidents, whereas larger operators may use indexed frequencies of events. Where safety objectives are defined according to a special type of event, we see that reducing collisions or SPADs will often be included as objectives. Reducing derailments is also often defined as a specific objective.

Objectives that do not directly measure the outcome of near misses or accidents are classified as other objectives. Instead, these safety objectives measure the indirect level of safety by following up any operational capacity, either in the operational or in the underlying organisational capacities. A breakdown of other safety objectives by type of capacity to be followed up can be seen in Figure 31. We note that organisational capacity for learning and anomaly reporting are relatively common safety objectives. Skills follow-up for operational staff is also a target for several railway undertakings.

Figure 31. Other safety objectives of railway undertakings analysed by operational capacity measured

Generally speaking, railway undertakings tended to achieve their stated objectives. Approximately 74% of the established near-miss targets were reached. SPAD targets had the lowest target achievement, where only 55% of the targets were found to be met. Target fulfilment is also relatively high in respect of targets other than near misses. Organisational objectives were more often set as ‘partially’ achieved than as fully met.

Among safety activities, more than one-third aim to increase organisational and management capacity; see Figure 32. Common safety activities of this kind are awareness-raising and training to increase reporting of near misses. Among the safety measures relating to procedures and work phases, most of the activity relates to reducing SPADs, shunting accidents, loading/alighting accidents and increasing emergency preparedness in the event of an accident. Several of these measures relate to reporting the near misses that have taken place to recognise patterns of events and make changes.

Figure 32. Safety activities by type of capacity with a view to improvement, railway undertakings



|  |  |
| --- | --- |
| Person | Person |
| Delsystem | Sub-system |
| Analys | Analysis |
| Arbetsmoment | Work phase |

Safety activities relatingto subsystems are mainly about inspection and purchasing vehicles or sub-components. Staff activities constitute measures as regards involving operational personnel in the safety mindset. Examples include the introduction of regular risk meetings, reviewing near misses, and staff newsletters.

### Follow-up of common risk assessment and monitoring methods

Infrastructure managers and railway undertakings have a duty to assess whether changes in their activities have a material impact on security under a European common safety method for risk evaluation and assessment (CSM-RA), pursuant to Regulation (EU) No 402/2013. In the vast majority of cases, they usually conclude that the changes are not material and that there is therefore no requirement to continue following the exact CSM-RA process in the change process. CSM-RA is furthermore not mandatory for the issuance of certificates and authorisations for infrastructure managers. This implies that the Swedish Transport Agency still has limited experience and knowledge of CSM-RA in practice. Furthermore, few significant changes were reported to the Swedish Transport Agency in respect of 2017.

That said, risk analyses are mandatory even if the precise CSM-RA method is not used: the revision process has long been risk-based in Sweden, and our approval process requires risk analyses to be carried out, but operators are free to decide on the method to be used. What counts is that they identify and deal with the risks. The Swedish Transport Agency also requires operators to have an adequate safety management system using established risk analysis methods. When the Swedish Transport Agency considers it necessary, an independent safety assessor is required to assess an operator’s work.

Random sampling shows that operators use independent auditors in most cases. Independent auditors are extensively used when approving changes to installations and railway vehicles. The frequency of use is different for different subsystems. Independent auditors are mandatory for the controller and signalling subsystems. For rolling stock, they are used almost at all times, except in the case of marginal changes. For infrastructure changes, the Swedish Transport Agency tends to require independent auditors if the change is complex or where there are clear deficiencies, thus assisting them with the management of the approval process. In many of the infrastructure cases, independent auditors are involved without the need for the Swedish Transport Agency to have requirements in place: the Swedish Transport Administration imposes requirements in its own processes and, as they run the majority of railway projects in Sweden, in practice this means independent auditors are used on most projects.

In the 2017 safety reporting by the operators, experience from implementation of CSM-RA and common monitoring methodology was fed back (CSM monitoring: Commission Regulation (EU) No 1078/2012). Comments on CSM-RA were mainly expressed positively, even if the vast majority of operators had no changes deemed significant. Risk assessment, as mentioned, is already integrated into the activities from before, but more players are mentioning that CSM-RA assists them further in this process.

Experiences from implementation of CSM monitoring vary. Many, especially minor infrastructure managers, find it difficult to relate the methodology to their own activities. The information session organised by the Swedish Transport Agency during the safety day was appreciated by many players, but even more pointed out that it was a problem not having the instructions and guidance about the Regulation in Swedish. The guides available in English were difficult to apply for Swedish players with less extensive activities. However, several players mentioned that cooperation within the industry has begun with a view to creating a common interpretation of the Regulation.

# Global factors

This chapter describes observations from the outside world that have either affected safety outcomes in 2017 or could potentially have an impact on safety in the coming years. The report is divided into market, regulatory and investment prospects.

## Scope of service, and finances

All results so far presented in this report should be interpreted taking into account the fact that the volume of traffic on the tracks has increased significantly in recent years. From 1990 to 2016, the number of train kilometres rose by almost 120%, while passenger kilometres increased by 94% (the Swedish Transport Agency, 2018). The increase is explained by the fact that distance travelled per person has increased, concurrent with population growth. The current boom cycle in 2017 also indicates that the demand for rail transport will probably remain strong. The Swedish Transport Administration’s forecast also indicates a continued strong increase in train journeys over the next few years (the Swedish Transport Administration, 2018e).

A rapid increase in traffic volume not only increases exposure, and thus the expected number of near misses and accidents, but can also put pressure on system capacity. On average, virtually twice as many people travelled on passenger trains on each route in 2016 compared to 1990, while the average weight of freight trains traversing each section has increased by 15% (the Swedish Transport Agency, 2018).

Market dynamics and changing patterns of travel can also change risk profiles in the system. In 1990, long-distance train travel accounted for less than one-third of all passenger kilometres, while in 2016, it accounted for 48% of journey kilometres. Competition, demand and changes in travel patterns also govern the profitability of transport operators, which in turn may affect their ability to prioritise safety in their operations.

The Swedish Transport Agency’s annual follow-up of the transport market (2018) shows that the railway undertakings are in a good position financially. Procured passenger services are regarded as particularly profitable to operations. A survey of rail passengers in Sweden (the Swedish Transport Agency, 2017a) also shows safety is their top priority when travelling by train. We interpret the financial scope and incentives for improving safety levels at industry level as high.

At the same time, there is a potential risk that increased turnover in passenger rail transport mainly depends on increased demand, and not greater availability or ticket prices (the Swedish Transport Agency, 2018). Operational costs for rail traffic cannot be easily adapted in times of demand reduction, and when income falls, it can be more difficult to finance safety aspects.

## Availability of skills

As of 2017, there is still a high demand for train drivers, according to the Swedish Public Employment Service (2018). A shortage of experienced staff can lead to difficulties in finding replacements, to stress, to staff lacking experience in relation to their responsibilities, and could potentially lead to an increased risk of accidents. A large number of drivers are estimated to have retired in recent years (Swedish Transport Agency, 2013). On the other hand, the number of drivers and jobs is estimated to reach equilibrium within five years (the Swedish Public Employment Service, 2018).

As regards controllers, the 2015 safety culture report (the Swedish Transport Agency, 2018) identified concerns from respondents that there was a risk of shortage of staff. The financial statements covering operation of the Swedish Transport Administration (2018f) show that, for the period 2013, the cost of rail traffic management outstripped the increase in volume of traffic. Part of this increase in costs must relate to staffing increases.

## Changes in the regulatory framework

Changes to the regulatory framework that entered into force in 2017 are shown in Annex B.

## Strategy and plans for the railway system

In 2017, the groundwork was laid for the national transport system plan 2018-2029 (the Swedish Transport Administration, 2018d). The proposal that was accepted in 2018 aims to recover functionality of railway infrastructure through maintenance and reinvestment. Stronger investment to enhance capacity is anticipated for the years ahead. Another focus area of the national railway plan is the widespread introduction in Sweden of the European Railway Traffic Management System (ERTMS) as a single standard of signalling.

No major improvements are expected in 2018-2019 compared to 2017 on the public rail network (the Swedish Transport Administration, 2017a). However, an increased maintenance budget for 2020-2021 will make it possible to recover from the maintenance backlog. The expectation is that only then will reinvestment be possible to maintain safety levels, e.g. for road safety at level crossings. Extensive maintenance activities, combined with increased traffic on the tracks, are mentioned as potential risk areas in terms of cost, planning and stress on workers (the Swedish Transport Administration, 2017a).

# Discussion and analysis

Overall, we consider that the indicators and the reported railway safety measures in 2017 show a positive or unchanged trend in safety levels. With the exception of unauthorised persons on the tracks, none of the official European injury indicators show an upturn, and even with regard to unauthorised persons, the supplementary indicators show that no major increase in risk is likely during the year.

The official European safety indicators in respect of unauthorised persons do not take suicides into account. The number of suicides decreased sharply in 2017 compared to the previous year. We note that reported near misses and accidents due to unauthorised persons on the tracks are down, while the reported number of delay hours due to unauthorised persons on the tracks remains basically unchanged since a sharp increase during 2014-2016. The Swedish Transport Administration’s reporting on measures in anticipation of saving 4 lives indicates that system safety should be physically modified. Overall, we interpret the result to mean there is a certain indication of scope for improvement in this aspect of safety, even if detailed assessments of the effect of the measures would be needed before it would be possible to rule out other societal factors as the reason for this change.

As regards level crossing safety, we note that the European indicator shows a decline, while the number of near misses and accidents reported overall also decreased. Technical safety at level crossings in Sweden has not changed significantly, however. Since 2015, the number of passive level crossings has remained largely unchanged. Neither have we observed any major security measures that could explain the increase in level of level crossing safety. Overall, we find that the safety of this group does not indicate either a rise or a decline.

Passenger safety remains high. The official European indicator shows zero two years in a row, i.e. the best possible level. Among supplementary indicators, we see a slight increase in notified train derailments for 2017; nevertheless, this is from a very low level. Train collisions and near-collisions show a decrease. The number of track geometry faults is decreasing, while the number of reported SPADs is increasing. We note also that SPADs are a priority area for most major railway undertakings, and that the industry is cooperating to reduce these. Overall, we see a possible indication of improvement in the prevention of train derailments. As regards SPADs and collisions, there are no clear explanations for the deteriorating safety situation, so it is not possible at this stage to comment on any trend.

Employee safety does not appear to have changed significantly in 2017. While we note that the official European indicator is lower, the number of injured persons in general is too few to determine whether there is any change. The number of reported near misses and accidents involving work on the tracks decreased in 2017. At the same time, a detailed analysis of these events shows that they could largely have been avoided from the outset by correct use of protection or train lookouts. Late evacuation is not only a risk for the workers themselves but can also cause stress and discomfort to train drivers, who often perceive the situation as more ominous than those working on the tracks. The number of accidents and near misses during shunting also decreased. Several railway undertakings use follow-up and analysis of these events as part of their ongoing safety activities. Overall, there are no significant indicators of employee safety having deteriorated, while we see that there is an indication of a better compliance regime for track work, not least in the wake of the findings from the investigation into the collision with a person at Markaryd (SHK, 2017e).

With regard to the challenges for railway safety in the coming years, due account can be taken, in particular, of a continued increase in traffic. While work is ongoing to catch up with maintenance and increase capacity, the impact of this will only be evident as of 2020. Until then, intensive traffic and extensive track work will have to coexist in a restricted space. Maintaining security in such circumstances may require effective, proactive cooperation in the form of communication and joint planning among multiple players involved in the railway sector.

The emergence of different types of railway activity will also create a major need for new skill-sets. As regards train drivers, there is an increase in the provision of trains, concomitant with large-scale retirements. Inclusion of newly trained people while ensuring that every person’s role is covered by people with sufficient experience is likely to be at the centre of railway safety in the coming years. An example of the potential shortage of skills can be seen in the report on the collision at Piteå-Arnemark (SHK, 2018c), where part of the cause was that the remote signaller had insufficient experience of the tasks involved at the time of the accident.

Compared to other land transport, rail remains by far the safest option for passengers. However, we note that investments and technological developments in road traffic have reduced the number of road traffic deaths, and that we will soon reach a level where the number of deaths among pedestrians involved in car accidents will be comparable to the level of the number of deaths among pedestrians involved in train accidents. This is despite the fact that the number of pedestrian-and-train interaction elements should be very minor compared to the number of interaction elements between pedestrians and road vehicles. The question of why rail and other transport-user interactions – compared to exposure – result in so many deaths is a matter for further study

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| --- | --- |
| Annex A | Common safety indicators |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Code** | **CSI** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017\*** |
| **R01** | Total number of train km | 141,329 | 140,339 | 140,4329 | 145,62 | 148,4026 | 148,4974 | 152,6565 | 157 |
| **R04** | Number of other train km | 6,28 | 0 |   |   | 0 | 0 | 0 | 0 |
| **R05** | Number of passenger train km | 94,407 | 96,975 | 100,8012 | 107,794 | 111,371 | 113,0791 | 116,9347 | 120,111 |
| **R06** | Number of freight train km | 40,642 | 43,364 | 39,63169 | 37,826 | 37,03164 | 35,41826 | 35,72183 | 36,469 |
| **R02** | Number of passenger km | 11036 | 11434 | 11530 | 11587 | 11868 | 12490 | 12520 | 13130 |
| **R07** | Number of freight tonne km | 23464 | 22705 | 22000 | 20700 | 21300 | 20600 | 21400 | 21800 |
| **R03** | Number of track kilometres | 15347 | 15601 | 14739 | 14510 | 14511 | 14392 | 14373 | 14459 |
| **R08** | Number of line kilometres | 11066 | 11206 | 9944 | 9765 | 9689 | 9716 | 9684 | 9676 |
|  |   |   |   |   |   |   |   |   |   |
| **T01** | Percentage of tracks with Automatic Train Protection (ATP) in operation | 65,5 | 81,16 | 81,95 | 81,95 | 84,33 |   |   | 81% |
| **T02** | Percentage of train kilometres using operational ATP systems | 96,61 | 96,44 | 96,44 | 96,44 | 96,44 |   |   | 98,00% |
|  |   |   |   |   |   |   |   |   |   |
| **T03** | Total number of active and passive level crossings | 11370 | 8730 | 8616 | 8221 | 7892 | 6630 | 6609 | 6980 |
| **T06** | Total number of active level crossings | 3334 | 3244 | 3282 | 3192 | 3080 | 3051 | 3030 | 3196 |
| **T07** | Total number of active level crossings with automatic user-side warning | 918 | 843 | 836 | 803 | 753 | 752 | 702 | 739 |
| **T08** | Total number of active level crossings with automatic user-side protection | 31 | 9 | 11 | 10 | 12 | 0 | 0 | 0 |
| **T081** | Total number of active level crossings with automatic with user side protection |   |   |   |   | 12 | 2146 | 2173 | 2313 |
| **T09** | Total number of active level crossings with automatic user-side protection and warning | 2280 | 2196 | 2215 | 2197 | 2154 | 0 | 0 | 0 |
| **T10** | Total number of active level crossings with automatic user-side protection and warning, and rail-side protection | 19 | 78 | 77 | 80 | 81 | 84 | 82 | 83 |
| **T11** | Total number of active level crossings with manual user-side warning | 62 | 87 | 87 | 68 | 55 | 0 | 0 | 0 |
| **T12** | Total number of active level crossings with manual user-side protection | 5 | 2 | 16 | 16 | 8 | 0 | 0 | 0 |
| **T13** | Total number of active level crossings with manual user-side protection and warning | 19 | 29 | 40 | 18 | 17 | 0 | 0 | 0 |
| **T14** | Total number of passive level crossings | 8036 | 5486 | 5334 | 5029 | 4812 | 3579 | 3579 | 3784 |
| **T15** | Total number of active level crossings - Manual |   |   |   |   | 80 | 69 | 73 | 61 |
|  |   |   |   |   |   |   |   |   |   |
| **I00** | Total number of precursors | 477 | 429 | 956 | 1137 | 1717 | 1330 | 1228 | 1085 |
| **I01** | Total precursors of accidents with broken rails | 62 | 55 | 34 | 53 | 39 | 73 | 67 | 53 |
| **I02** | Total precursors of accidents with track buckles and other track misalignments | 68 | 70 | 590 | 783 | 1422 | 1117 | 914 | 743 |
| **I03** | Total precursors of accidents with wrong-side signalling failures | 1 | 2 | 1 | 1 | 3 | 0 | 9 | 8 |
| **I04** | Total precursors of accidents with signals passed at danger | 341 | 297 | 328 | 298 | 249 | 140 | 233 | 280 |
| **I041** | Total precursors of accidents with signals passed at danger when passing a danger point |   |   |   |   |   | 44 | 11 | 24 |
| **I042** | Total precursors of accidents with signals passed at danger without passing a danger point |   |   |   |   |   | 96 | 222 | 256 |
| **I05** | Total precursors of accidents with broken wheels on rolling stock in service | 4 | 4 | 1 | 1 | 2 | 0 | 4 | 0 |
| **I06** | Total precursors of accidents with broken axles on rolling stock in service | 1 | 1 | 2 | 1 | 2 | 0 | 1 | 1 |
|  |   |   |   |   |   |   |   |   |   |
| **N00** | Total number of significant accidents | 69 | 54 | 47 | 43 | 53 | 40 | 36 | 40 |
| **N01** | Collisions of trains | 3 | 2 | 4 | 2 | 4 | 3 | 2 | 2 |
| **N011** | Collisions of train with rail vehicle |   |   |   |   | 2 | 0 | 1 | 0 |
| **N012** | Collisions of train with obstacle within the clearance gauge |   | 2 | 4 | 2 | 2 | 3 | 1 | 2 |
| **N02** | Derailments of trains | 7 | 7 | 10 | 9 | 10 | 3 | 3 | 4 |
| **N03** | Level-crossing accidents | 14 | 7 | 11 | 13 | 13 | 9 | 7 | 16 |
| **N031** | Level crossing accidents on passive LCs |   |   |   |   | 7 | 5 | 3 | 6 |
| **N032** | Level crossing accidents on manual LCs |   |   |   |   | 1 | 0 | 0 | 0 |
| **N033** | Level crossing accidents on LCs automatic with user-side warning |   |   |   |   | 1 | 2 | 0 | 2 |
| **N034** | Level crossing accidents on LCs automatic with user-side protection |   |   |   |   | 4 | 2 | 4 | 7 |
| **N035** | Level crossing accidents on rail-side protected LCs |   |   |   |   | 0 | 0 | 0 | 1 |
| **N04** | Accidents to persons | 38 | 28 | 14 | 16 | 17 | 16 | 15 | 11 |
| **N05** | Fires in rolling stock | 0 | 2 | 3 | 2 | 3 | 2 | 4 | 1 |
| **N06** | Other accidents | 7 | 8 | 5 | 1 | 6 | 7 | 5 | 6 |
| **N07** | Suicides | 68 | 62 | 82 | 90 | 77 | 86 | 69 | 50 |
| **N08** | Attempted suicides |   |   |   |   | 4 | 3 | 6 | 8 |
| **N18** | Total number of accidents involving at least one railway vehicle transporting dangerous goods | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 3 |
| **N19** | Accidents involving dangerous goods NOT released | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 3 |
| **N20** | Accidents involving dangerous goods which ARE released | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|  |   |   |   |   |   |   |   |   |   |
| **TK00** | Total number of persons killed in all accidents | 42 | 24 | 15 | 17 | 25 | 16 | 13 | 14 |
| **TS00** | Total number of persons seriously injured in all accidents | 25 | 15 | 18 | 17 | 9 | 12 | 11 | 12 |
| **LK00** | Total number of level-crossing users killed in all accidents | 7 | 7 | 7 | 7 | 9 | 6 | 5 | 4 |
| **LS00** | Total number of level-crossing users seriously injured in all accidents | 5 | 3 | 10 | 9 | 4 | 5 | 2 | 6 |
| **OK00** | Total number of other persons killed in all accidents | 0 | 0 | 2 | 0 | 1 | 0 | 2 | 0 |
| **OS00** | Total number of other persons seriously injured in all accidents | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 2 |
| **OKE00** | Total number of other persons not on platform killed |   |   |   |   | 1 | 0 | 2 | 0 |
| **OSE00** | Other persons not on platform seriously injured |   |   |   |   | 1 | 0 | 0 | 1 |
| **OKP00** | Total number of other persons on platform killed |   |   |   |   | 0 | 0 | 0 | 0 |
| **OSP00** | Other persons on platform seriously injured |   |   |   |   | 0 | 0 | 0 | 1 |
| **PK00** | Total number of passengers killed in all accidents | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **PS00** | Total number of passengers seriously injured in all accidents | 10 | 2 | 1 | 1 | 0 | 1 | 0 | 0 |
| **SK00** | Total number of employees killed in all accidents | 2 | 2 | 1 | 0 | 1 | 1 | 0 | 0 |
| **SS00** | Total number of employees or contractors seriously injured in all accidents | 5 | 2 | 0 | 0 | 1 | 1 | 4 | 2 |
| **UK00** | Total number of unauthorised persons killed in all accidents | 31 | 15 | 5 | 10 | 14 | 9 | 6 | 10 |
| **US00** | Total number of unauthorised persons seriously injured in all accidents | 5 | 8 | 6 | 7 | 3 | 5 | 5 | 2 |
|  |   |   |   |   |   |   |   |   |   |
| **C10** | Economic impact of significant accidents ONLY | 1,09E+08 | 66861848 | 43123975 | 53374621 |   | 61628859 | 50587775 | 48175076 |
| **C01** | Economic impact of fatalities | 98255164 | 56907840 | 36689400 | 46568629 | 68483278 | 45430368 | 37887826 | 41592743 |
| **C02** | Economic impact of serious injuries | 10896755 | 5198166 | 6434575 | 6805993 | 3603173 | 4979727 | 4685404 | 5199098 |
| **C13** | Cost of material damages to rolling stock or infrastructure for significant accidents |   | 4755842 |   |   |   | 11218764 | 6308859 | 1182705 |
| **C14** | Cost of delays as a consequence of significant accidents | 0 | 0 | 0 | 0 | 0 | 0 | 1705685 | 289512 |
| **C15** | Minutes of delays of passenger trains of significant accidents |   |   |   |   |   | 0 | 46560 | 9780 |
| **C16** | Minutes of delays of freight trains of significant accidents |   |   |   |   |   | 0 | 35160 | 5880 |
| **C17** | Cost of damage to the environment for significant accidents |   | 0 |   |   |   | 0 | 0 | 1017,38 |

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| Annex B | Changes in the regulatory framework |

| **Laws and other national rules** | **Legal reference** | **Date legislation entered into force** | **Description of change** | **Reason for the introduction/change** |
| --- | --- | --- | --- | --- |
| The Swedish Transport Agency’s regulations (TSFS 2017:65) rescinding the Swedish Railway Inspectorate’s regulations (BV-FS 2000:3) on training for staff whose work impacts traffic safety | Chapter 2, Section 5a of the Railway Act (2004:526). | 1 September 2017 | The Swedish Railway Inspectorate’s regulations (BV-FS 2000:3) on training for staff whose work impacts traffic safety were notified to the European Commission in accordance in accordance with Point 6 of Annex II to Directive 2004/49/EC. The regulations having been rescinded, there are no notified national safety provisions on training for staff whose work impacts traffic safety. | The respective technical specifications for interoperability (TSI) for subsystems set out the professional competence requirements referred to in Section 4.6. This, combined with the requirements of the Safety Management System (competence management system) replaces the requirements of the rescinded regulations.  |
| Regulations amending the Swedish Transport Agency’s regulations (TSFS 2011:60) on driver training, etc. in accordance with the Act (2011:725) on Authorisation for Train Drivers  | Section 8 of the Ordinance (2001:728) on Authorisation for Train Drivers | 1 May 2017 | Introduction of provisions concerning the language of the driver’s communication with the infrastructure manager. | Introduction of Directive (EU) 2016/882 amending Directive 2007/59/EU. |

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| --- | --- |
| Annex C | Results of safety recommendations and other safety activities |

Table 1: Safety-focused activities initiated by safety recommendations from the Swedish Accident Investigation Authority (SHK).

| **Safety recommendation** |
| --- |
| RJ 2017:03 R3.The Swedish Transport Agency was advised, within the framework of its oversight, to examine how the Swedish Transport Administration could use its safety management system to learn lessons from experiences regarding understanding of, providing training in, the functionality of and follow-up of the STEG planning and documentation system as highlighted in this report. |
| **Efforts occasioned by the recommendation** |
| This activity concerns oversight of the safety management system with respect to understanding of, training in, functionality of and follow-up of new technical systems that impact traffic safety.Oversight is scheduled for autumn 2018. |

Table 2: Safety improvements made by the Swedish Transport Agency and the industry beyond the recommendations from the Swedish Accident Investigation Authority

| **Area of focus** | **Cause of initiation** | **Safety measure(s) introduced** |
| --- | --- | --- |
| Legislation applicable to minor infrastructure managers | When reconsidering safety authorisations, we have become aware that many minor infrastructure managers are not fully aware of what is required of them and the rules applicable and which regulations apply to them. | The Swedish Transport Agency held some ten briefings at various locations throughout Sweden to raise awareness of the infrastructure managers’ obligations and the regulations they are expected to follow. |
| Safety culture | The fourth railway package and the rules introduced in connection with it require railway undertakings and infrastructure managers to promote a positive culture of safety in the organisation. | The Swedish Transport Agency has begun work to measure safety culture among authorisation holders. This matter was also addressed at safety conferences and briefings.  |
| Monitoring through measurable indicators of activity  | Supervision of railway undertakings has shown that Regulation (EU) No 1078/2010 on oversight of the safety management system has been difficult to implement in the undertakings. | The Swedish Transport Agency facilitated an industry meeting of railway undertakings for discussion and training with a view to increasing understanding regarding the introduction of measurable indicators in the undertaking. |
| National Cooperation Group (GNS) – railwayThe group is led by the Swedish Transport Administration. The Swedish Transport Agency takes part | Expert groups* Level crossings and collisions with persons
* Collisions, collisions with persons and derailments
* Work on track
 | GNS participants – railways decided jointly to terminate the group. The expert groups on traffic safety relocated to the Joint Risk Management Forum (FRI). |
| Forum to deal with common traffic safety risks (FRI)The forum is led by the Swedish Transport Administration | To satisfy, in an effective way, the need to (proactively) prevent and (reactively) deal with common traffic safety risks. | Focus groups to process common risks, including in the following areas:* traffic regulations
* signal passed at danger
* unauthorised track access.
* Safety in connection with activities in track area
* Safety at level crossings
 |
| National SPAD group (consisting of representatives from the Swedish Transport Administration and representatives from railway undertakings that are members of the Association of Swedish Train Operators, BTO) with a focus on unauthorised instances of SPAD. | The late 1990s saw increased understanding of the fact that unauthorised signals passed at danger (SPAD events) constitutes a risk of serious accidents such as collisions and derailments.The realisation that the ATC system is not comprehensive contributed to this, as did a number of serious accidents that occurred in the UK, Denmark and Norway.With this in mind, the Stockholm area undertook a pilot project of targeted work to jointly manage SPAD events. The procedures were later made permanent and extended throughout Sweden. For various reasons, however, commitment to joint work waned over time.In 2009, the Swedish Transport Administration and BTO carried out work by forming a joint analysis team tasked with reducing the number of SPAD events over the long term. | The long-term objectives of the SPAD work are:* to be able to detect and overcome systematic errors and thus reduce the number of SPAD events and reduce the risk of collisions and derailments
* to create a system of standardised investigation templates
* to create a coherent SPAD work function for the railway sector.

Among other things, the national SPAD group provides an overview of the signals most frequently passed at danger. The summary also includes any measures taken and planned. The latest compilation (2015-2017) is available on the Swedish Transport Administration’s website. |
| Securing of loads | For a number of years, there has been a lack of national rules governing securing loads in rail traffic. This is the result of liberalisation of the railways.  | The Association of Train Operators (BTO) started work in 2017 to come up with joint rules for securing loads. BTO created a model for managing the securing of loads. In practical terms, BTO created a group around the model involving hauliers, contractors working on railways and the Swedish Transport Administration. The purpose of the group is to coordinate and develop rules for securing loads.The resultant rules for securing loads were published on the BTO website. |

Table 3. Description of contributing factors from the Swedish Accident Investigation Authority’s railway investigations 2017.

| **Investigation** | **Type of precursor** | **Defect** | **Defective barrier** | **Description of defect** |
| --- | --- | --- | --- | --- |
| RJ2017:01 – Markaryd | Precursor: Accident to person: Authorised person on tracks | A | Work phase: Maintenance/track-side works: Request for protection | Maintenance work was taking place on the tracks with STH 100km/h and in darkness where A-protection should have been requested, but instead the work was being done with a train lookout. |
| RJ2017:01 – Markaryd | Precursor: Accident to person: Authorised person on tracks | B | Person: Role of responsibility | In the course of the maintenance work, the absence of the role of a protection and safety officer in situ to take charge of the safety of the technicians probably contributed to failure to implement A-protection. |
| RJ2017:01 – Markaryd | Precursor: Accident to person: Authorised person on tracks | C | Work phase: Preparation: Opening meeting:  | The risks involved in the maintenance work were not reviewed, and the technicians did not receive instruction on safety in situ. |
| RJ2017:01 – Markaryd | Precursor: Accident to person: Authorised person on tracks | D | Work phase: Maintenance/track-side works: Train lookout | A ‘train lookout’ was selected to protect the technicians, but it is unclear who was ultimately responsible for giving the warning. |
| RJ2017:01 – Markaryd | Precursor: Accident to person: Authorised person on tracks | E | Person: Culture: Inclination to report deviation:  | Given the level of skills of these technicians, the risks from A, B, C and D should have been obvious. The fact that they nevertheless accepted the work is indicative of tolerance for work-related risks. |
| RJ2017:02 – Västerås | Precursor: Collision:  | A | Subsystem: Infrastructure: Equipment on line: Signal installation | Experienced staff with local knowledge, without any health problems, failed to observe a stop signal. The investigation considers that the most reasonable explanation for this is that the signal was located where there were lots of competing and distracting stimuli from other light sources. |
| RJ2017:03 – Piteå-Arnemark | Precursor: Collision:  | A | Work phase: Controller: Stop signalling: Proceeding at stop | The train management misjudged a section as being unobstructed despite the fact that a vehicle had stopped there. Obstacle clearance control of the section did not conform to the requirements set out in TTJ 2015:0309:17:1. |
| RJ2017:03 – Piteå-Arnemark | Precursor: Collision:  | B | Subsystem: Communication: Signal control centre:  | The ARGUS train management system and the STEG planning system allow for incorrect information to be sent to the controller; accordingly, procedures must be created for the controller to interpret the information. |
| RJ2017:03 – Piteå-Arnemark | Precursor: Collision:  | C | Person: Culture: Inclination to take operational risks:  | The notification system and controller gave conflicting information to the controller. Despite being queried by a colleague, the controller chose to act on the information that would result in less restrictive movement. |
| RJ2017:03 – Piteå-Arnemark | Precursor: Collision:  | D | Person: Skills: :  | The controller was recently qualified, and a check after the event indicates that the controller was not prepared for the duties of the day. |
| RJ2017:03 – Piteå-Arnemark | Precursor: Collision:  | E | Analysis: Identification of defect: Risk assessment:  | When ARGUS and STEG were introduced, insufficient consideration was given to the major demands that these systems would present to beginners. |

| RJ2017:04 – Deje – Molkom | Precursor: Collision:  | A | Person: Culture: Inclination to take operational risks:  | The investigation finds that the driver probably wanted to complete the assistance task quickly in order to keep up with ordinary duties |
| --- | --- | --- | --- | --- |
| RJ2017:04 – Deje – Molkom | Precursor: Collision:  | B | Work phase: Rolling vehicle: Free movement of a train on a section of track: Auxiliary vehicle | The driver of the auxiliary vehicle had limited experience of the process. Among other things, the driver attempted to establish the exact position of the vehicle requiring assistance by contacting the driver (in order to be able to adjust speed and take care of the task promptly, according to A), which is prohibited according to TTJ 2015:0309 9M 5.15. |
| RJ2017:04 – Deje-Molkom | Precursor: Collision:  | C | Work phase: Rolling vehicle: Speed adjustment:  | The driver of the auxiliary vehicle did not adjust speed to match the requirements of the situation, which was ‘full visibility speed’, i.e. maximum 40 km/h and considerably slower at the scene of the accident, where visibility was restricted. At the time of the accident, the speed before braking was 71 km/h, which is too fast, probably motivated by imprecise information obtained via B. |
| RJ2017:05 – Fångsjöbacken | Precursor: Collision:  | A | Work phase: Rolling vehicle: Signal and stop: Interaction with stop signal | The driver of the second vehicle failed to observe a stop signal, possibly because of strong light from the other direction at the signal point. |
| RJ2017:05 – Fångsjöbacken | Precursor: Collision:  | B | Work phase: Rolling vehicle: Response to deviation: ATC indication | The driver of the second vehicle did not respond to the audiovisual warning from the ATC panel after passing the stop signal. |
| RJ2017:05 – Fångsjöbacken | Precursor: Collision:  | C | Subsystem: Vehicle: Locomotive and motorised carriage:  | The second vehicle was old and its noise level in operation was so high that the driver had to wear hearing protection, which probably contributed to B. |
| RJ2017:05 – Fångsjöbacken | Precursor: Collision:  | D | Subsystem: Vehicle: Brake:  | Reduced braking performance due to a vehicle fault. |
| RJ2017:05 – Fångsjöbacken | Precursor: Collision:  | E | Work phase: Preparation: Setting up the vehicle system:  | The ATC setting for the brake value did not match the actual value (see D), which resulted in late initiation of automatic braking in relation to deceleration capacity. |
| RJ2017:05 – Fångsjöbacken | Precursor: Collision:  | F | Work phase: Rolling vehicle: Braking: Deceleration test | A routine deceleration test was not performed; D should probably have noticed this. If deceleration capacity cannot be checked, the restrictive ATC setting must be applied, which was not done in this case (see E). |
| RJ2017:05 – Fångsjöbacken | Precursor: Collision:  | G | Analysis: Identification of defect: :  | The factors in B-F indicate serious and recurrent operational failures that should have been noticed and remedied by means of a brake inspection, driver training and ATC control.  |