RSR

Railway Safety Regulator

State of Safety Report 2017/18

Table of contents

ABBRE	VIATIONS	4
CEO'S F	FOREWORD	6
EXECUT	TIVE SUMMARY	8
CHAPTE	ER 1: INTRODUCTION	13
1.1	Scope of the report	
1.2	Where the data comes from	14
1.3	How safety is analysed	14
1.4	Recorded harm	
1.5	Report structure	
1.6	Data cut-off	
CHAPTE	ER 2: RAILWAY SAFETY AND SECURITY OVERVIEW	19
2.1	Railway traffic volumes	
2.2	Railway safety and security	
2.3	Operational safety performance	
2.4	Persons affected by operational safety occurrences	
2.5	Security performance	
CHAPTE	ER 3: TRAIN COLLISIONS	
3.1	Safety performance	
3.2	Collisions risk profile	
3.3	Collisions between rolling stock causality profile	
CHAPTE	ER 4: TRAIN DERAILMENTS	
4.1	Safety performance	
4.2	Derailments risk profile	
4.3	Derailments on running lines causality profile	
CHAPTE	ER 5: LEVEL CROSSING OCCURRENCES	41
5.1	Safety performance	43
5.2	Level crossing risk profile	
5.3	RSR interventions	

CHAPT	ER 6: PEOPLE STRUCK BY TRAINS DURING MOVEMENT OF ROLLING STOCK	49	
6.1	Safety performance	51	
6.2	People struck by trains risk profile	53	
6.3	RSR interventions	53	
CHAPTI	ER 7: PLATFORM-TRAIN INTERCHANGE OCCURRENCES		.55
7.1	Safety performance		
7.2	Risk profile for platform-train interchange occurrences		
7.3	RSR interventions	60	
CHAPTE	ER 8: SAFETY-RELATED SECURITY INCIDENTS		.61
8.1	Railway security performance		
8.2	Detailed analysis	64	
8.3	Injuries and fatalities	67	
8.4	Rapid Railway Police - South African Police Services	68	
APPENI	DIX A: STATE OF SAFETY INDUSTRY DIALOGUES		.71
APPENI	DIX B: RSR OPERATIONAL OCCURRENCE INTERVENTIONS		.79
APPENI	DIX C: SANS 3000-1 RAILWAY OCCURRENCE CATEGORIES		.83
APPENI	DIX D: SANS 3000 OPERATIONAL SAFETY OCCURRENCES (2015/16 - 2017/18)		.89
APPENI	DIX E: SANS 3000 FATALITIES AND INJURIES (2010/11 – 2017/18)		.95
APPEN	DIX F: APPLICATION OF FWI IN ASSESSING RAILWAY SAFETY RISKS		.99

Abbreviations

Act	National Railway Safety Regulator Act No 16 of 2002 (as amended)
ASoSR	Annual State of Safety Report
BOC	Bombela Operating Company
CAS	Crime Administration System
DoL	Department of Labour
DoT	Department of Transport
FWI	Fatalities and weighted injuries
FY	Financial Year
NIMS	National Information Monitoring System
PRASA	Passenger Rail Agency of South Africa
PSBT	People struck by trains
PTI	Platform-train interchange (colloquially referred to as interface)
RRP	Rapid Rail Police (a subdivision of the South African Police Services)
RSR	Railway Safety Regulator
RTMC	Road Traffic Management Corporation
SANS	South African National Standard
SANS 3000	South African National Standard for Railway Safety Management
SAPS	South African Police Service
SPAD	Signal Passed at Danger
тсо	Train Control Officer
TFR	Transnet Freight Rail

Foreword & Executive summary





CEO's Foreword



his has been a very difficult foreword to pen. It has been a tough year for the RSR, the rail industry and the economy in general. After taking a long hard look at this Report; feedback to the South African public by means of this Report is a mixed bag of achievements. As a Regulator with a mandate of improving and promoting railway safety, it is important that the achievements of the RSR are put into perspective in relation to this role.

This year's Annual State of Safety Report (ASoSR) differs from its predecessors in that it focuses on harm to persons (inclusive of the public, passengers and workforce) when analysing safety risk profiles to obtain a more holistic picture of the railway's safety performance. Harm in this Report is expressed as fatalities and weighted injuries (FWI) and inferences are made to the contributions of each railway safety operational occurrence category to the overall level of harm.

The RSR's vision of zero occurrences is a bold statement that requires not only the Regulator, but the industry in general to focus on risk assessment and management to reduce occurrences instead of only looking at compliance. To this end, the RSR has been focusing on five strategic focus areas in order to have a positive impact on the levels of safety in the rail industry. These focus areas have formed the basis of the RSR's strategic objectives and interventions since 2013/14, when the RSR redirected itself towards risk reduction, rather than focusing only on compliance and enforcement. The focus areas look at the top five operational occurrences, which if the industry works hand in hand to reduce them, would massively improve safety levels in our railways. To reduce the risks associated with the top five operational occurrences as reported in the annual State of Safety Report, it was important that risk management is strengthened at both the Regulator and operator level. The RSR, therefore, committed to safe railways and has subsequently invested a lot of time, resources and effort in the five priority areas, namely level crossings, people struck by trains, mainline derailments, mainline collisions between rolling stock and platform-train interchange occurrences.

The ASoSR for the 2017/18 FY shows successes in some areas, while others remain a cause for concern. All operational safety occurence categories, with the exception of people struck by trains during movement of rolling stock, showed an increase when compared with the 2016/17 FY. Despite this general increase in occurences, the overall harm expressed as FWI decreased when compared to the previous reporting period.

The occurrences and their related consequences remain a huge concern for the Regulator because they undermine efforts and collaboration between the RSR and operators to improve safety and the quality of service given to commuters. A further cause for concern was the continued identification of human factors as one of the leading root causes behind these occurrences.

While improvements in certain categories are encouraging, a lot more still needs to be done. Based on engagements with key role players in the industry, it is evident that challenges in the rail industry can only be addressed through the collective effort of all rail stakeholders.

The RSR is committed to driving collaboration between the railway industry and all interested and affected parties to find ways to ensure that railway safety remains the number one priority.

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Ms Tshepo Kgare Acting Chief Executive Officer

Executive summary

The RSR oversees railway safety in South Africa. In order to promote rail as the preferred mode of transport, the RSR ensures that all role players involved in the rail sector play their respective parts in creating a safe and reliable rail industry. Safety, as defined in the Act, means "the lack of railway occurrences, fatalities, injuries or damage within railway operations".

In compliance with Section 20 of the Act, the RSR annually produces a report on the state of safety of the South African railways. The ASoSR provides an analysis of operational occurrences and securityrelated incidents. This year's ASoSR differs from its predecessors in that it focuses on harm to persons (inclusive of the public, passengers and workforce) when developing safety risk profiles to obtain a more holistic picture of the railway's safety performance. This harm is expressed as fatalities and weighted injuries (FWI) and inferences are made to the contributions of each operational occurrence category to the overall level of harm.

The ASoSR incorporates data from the RSR's NIMS, the SAPS, occurrence and harm reports by passengers and members of the public via the RSR's Call Centre, and occurrence data received directly from railway operators. Although the scope of the ASoSR is predominantly confined to operational occurrences and safety-related security incidents in railway operations that are reported to the RSR, it has been extended to include fatalities and injuries (that is, harm) to the workforce, the public and train passengers.

When analysing collective risks and developing risk profiles of key focal occurrence categories (that is collisions, derailments, level crossings, people struck by trains and platform-train interchange occurrences), injuries of differing levels of seriousness have been combined into one composite measure. For the purpose of the present safety analysis, an approach has been used which is based on an established norm in risk analysis of transport modes. This composite measure is termed "fatalities and weighted injuries" or FWI, abbreviated.

FWI is calculated using the following formula: [number of fatalities] + 0.1 x [number of injuries]. It should be noted that this derivation of harm does not correspond with that used within the European Union member states where harm is expressed as fatalities and weighted serious injuries (FWSI). This is because the RSR's occurrence reporting framework does not differentiate between degrees of injuries. Also, in compliance with the definition of safety set forward in



the Act, the RSR's focus is delimited to reporting on trends, causality and interventions pertaining to railway safety occurrences, fatalities and injuries and not exclusively on fatalities and severely injured persons (as per the FWSI index).

Understanding the overall profile of risk on the railway helps with its management by enabling focus to be given to areas that are identified as priority. When calculating the overall railway risk profile and that of individual key focal occurrence categories, injuries and fatalities data for the 2010/11-2017/18 period was used because this provided for a better estimation of risk due to the size of the data. This is especially important for those categories of operational occurrences that present with low frequency events that have high consequences.

The ASoSR 2016/17 sets the overall safety performance context by starting with an overview of railway safety performance. In compiling this overview, railway occurrence and consequence (fatalities and injuries) data was analysed to identify and understand key safety performance risks in the railway transport industry.

Overview

The Safety Overview indicates that security and safety occurrence data show increasing trends while traffic

volumes for each of the three major operators (TFR, PRASA and Bombela (Gautrain)) illustrate decreasing trends. In the case of security occurrences, the trend is obvious, in the case of safety occurrences, a trend can only be assumed. Of note, the increasing trend in operational occurrences is not reflected in all of the SANS occurrences categories.

With regard to the number of occurrences reported in 2017/18, the top five categories are: Collisions (1027) followed by fire (745 - 70% of which are attributed to veld fires), platform-train interchange occurrences (744), people struck by trains (588) and derailments (450). TFR contributed most to three of the aforementioned operational occurrence categories.

However, by examining the consequences of all the occurrences reported in 2017/18, the top five categories of concern were found to be: people struck by trains, (FWI = 367.4), platform-train interchange occurrences (FWI = 77.8), level crossing occurrences (FWI = 67.6), collisions (FWI = 41.2) and passengers travelling outside designated area of train (FWI = 39). PRASA was responsible for contributing most to three of the five mentioned operational occurrence categories.

In contrast to the number of occurrences, the consequences expressed as FWI clearly showed increasing trends since



2010/11. This trend is primarily due to significant increases in values for train passengers over the last three financial years. However, the safety overview indicates that the public is most at risk (that is, this group contributes for most financial years to more than 65% of the overall FWI value for 2010/11 - 2017/18).

The ASoSR 2017/18 then examined, in greater detail, the safety performance of the high consequence occurrence categories to better understand their risk profiles and where possible, causal factors. Here is a high level overview of the main findings from each occurrence category:

Collisions

This chapter focused on the safety risks related to collisions during movement of rolling stock (SANS occurrence Category A). Special attention was given to collisions between rolling stock on running lines [A-a] as this sub-category presented the greatest contribution (over 90%) to the overall harm associated with train collisions (2010/11 - 2017/18). Not surprisingly, the majority of risk was found to be borne by train passengers. Gauteng recorded the highest levels of harm. The risk profile for collisions between rolling stock on a running line shows that 44% of the occurrences did not result in injuries and fatalities. However, 31% of the occurrences resulted in one to nine injured persons and 10% were responsible for FWI greater than 10 (equals 10 fatalities or 100 injuries).

Derailments

This chapter covered safety risks pertaining to derailments during movement of rolling stock on a running line and during tippler activities (SANS Occurrence Category B). The 2017/18 FY witnessed a 17% increase in train derailments from 2016/17 with a concomitant increase in FWI by 67.4%. Though in a less significant manner than collisions, the analysis revealed that single occurrences with high consequences are able to drastically influence FWI values for derailments for any given financial year. Derailments of rolling stock on a running line accounted for the majority of fatalities and injuries recorded for the 2010/11-2017/18 reporting period thereby posing a risk to train passengers and the workforce. Gauteng (55%) and KwaZulu-Natal (17%) account for the majority of the consequences. The causes for derailments include theft and vandalism; poor maintenance of rolling stock wheels; and the incorrect setting of points.





Level crossings

The chapter looked at the risks arising from train accidents at level crossings, and also examined the relationships between occurrence sub-categories and their respective consequences. For the 2017/18 FY, distinctions were made between train passengers, pedestrians and road vehicle users (that is, the public), and workforce (train drivers and assistants) to understand the risks borne by different road-rail user groups. Of the 34 fatalities at level crossings during 2017/18, 23.5% were road vehicle users and 6% were pedestrians. Train passenger fatalities contributed 70.5% to the total fatality record due to level crossing occurrences in 2017/18. The Geneva level crossing occurrence was responsible for 100% of the total passenger fatalities recorded during this period. The overall level of harm at level crossing occurrence not occurred, the overall level of harm at level crossings would have been 17.3 FWI.

People struck by trains

This chapter examined the safety risks related to people struck by trains and excluded pedestrian level crossing occurrence that are accounted for in the level crossings chapter. Inclusive in this occurrence category were members of the public, railway employees and railway contractors. Since the majority of risk was found to be borne by members of the public when interacting with a running line, the outcomes of the time-series (inclusive of time-of-day analysis and geographical distribution) and risk analysis primarily focused on those occurrences in which a member of the public is struck by rolling stock on a running line.

People struck by trains on running lines contributes the most to the overall number of fatalities caused by rail operations. The public accounted for 98.8% of the total fatalities and 98.4% of the total injuries reported in 2017/18 for this category of occurrences compared to the workforce (employees and contractors). Occurrences in this category decreased by 10% when comparing those reported in 2017/18 with 2016/17. Fatalities decreased by 17.1% and injuries increased by 1.7%. The overall level of harm for this occurrence category in 2017/18 was 367.4 expressed as FWI, compared to 438 FWI for 2016/17. Most of the people struck by train occurrences occur in Gauteng (33%), Western Cape (29%) and KwaZulu-Natal (26%). The analysis also revealed that the public is most at danger during the hours of 06h00-08h00 and 16h00-18h00.

Platform-train interchange

This chapter focused on those occurrences that occurred at the station/on the platform as passengers and workforce entrain and detrain stationary or moving trains. The total number of platform-train interchange occurrences recorded during the 2017/18 FY increased by 30% compared to 2016/17. Passengers accounted for 99.9% of the total fatalities and injuries reported in 2017/18. Only one occurrence per annum involved rail employees and/or contractors from 2015/16 to date. The overall level of harm for this occurrence category in 2017/18 was expressed as 77.8 FWI, compared to 66.5 FWI for 2016/17. Most of the platform-train interchange occurrences occurred in Gauteng (53%), Western Cape (22%) and KwaZulu-Natal (24%) for 2017/18. Passengers were found to be most at risk during the following peak travel hours: 06h00-08h00 and 16h00-20h00 and on Fridays.

Railway security

Railway security incidents reported to the RSR by railway operators and the SAPS were examined. The chapter focused on the most prevalent security concerns and provided a geographical overview of the overall harm arising from security related incidents. Due to the nature and format of reporting security incidents, neither risk analysis per rail user group nor risk profiles were calculated.

A high-level analysis of railway security data revealed that security incidents increased by 21.3% from 2016/17 to 2017/18. The theft of assets and malicious damage of property (vandalism) continue to plague the railway environment. Of all the operators, PRASA appears to be most affected by these incidents.

PRASA reported the most malicious damage to property (50%) in 2017/18. A significant proportion (73%) of personal safety at stations incidents occurred in Western

Cape with 42% of all the security-related incidents reported under this sub-category being cases of "assault". This province also recorded the greatest number of assault incidents for personal safety on trains in 2017/18.

The highest numbers of fatalities stemming from securityrelated incidents were recorded in KwaZulu-Natal (36%) and Western Cape (36%). Western Cape also recorded the highest number of security-related injuries (60%).

Railway safety interventions

Contained in Appendices A and B are detailed railway safety initiatives organised and undertaken by the RSR to address relevant risks associated with operational occurrences. These safety interventions pertain to industry dialogues led by the RSR, and public education and awareness campaigns:

In recognising the complex nature of railway safety risks, the RSR hosts annual industry dialogues on the outcomes of the ASoSRs at which the country's railways state of safety is discussed with all relevant rail stakeholders. Focal discussion areas include: derailments, collisions, level crossings, platform-train interchange occurrences and people struck by trains. To date, six industry dialogue sessions were held following the launch of the ASoSR on 20 November 2017. Tabulated in Appendix A are the resolutions adopted by industry in addressing some of the most urgent occurrence risk factors.

During the 2017/18 FY, various platforms were used to educate and create awareness among the RSR's diverse stakeholders with a special focus on the public, given that this group was found to be most at risk. These interventions (listed in Appendix B) included, among others, debate competitions and edutainment initiatives such as industrial theatre for schools and communities. These served to educate the public on rail safety, their responsibilities and how to approach railways without posing a danger to themselves and others.

Chapter 1 Introduction





Introduction

The ASoSR is a legislative requirement embodied in the Act and provides a range of safety-related information for railway operators, the general public and members of the broader railway industry, to assist in the management of railway safety.

Safety, as defined in the Act, means "the lack of railway occurrences, fatalities, injuries or damage within railway operations". The ASoSR is compiled in accordance with the RSR's mandate, that is, to oversee the safety of railway transport; to promote improved safety performance in order to promote the use of rail; and to monitor and ensure compliance with the Act.

The ASoSR incorporates data from the RSR's NIMS, the SAPS, occurrence and harm reports by passengers and members of the public via the RSR's Call Centre, and occurrence data received directly from railway operators.

The information contained in the ASoSR is also of use and interest to others, such as the media, those public bodies that are involved in the industry's funding and oversight, and those who use the railway, or who are employed by the rail industry.

The aim of the ASoSR is to support the rail industry in its aim to reduce the risks associated with railway operations that may impact on the safety of persons and property transported by railway. It is also to reduce the risks associated with the safety of other persons, other property and the environment, to levels as low as is reasonably practicable. It does this by providing insight into the state of railway safety by analysing the number and frequency of operational safety occurrences and security incidents, as well as their associated consequences and causes (where possible).

The RSR is the main source of railway safety statistics in South Africa, while the SAPS is the custodian of securityrelated statistics.

1.1 Scope of the report

The scope is predominantly focused on operational occurrences and security incidents connected with the railway operations that are reported to the RSR, but has been extended to include fatalities and injuries (that is, harm) to the workforce, the public and train passengers.

1.2 Where the data comes from

Most of the analyses in the ASoSR are based on operator-reported safety occurrences and security incidents. These are supplemented, where appropriate, with data from other sources, such as the SAPS, the general public and media reports.

The analysis in this report is based on occurrence data from the 2010/11 FY and includes events up to and including 31 March 2018. Due to the different data sources and the related quality of the data, the analysis of the data cannot be extended to the entire dataset, that is, that which spans the 2010/11-2017/18 reporting period for each occurrence category. In such cases, the focus is delimited to the 2015/16-2017/18 reporting period.

1.3 How safety is analysed

The RSR collects a vast amount of safety-related information during each year: more than 4478 operational occurrence records were analysed in 2017/18. Each occurrence record contains information on the type of occurrence and their respective consequences (that is, injuries and fatalities), short descriptions pertaining to the occurrences and the network and train operators involved in these occurrences. This allows for detailed analysis to be carried out by examining trends and, where possible, identifying the causes of occurrences and their respective consequences.

When analysing collective risks, injuries of differing levels of seriousness have to be combined into one composite measure. For the purpose of the present safety analysis, an approach has been used which is based on an established norm in risk analysis of transport modes and is used extensively in international railway safety performance analysis and reporting. The composite measure is termed "fatalities and weighted injuries" (FWI) in this Report or "fatalities and weighted serious injuries" (FWSI) in most international safety performance reports.

1.3.1 Defining risk

Dealing with risk first requires defining some of the technical terms to create a common understanding. The use of terms in this Report is based on the ISO/IEC Guide 73 "Vocabulary – Guidelines for Use in Standards" and ISO/IEC Guide 51 "Safety Aspects – Guidelines for their inclusion in standards", which is to be applied to safety-related standards. In general, risks can be of a different nature, e.g. political, financial, technical or medical and can either be positive or negative. In the context of this Report, risk is only a transport safety issue. Hence, the more safety specific definitions of risk-related terms in ISO/IEC Guide 51 are preferred.

Risk is mathematically expressed as a combination of the probability of occurrence of harm and the severity (consequences) of harm ("combination" typically means "product"). Note that in case of using the definition of risk simply as the product of probability and harm, one may obtain the same risk value from a high probability – low harm event as from a low probability - high harm event.

Harm is generally defined as physical injury or damage to the health of human beings, or damage to property or the environment.

Risk assessment is the overall process of risk analysis and risk evaluation. The use of FWIs/FWSIs in the assessment of railway safety risks is substantiated in Appendix F.

1.3.2 Methodology for calculating FWIs

The RSR developed and implemented a Common Safety Method for Conformity Assessment (CSM CA) in the 2017/18 Financial Year; and is in the process of developing a Common Safety Method for Risk Assessment (CSM RA) and a Common Safety Method on Supervision to enhance the Safety Management System. In its quest to harmonise railway safety among European Union (EU) member states, the European Railway Agency (ERA) developed, among others, the first set of common safety targets (CSTs) and the first set of common safety methods (CSMs) under Directive 2004/49/EC. The methodologies used to develop the set of the EU's CSMs has informed the design and development of the RSR's CSM CA. In order to assess risks and compute CSTs, FWIs/FWSIs have to be calculated (refer to Appendix F).

FWI, in this Report, is a **measurement** of the consequences of railway operational occurrences by combining fatalities and injuries into classes of harm where 1 injury (regardless of severity) is considered statistically equivalent to 0.1 fatalities. However, the European Union (EU) distinguishes between serious and slight injuries when measuring harm where 1 serious injury is considered statistically equivalent to 0.1 fatalities in the form of 'fatalities and serious weighted injuries expressed as FWSI'.

Understanding the overall profile of risk on the railway helps with its management by enabling focus to be given to areas that are identified as priority. When calculating the overall railway risk profile and that of individual key focal occurrence categories (that is, collisions, derailments, level crossings, people struck by trains and platform-train interchange occurrences), injuries and fatalities data for the 2010/11-2017/18 period was used because this provides for a better estimation of risk due to the size of the data. This is especially important for those categories of occurrences with low frequencies and high consequences.

1.4 Recorded harm

It is important to understand the limitations of recorded harm given the RSR's mandate and the public's requirement for safe rail transport. Whether railway safety is improving or not is normally a more complicated question to answer than by just looking at how recorded levels of harm have changed from one year to the next. Level crossing occurrences offer the most ready example of this effect; a year without an accident involving a collision between a passenger train and a bus or truck does not necessarily indicate an improvement in safety, and a year with such an accident does not necessarily imply a rise in risk. Answering the "better/worse" question normally involves looking at trends calculated over a longer period, considering how harm has changed in relation to other system factors such as usage (normalisation), and risk modelling.

1.5 Report structure

The **Safety Overview** chapter follows the introduction. It sets the overall context by analysing the railway occurrence and consequence (fatalities and injuries) data to identify and understand the safety performance in the railway industry. It makes use of time series analyses of railway occurrences and consequences to provide an overview of the high-level trends and risk profiles in passenger, public and workforce safety performance. The available data does not make provision for a detailed analysis of damage to property per occurrence category, hence the risk profiles have been restricted to expressing harm to persons in the form of FWI.

The chapters following the Safety Overview are divided into the following main occurrence categories where industry has committed to work together in support of improved operational safety management: Collisions; derailments; level crossings; people struck by trains and platform-train interchange occurrences. Added to these main operational safety chapters is a chapter on railway security given the relationship between security and safety. The Act defines a threat to safety as "a hazardous condition, or behaviour, that could reasonably be expected to develop into a situation in which illness or injury to, or death of, a person could occur or in which damage could be caused to the environment or property, and a threat to safety is immediate if such a situation already exists".

The **Collisions** chapter focuses on the safety risks related to collisions during movement of rolling stock (SANS Occurrence Category A). Special attention is given to collisions between rolling stock on running lines [A-a] as this sub-category presents the greatest overall risk. Running line refers to main line including crossing loops between stations or terminals, or both, and excludes service lines, sidings and private sidings. Since the majority of risk is borne by train passengers, the risk analysis primarily focused on collisions between rolling stock.

The **Derailments** chapter covers safety risks pertaining to derailments during movement of rolling stock on a running line and during tippler activities (SANS Occurrence Category B). The chapter also presents information on the risk presented to passengers and the public. Included in this analysis are risks to the train crew and contractors when they are on or about the track and engaged in activities related to the movement of trains.

The Level Crossings chapter looks at the risks arising from train accidents at level crossings, and also examines the relationships between occurrence sub-categories and their respective consequences. Distinctions are made between train passengers, pedestrians and road vehicle users (that is, the public), and workforce (train drivers and assistants) for the 2017/18 FY to understand the risks borne by different road-rail user groups. The chapter also examines level crossing occurrence patterns using time series analysis (inclusive of seasonal variation and geographical distribution). A risk profile for level crossings illustrates the probability of harm of certain consequence class.

The **People Struck by Trains** chapter looks at the safety risks related to people struck by trains and excludes pedestrian level crossing occurrences as these are accounted for in the level crossings chapter. Inclusive in this occurrence category are members of the public, railway employees and railway contractors. Since the majority of risk is borne by members of the public when interacting with a running line, the outcomes of the time-series (inclusive of time-of-day analysis and geographical distribution) and risk analysis primarily focuses on those occurrences where a member of the public is struck by rolling stock on a running line.

The **Platform-Train** Interchange chapter focuses on those occurrences that occur at the station/on the platform as passengers and workforce entrain and detrain stationary or moving trains. It follows the same approach used to look at the safety risks related to people struck by trains. Since the majority of risk is borne by train passengers, the outcomes of the time-series (inclusive of time-of-day, day-of-week and geographical distribution analyses) and risk analysis primarily focuses on train passengers as opposed to the workforce.

The **Railway Security** chapter looks at the railway security incidents reported to the RSR by operators as well as those incidents recorded by the RRP. It examines the most prevalent security concerns and provides a geographical overview of the overall harm arising from security related incidents. Due to the nature and format of reporting security incidents, neither risk analysis per rail user group nor risk profiles can be calculated.

In addition, there are a number of appendices which include definitions of occurrence categories, the proceedings and outcomes of industry workgroups that were formed to identify and engage on key operational safety risk factors, and supporting data for the chapters.

1.6 Data cut-off

The data used in the ASoSR 2017/18 is based on the latest and most accurate and verified information available at the time of production. The data cut-off date for this Report was 30 April 2018.





Chapter 2 Railway safety & security overview





Railway safety and security overview

An overview of the state of railway safety provides a national indication of those variables that negatively affect railway safety (occurrences and security incidents) and their respective consequences in the form of harm to persons. Persons, in this context, refer to train passengers, pedestrians, road vehicle users and the railways workforce (that is, employees and contractors).

The South African railway industry comprises a number of railway operators that transport freight, raw material, dangerous goods, passengers and tourists. TFR, PRASA and BOC (trading as Gautrain) are the country's three largest operators. TFR primarily focuses on freight, with both PRASA and Gautrain dedicated to passenger transport. The Gautrain is the only standard gauge railway operator in South Africa. The other operators in the industry comprise:

· Cross-border operators from Botswana, Mozambique, and Swaziland entering South Africa in terms of access agreements

concluded with TFR as well as safety permits from the RSR;

- Municipal sidings and service lines that provide access from the national network to private sidings;
- Private siding operators from the agricultural, manufacturing as well as the petro-chemical sectors;
- Railway operators at the ports;
- Surface operators at mines; and
- Tourist operators.

2.1 Railway traffic volumes

Table 1: TFR, PRASA and Gautrain traffic volumes for 2010/11 – 2017/18

OPERATOR	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
TFR (million train km)	45,9	46,3	46	46,9	47,03	39,04	39,14	40,31
TFR (billion ton km)	117,9	126,5	132,4	134,6	144,7	138,4	143,46	151,53
PRASA (Million train km)	26,3	19,9	24,53	24,97	23,9	22,2	21,4	20,3
PRASA (million passenger km)	12 232	13 651	16 735	14 269	13 670	11 854	9872	*4499
Gautrain (million train km)	0,48	2,515	4,38	4,849	5,279	5,22	5,166	3,65
Gautrain (million passenger km)	0,46	2,312	3,988	4,35	4,68	4,628	4,58	3,24

* Quarters 3 & 4 data for Western Cape and Gauteng not included

Table 1 lists the traffic volumes for the period 2010/11 - 2017/18, as submitted to the RSR by TFR, PRASA and BOC. When examining the annual train kilometres per operator from 2010/11 to 2016/17, interesting trends for each of the operators are revealed.

For TFR, South Africa's major freight operator, Table 1 indicates a decreasing trend in million train km since 2010/11 from more than 45 million train km to just over 40 million train km in 2017/18. Though a minor increase in train kilometres was reported for the 2010/11 - 2014/15 period and again for 2016/17 - 2017/18 with a sharp decrease in activity in 2015/16, the overall performance is still below the initial 45 million train km recorded in 2010/11. In comparison, however, the billion-ton km trend shows a steady increase over the same review period with the greatest volumes recorded in 2017/18.

For PRASA, Table 1 reflects a decreasing trend in both the million train km and million passenger km since 2010/11, bearing in mind the underreporting of passenger kilometre data for the 2017/18 FY. PRASA has, however, confirmed that revenue obtained from ticket sales illustrated a decline when compared with the previous financial year thereby indicating an overall decline in passenger kilometres for 2017/18 when using revenue as a proxy for passenger traffic volumes.

Similarly, the Gautrain performance indicates a decrease in both million train km and million passenger km from 2015/16 to the current reporting year with the lowest activity recorded in 2017/18. This operator recorded the greatest variance in million train km when comparing the level of activity recorded in 2017/18 with 2016/17. This was attributed to the following reasons:

- A reduction in passenger carrying capacity during peak hours (7x8car trains were replaced with 6x8car trains);
- The optimisation of insertion and withdrawal of trains (all trains were withdrawn back to depots and reinserted back in the system in the afternoons); and
- The scaling down of the December month schedule due to a low demand in this month.

2.2 Railway safety and security

Railway occurrence data is classified into two broad categories; operational occurrences and security-related incidents as contained in SANS 3000-1 (2009). In terms of the Act, operational occurrences fall within the ambit of the RSR's oversight activities. The Act also instructs the RSR to play a supporting and advocacy role regarding security-related incidents. In this regard, the RSR monitors and supports the efforts of other organs of state (such as the SAPS and the Department of Labour) that share concurrent jurisdiction and mutual interests in addressing railway safety.

SANS 3000-1 stipulates the minimum requirements for the reporting of operational occurrences and securityrelated incidents. The Standard defines and classifies occurrences into categories to be used by railway operators when reporting to the RSR. These categories are further sub-divided into sub-categories for purposes of more detailed data analyses.

Operational occurrences are captured in 12 major categories [A-L] and security-related incidents into nine.

Table 2 provides an overview of the major operational occurrence and security-related incidents. A detailed listing is presented in Appendix C; it can also be found in SANS 3000-1 (2009) version 2, clauses 7.2 and 10.2 respectively.

OPERATIONAL OCCURRENCES							
CATEGORY	DESCRIPTION						
А	Collisions during movement of rolling stock						
В	Derailments during movement of rolling stock						
С	Unauthorised movements including rolling stock movements exceeding limit of authority						
D	Level crossing occurrences						
E	People struck by trains during movement of rolling stock						
F	People-related occurrences: trains outside station platform areas or in section						
G	Passenger-related occurrences: travelling outside designated area of train						
Н	People-related occurrences: platform-train interchange						
I	People-related occurrences: station infrastructure						
J	Electric shock						
K	Spillage/leakage, explosion or loss of dangerous goods						
L	Fires						
	SECURITY-RELATED INCIDENTS						
1	Theft of assets (impacting on operational safety)						
2	Malicious damage (vandalism) to property						
3	Threats (to operational safety)						
4	Hijacking of trains						
5	Crowd-related occurrences						
6	Industrial action						
7	Personal safety on trains						
8	Personal safety at stations						
9	Personal safety outside platform area (including yards, sidings and depots)						



Figure 1: Overview of operational safety occurrences and security incidents for 2010/11 – 2017/18

Figure 1 indicates that a significant increase in security incidents reported over the last three financial years (2015/16 – 2017/18) was preceded by two years (2012/13 – 2013/14) of relatively lower incidents reported. The 2017/18 FY recorded the highest number of safety-related security incidents reported since 2010/11. Figure 1 also indicates that the number of security incidents always exceeds the number of operational safety occurrences with the exception of the 2012/13 FY. In contrast to the numbers of security incidents reported, those recorded for operational safety reveal that the highest number of operational occurrences occurred in the 2017/18 FY. No definitive trend for operational occurrences can be observed for the reporting period. However, going forward, an increasing trend similar to that observed for security incidents cannot be excluded for operational occurrences given the decreasing trend in traffic volumes.

2.3 Operational safety performance

SANS 3000-1 (2009) defines operational safety as "the lack of railway occurrences, fatalities, injuries or damage within railway operations". Operational occurrences occur as a result of unsafe or systemic faults within railway operations. Table 3 illustrates all the operational safety occurrences reported for 2013/14 to 2017/18 per the major SANS reporting categories. For the 2017/18 FY, Table 3 also highlights the occurrence contributions from the two major railway operators – TFR and PRASA, and illustrates the differences in occurrences reported for the 2016/17 FY.

Table 3: Overview of operational safety occurrences for 2013/14 – 2017/18

Reporting year	2013/14	2014/15	2015/16	2016/17	2017/18				
South African National Standards (SANS) Category	All	All	All	All	TFR	PRASA	Other	All	Variance
A: Collisions during movement of rolling stock	980	1059	1100	1006	921	45	61	1027	2%
B: Derailments during movement of rolling stock	718	592	420	386	234	42	174	450	17%
C: Unauthorised movements including rolling stock movements exceeding limit of authority	121	93	94	84	57	26	12	95	13%
D: Level crossing occurrences	119	109	87	119	94	19	13	126	6%
E: People struck by trains during movement of rolling stock	588	643	541	651	188	390	10	588	-10%
F: People-related occurrences: trains outside station platform areas or in section	209	338	337	325	2	163	4	169	-48%
G: Passenger-related occurrences: travelling outside designated area of train	94	163	131	140	0	160	0	160	14%
H: People related occurrences: platform-train interchange	715	612	658	573	0	733	11	744	30%
I: People related occurrences: station infrastructure	190	166	130	111	0	112	4	116	5%
J: Electric shock	35	34	27	30	9	35	2	46	53%
K: Spillage/leakage, explosion or loss of dangerous goods	250	265	223	209	212	0	0	212	1%
L: Fires	568	558	502	432	643	87	15	745	72%
TOTAL	4587	4632	4250	4066	2360	1812	306	4478	10%

As seen in Table 3, all operational occurrence categories with the exception of *People struck by trains* [E], and *People-related occurrences: trains outside station platform areas or in section* [F], demonstrate an increase in occurrence numbers compared to 2017/18. In the case of operational occurrence categories D, H, J and L, the highest values since 2013/14 are recorded for 2017/18. The 2017/18 FY saw a 10% increase in operational occurrences compared to that recorded for 2016/17.



Figure 2.1a: Operational occurrence categories with the most number of occurrences recorded for 2017/18

When examining the number of operational occurrences recorded for 2017/18, the following five categories showed the highest values in descending order: A, L, H, E, B (refer to figure 2.1a). TFR contributed the most to three of these five categories: collisions, derailments and fires. Of importance, veld fires contributed approximately 70% to all the occurrences in this category [L]. However, a different picture emerges when the consequences of the occurrences expressed as FWI are considered (refer to figure 2.1b). The top five occurrence categories for FWI in descending order are as follows: E, H, D, A and G. PRASA, on the other hand, contributed the most to three of these five categories: People struck by trains [E], People-related occurrences: platform-train interchange [H] and Passenger-related occurrences: travelling outside designated area of train [G].



Figure 2.1b: FWI for each SANS operational occurrence category for 2017/18

When comparing 2017/18 with preceding financial years FWI, it is evident that the values of the SANS occurrence categories [E], [G], [H], [I] and [J] (in which PRASA had the highest contribution) do not display huge annual fluctuations in FWI whereas occurrence categories [A], [B] and [D] (dominated by contributions from TFR) display significant annual fluctuations (refer to figure 2.1c). The reason for this pattern is that collisions and derailments seldom have high consequences meaning that a single high consequence event can dominate any given financial year as evidenced and substantiated in the level crossings chapter (refer to sections 3.1 and 3.3). Harm (in the form of fatalities and/or injuries) arising from operational occurrence categories [E], [G], [H], [I] and [J] is almost always a given and will vary proportionately with the number of these types of occurrences.



Figure 2.1c: Relative contribution of SANS operational occurrence categories to FWI calculated for 2010/11 - 2017/18

Figure 2.1d illustrates how the FWI for all the SANS operational occurrence categories vary per geographical location. The big cities with high commuter traffic volumes, that is, Gauteng, KwaZulu-Natal and Western Cape, recorded the highest FWI values.



Figure 2.1d: Relative contribution of SANS categories to FWI for 2015/16 - 2017/18

2.4 Persons affected by operational safety occurrences

Figure 2.2 illustrates FWI for 2010/11-2017/18 and reveals an increasing trend for this period. Of concern is the slight decreasing trend in traffic volume (million train kilometres) for both PRASA Rail and TFR over the 2010/11-2017/18 reporting period. The increase in FWI can, therefore, not be explained by increases in transport volumes. A decrease in rail activity is normally associated with a decrease in FWIs. The inverse of this norm is cause for concern. In the following sections, the persons affected by operational safety occurrences will be analysed in greater detail.



Figure 2.2: FWI for the 2010/11 - 2017/18 reporting period

2.4.1 Passenger¹ safety

Around 4 502.24 million passenger kilometres were recorded for 2017/18. This figure represents a decrease in rail passenger activity by 54.4% when compared to the previous financial year. Figure 2.3a illustrates the calculation for passenger FWI for the 2010/11-2017/18 reporting period. An increasing trend in passenger FWI can be observed for this period. Passenger FWI contributes approximately 28% to the overall FWI represented in Figure 2.2. Prior to the 2015/16 FY, the contribution of passenger FWI to the overall FWI was between 20-25%. Since 2015/16, the relative contribution of passenger FWI increased by 33-40% thereby making the increase in passenger FWI responsible for the increase in the overall FWI. Figure 2.3a also illustrates that the greatest harm to passengers was recorded in the 2015/16 FY as opposed to the 2013/14 FY in which the least harm to passengers was recorded.

¹ SANS 3000-1, 2009 occurrence reporting categories were used to identify passenger harm: [A], [B], [F-a], [G], [H-a], [H-b], [I-b], [J-b] and [L] for the period 2015/16-2017/18; 2010/11-2014/15 reporting period used information from previous ASoSR



Figure 2.3a: Passenger FWI for 2010/11 - 2017/18

Of the passengers that were harmed as a result of operational occurrences during the 2010/11-2017/18 reporting period, 2% were fatalities (on average) and the remainder were injured persons. Figure 2.3b illustrates the distribution of the operational occurrences per passenger FWI class. In over 65% of all operational occurrences, there have been no recorded fatalities and injuries. In 33% of operational occurrences, there were no fatalities and one to nine injured passengers. However, operational occurrences associated with a very high number of fatalities and injuries have a significant probability of roughly 0.02%. This means that in a period of eight years, three occurrences with FWI values around 60 are likely to occur. This is due to the characteristics of collisions and derailments (refer to Chapters 3 and 4).



Figure 2.3b: Risk profile for passengers from 2010/11 to 2017/18

2.4.2 Workforce² safety

Figure 2.4 illustrates the calculation for workforce FWI for the 2010/11-2017/18 reporting period. The lowest FWI values for workforce harm were recorded in 2016/17 (6.4) and 2017/18 (8). It should be noted that the contribution of workforce harm to the overall FWI (reflected in Figure 2.2) is negligible. The proportion of fatalities vary strongly from one financial year to the next and this variance can be anywhere between 10-90%. The variance is dependent on the nature of the occurrence or the occurrence category.



Figure 2.4: Workforce FWI for 2010/11 - 2017/18

2.3.3 Public³ safety

Figure 2.5a illustrates the calculation for public FWI for the 2010/11-2017/18 reporting period. This figure illustrates that public FWI values vary year-on-year and show no visible trend. According to SANS 3000, a member of the public is anyone who is not employed by a network, train or station operator or is an employee of a network, train or station operator and who is not officially on duty. When comparing levels of train passenger harm with that of the workforce and the general public, Figure 2.5a reveals that the public is predisposed to the greatest harm arising from railway operations.

² The following SANS 3000-1, 2009 occurrence reporting categories were used to identify workforce harm: [E-b], [E-c], [E-e], [E-f], [F-b], [F-c], [H-c], [H-d], [H-e], [H-f], [I-c], [I-d], [I-e], [I-f], [J-b], [J-c], [J-e], [J-f], [J-h], [J-i], [J-k] and [J-I] for the period 2015/16-2017/18; 2010/11-2014/15 reporting period used information from previous ASoSR

³ The following SANS 3000-1, 2009 occurrence reporting categories were used to identify public harm: [D], [E-a], [E-d], [I-a], [J-a], [J-g] and [J-j] for the period 2015/16-2017/18; 2010/11-2014/15 reporting period used information from previous ASoSR



Figure 2.5a: Public FWI for 2010/11 - 2017/18

In contrast to train passengers and workforce, Figure 2.5b illustrates that there are always slightly more fatalities than injured persons. This is especially due to occurrence category [E] – People struck by trains during movement of rolling stock (refer to Chapter 6 for more detail).



Figure 2.5b: Risk profile for members of the public from 2010/11 to 2017/18

2.5 Security performance

The Act acknowledges that safety and security matters are interconnected and that the Regulator plays a supporting role in railway security. Risk profiles and FWI values for passenger, workforce and public harm have not been calculated for this sub-section because they do not provide any further insights into the nature and severity of the security-related incidents reported to the RSR. The information contained in Chapter 8 of this report provides a more comprehensive analysis in this regard.

Chapter 3 Train collisions





Train collisions

This chapter covers the safety risks related to collisions during movement of rolling stock (SANS Occurrence Category A). Special attention is given to collisions between rolling stock on running lines [A-a] as this sub-category presents the greatest overall risk. Running line refers to main line including crossing loops between stations or terminals, or both, and excludes service lines, sidings and private sidings.

The 2017/18 FY witnessed an increase of 1.6% in train collisions when compared to the previous financial year. However, the FWI value decreased by 58.2 % since 2016/17.

2017/18 Headlines

- The majority of risk emanating from train collisions is borne by train passengers.
- Collisions with an obstacle on a running line (including cattle, rocks, etc, colliding with rolling stock) contributes to 91% of all the train collisions (2010/11 – 2017/18)
- Collisions between rolling stock on a running line contributes most (89%) to the overall harm associated with train collisions (2010/11 – 2017/18). Gauteng province recorded the highest levels of harm.
- The risk profile for collisions between rolling stock on a running line shows that 44% of the occurrences did not result in injuries and fatalities. However, 31% of the occurrences resulted in 1 - 9 injured persons and 10% were responsible for FWIs greater than 10 (equals 10 fatalities or 100 injuries).

3.1 Safety performance



Figure 3.1a: Percentage distribution of train collisions per SANS sub-categories

Figure 3.1a illustrates how each of the SANS [A] sub-categories contribute (in percentage) to the total amount of collisions during movement of rolling stock recorded for the period 2010/11-2017/18. *Collisions with an obstacle on a running line (including road vehicles colliding with rolling stock)* contributed to 91% of all the train collisions that occurred during 2010/11 – 2017/18. *Collision of rolling stock other than on a running line* [A-d] and *collision of rolling stock with an obstruction other than on a running line* [A-e] together contributed to the overall number of the train collisions that occurred during the reporting period by 6%. *Collisions between rolling stock on a running line* [A-a] were responsible for only 1% of the total number of train collisions. However, when investigating which train collisions sub-category was responsible for the most harm during the reporting period, a very interesting picture emerged.

Figure 3.1b illustrates that *Collisions between rolling stock on a running line* [A-a] contributed most (89%) to the overall FWI for train collisions during the reporting period. *Collisions with an obstacle on a running line (including road vehicles colliding with rolling stock)* were responsible for 9.7% of the overall FWI and *Collision of rolling stock other than on a running line* contributed to the overall FWI by 1%. Thus, despite having contributed to only 1% of the total number of train collisions that occurred during 2010/11 -2017/18, *Collisions between rolling stock on a running line* were responsible for 89% of the injuries and fatalities reported during this period.



Figure 3.1b: Percentage contribution of each train collisions SANS sub-category to the overall FWI for train collisions for the 2010/11-2017/18 reporting period

Figure 3.1c shows the number of train collisions and their respective consequences (fatalities and injuries) for the 2010/11 to 2017/18 financial years. This figure indicates a slightly increasing trend in train collisions for the reporting period. Injuries arising from these occurrences fluctuate year-on-year and tend to be independent of the number of train collisions. Of note, fatalities arising from train collisions appear to be negligible with the exception of the 2011/12 (FWI = 118.2) and 2015/16 financial years (FWIs = 88.1). These anomalies are as a result of single events that dominated the dataset for the respective financial years. A single collision (on 20 May 2011 between Mzimhlophe and Phomolong) that resulted in 857 injured passengers was responsible for the high FWI value in 2011/12. The same could be observed for the 2015/16 FY during which a Metrorail collision with a taxi on a running line resulted in 15 fatalities.

Given that Figure 3.1b revealed that *Collisions between rolling stock on a running line* contributed most to the harm recorded during the reporting period, a more detailed analysis was conducted to understand how fatalities and injuries vary with the number of collisions between rolling stock on a running line for the 2011/10-2017/18 reporting period.



Figure 3.1c: Number of train collisions and related fatalities and injuries time series

As can be seen in Figure 3.1c, there was an exceptionally high number of injuries in the 2011/12 – 2012/13 and 2015/16 - 2017/18 financial years. These were as a result of train-on-train collisions. The 2011/12 FY recorded the greatest FWI value (118.2) and number of injuries (1162). Of note, the FWI values for the last three financial years correlated with the number of injuries reported during this period.

Figure 3.1d indicates that collisions between rolling stock on running lines that occurred in Gauteng during 2010/11 – 2017/18 reporting period contributed to 80% of the total FWI value. Twelve percent of the total FWI was attributed to train collisions in KwaZulu-Natal and 5% to Eastern Cape.



Figure 3.1d: Geographical distribution of the FWI calculated for train collisions for the 2010/11 – 2017/18 reporting period

3.2 Collisions risk profile

Figure 3.2 shows the risk profile for collisions between rolling stock on running line (SANS subcategory A-a). As already mentioned, this subcategory contributes to 92% of the total FWI that was calculated for collisions during movement of rolling stock. For the risk profile, the probabilities of the different consequence classes that are expressed as FWI were calculated on the basis of the reported occurrences for the 2010/11 – 2017/18 reporting period.



Figure 3.2: Risk profile for collisions between rolling stock on running line

Figure 3.2 reveals that for 44% of train collisions, no injuries or fatalities were recorded. For 31% 1 - 9 injured persons were recorded. However, train collisions with FWI values over 10 (equals 10 fatalities or 100 injuries) are responsible for 10% of these occurrences. Hence, these occurrences, though rather seldom, have a significant influence on the time series of consequences of all SANS Category A occurrences - collisions during movement of rolling stock.

3.3 Collisions between rolling stock causality profile

Major train-on-train collisions that were investigated by the RSR in 2017/18 revealed that poor maintenance of infrastructure and the failure of signalling systems lead to some of the collisions. Failure of signalling systems were as a result of theft and vandalism (refer to Chapter 8 for more detail regarding these security incidents) which led to prolonged abnormal working for the authorisation of trains. The investigations also revealed that some of the collisions that occurred under abnormal working conditions were due to TCOs and train crew failing to adhere to operating procedures.

The railway industry experienced collisions between rolling stock due to improper handover processes during shift changeovers that led to the authorisations of trains into an already occupied sections. Another factor that contributed to train collisions is the significant vacancy rates in safety critical grade categories. It was also found that there was sometimes poor supervision or a lack of supervision which resulted in employees operating trains unsafely.

To prevent the recurrence of train collisions in future, infrastructure including signalling equipment must be maintained in accordance with the applicable safety standard and vacancies in safety critical grades should be filled.
Chapter 4 Train derailments





Train derailments

This chapter covers the safety risks pertaining to derailments during movement of rolling stock on a running line and during tippler activities (SANS Occurrence Category B). The chapter also presents information on the risk presented to passengers and the public. Included in this analysis are risks to the train crew and contractors when they are on or about the track and engaged in activities related to the movement of trains.

2017/18 Headlines

- The 2017/18 FY witnessed a 17% increase in train derailments from 2016/17 with a concomitant increase in FWI by 67.4%.
- Unlike collisions, no single occurrences with high consequences influenced the FWI values for derailments despite a spike in the number of injuries recorded for the 2015/16 FY.
- Derailment of rolling stock on a running line accounted for the majority of fatalities and injuries recorded for the 2010/11-2017/18 reporting period.
- Gauteng (55%) and KwaZulu-Natal (17%) account for the majority of the consequences.
- For over 96% of all derailments on running lines, no injuries or fatalities are recorded.
- Root causes for derailments include theft and vandalism; poor maintenance of rolling stock wheels; and the incorrect setting of points.

4.1 Safety performance

Figure 4.1a depicts the number of train derailments and their respective consequences (fatalities and injuries) for the 2010/11 to 2017/18 reporting period. This figure indicates a decreasing trend for the number of occurrences during 2010/11 - 2016/17 with an increase recorded for 2017/18. The number of reported injuries show a similar pattern with the exception of 2015/16. The FWI value for the 2015/16 FY increased as a result of this spike in the number of injuries (116% increase compared to 2014/15). Contrary to the collision data (refer to subsection 3.1 of Chapter 3), no single derailment occurrence was responsible for this spike in injuries.



Figure 4.1a: Number of train derailments and related fatalities and injuries time series

The derailment of rolling stock on a running line accounts for the majority of fatalities and injuries caused by derailments, despite its lower amount of occurrences compared to other sub-categories for the 2017/18 FY - *derailment of rolling* stock on a line other than a running line; and derailment during tippler action.

Figure 4.1b shows the relative distribution of the consequences of derailments per province expressed as FWI. Similar to Figure 3.1e in Chapter 3, Gauteng (55%) and KwaZulu-Natal (17%) account for the majority of the consequences.





4.2 Derailments risk profile



Figure 4.2a: Risk profile for collisions between rolling stock on running line

Figure 4.2a shows the risk profile for derailments on running lines (SANS Sub-category B-a). This sub-category contributed 84.4% to the total FWI of the SANS Category B (derailments during movement of rolling stock) for the period 2010/11 - 2017/18.

For the risk profile, the probabilities of different consequence classes that are expressed as FWI were calculated on the basis of the derailment occurrences reported during 2010/11 - 2017/18.

Figure 4.2a illustrates that for over 96% of all derailments on running lines, no injuries or fatalities are recorded. For 2.6%, 1 - 9 injured persons are recorded. However, similar to that of collisions, derailment occurrences with several fatalities or tens of injuries are probable, though the magnitude is clearly lower when compared with collisions. Hence, these occurrences, though seldom in nature, significantly influence the time series of consequences of the entire derailment category.

4.3 Derailments on running lines causality profile

RSR investigations into some of the major derailments that occurred in 2017/18 revealed the following root causes:

- Poor maintenance of rolling stock wheels: Rolling stock wheels have been one of the main causes of train derailments. Pre-trip inspections can be used to detect trains operating with excessive wheel wear.
- Theft and vandalism of the rail components: There have been instances in which railway fasteners were found to have been stolen from tracks and in other cases the rail was found to be cut at the point of derailment; and
- · Incorrect setting of points: Trains have entered crossing points that were incorrectly set.

The above causality factors were exacerbated by the lack of fitness for duty checks during sign on and off. The lack of fitness for duty checks has resulted in tired and fatigued employees, as well as employees that are under the influence of substances responsible for safety critical operational tasks. Fatigue is one of the main indications of the impact of the human factors issues in train operations. Supervision is one of the critical controls to ensure that employees in safety critical grades declare their fitness before commencing their duties. For this to work, operators require reliable alcohol testing machines; the filling of vacancies in safety critical grades; and conducting of task observations.

Chapter 5 Level crossing occurrences





Level crossing occurrences

This chapter covers the safety risks related to level crossings. The 2017/18 FY witnessed a slight increase in level crossing occurrences when compared to the previous financial year that explains the FWI differential of 52.8. Though the 2017/18 reporting period indicates that the majority of risk was borne by train passengers, road vehicle occupants were generally most affected by level crossing occurrences. This anomaly in the dataset was caused by a single event – a PRASA train collision with a lorry on the Geneva level crossing in Free State at which eight coaches and a locomotive derailed and five coaches caught fire resulting in 24 fatalities and 263 injuries.

2017/18 Headlines

- Of the 34 fatalities at level crossings during 2017/18, 23.5% were road vehicle users and 6% were pedestrians. Train passenger fatalities contributed to 70.5% of the total fatality record due to level crossing occurrences in 2017/18. The Geneva level crossing occurrence was responsible for 100% of the total passenger fatalities recorded during this period.
- Of the 336 injuries at level crossings during 2017/18, 13.7% were road vehicle users, 3.3% were train drivers/ assistants, 0.9% were pedestrians and 78.6% were train passengers. The remainder were unclassified.
- Of the total train passenger injuries recorded for level crossing occurrences in 2017/18, 99.6% were directly
 attributed to the Geneva level crossing occurrence.
- The overall level of harm at level crossings in 2017/18 was 67.6 FWI, compared to 14.8 FWI for 2016/17. Should the Geneva level crossing occurrence not have occurred, the overall level of harm at level crossings would have been 17.3 FWI.
- Most level crossing risk in 2017/18 arose from road user behaviour.
- Improving level crossing safety is a major focus for the rail industry. Provincial level crossing technical
 committees were established in 2015/16, with representatives from both the road and rail sectors to coordinate
 interventions identified to address the risks associated with pedestrian and road user behaviour, when
 interacting with level crossings.
- The RSR conducted a detailed behavioural intervention study in 2016/17 to better understand the behavioural
 risks of motorists, pedestrians and train drivers when interacting with level crossings. The study found that road
 vehicle users violating the law appeared to be the norm rather than the exception, thereby indicating the need
 for the development of a long-term systematic and systemic safety strategy for level crossings to bring about a
 positive cultural change.
- The RSR conducted railway safety promotion and awareness campaigns at nine high risk level crossings in 2017/18. Four safety education and awareness campaigns (in the form of school debates, back-to-school safety awareness and school education programmes) targeted schools where children used trains to commute to and from school.

5.1 Safety performance

Figure 5.1a depicts the number of level crossing occurrences and their respective consequences (fatalities and injuries) for the 2010/11 to 2017/18 financial years. This figure illustrates a decreasing trend in level crossing occurrences from 2010/11-2015/16. However, the last two financial years witnessed a steady increase in the frequency of level crossing occurrences. This variation in the overall trend for level crossing occurrences is evidenced in the following level crossing occurrence categories: *Collisions between rolling stock and road vehicle/s on a running line* (refer to Table 3).

As seen in figure 5.1a, there was an exceptionally high number of injuries in the 2010/11 (134) and 2017/18 (336) financial years. Of note, the number of fatalities resulting from level crossing occurrences were especially high for the 2010/11 (44), 2012/13 (38) and 2017/18 (34) financial years.



Figure 5.1a: Number of level crossing occurrences and related fatalities and injuries time series

A detailed analysis of the reported occurrences illustrated that single occurrence events with extraordinarily high consequences dominated the time series of consequences. Two accidents caused 11 fatalities and 41 injuries; on 31 July 2010 (three fatalities and 33 injuries) and on 25 August 2010 (eight fatalities and eight injuries). A single accident on 13 July 2012 between Impala and Hectorspruit, Mpumalanga caused 26 fatalities. On 4 January 2018, the level crossing accident at Geneva, Free State resulted in 24 fatalities and 263 injuries. In cases in which such high consequences were observed, the data indicated that a minibus or school bus was involved or that the train collided with a lorry that resulted in a derailment and fire (as seen in the Geneva level crossing occurrence). The nature of these accidents reveal that a decrease in level crossing occurrences will not necessarily result in a decrease in fatalities and injuries.

A more detailed analysis of the various level crossing occurrence categories that examined the relationships between occurrences and consequences indicated that most level crossing occurrences with substantial consequences occur on a running line and comprise of collisions between rolling stock and road vehicles (Figure 5.1b).



Figure 5.1b: Fatalities and injuries vs the number of level crossing occurrences involving collisions between rolling stock and road vehicle/s time series

When examining how the distribution of the level crossing occurrence data according to the seasons, the analysis revealed that the majority of occurrences (33%) tend to occur in the second quarter of the financial year – July to September; primarily during the months of July and August, typical winter months. The reason for this phenomenon is not known yet and will require a detailed investigation for meaningful interventions to be implemented.



Figure 5.1c: Quarterly distribution of level crossing occurrences

Table 5.1 indicates that for the 2015/16 – 2017/18 financial years, an increasing trend can be observed. This increase can be primarily attributed to the level crossing occurrences that took place in Western Cape and North West, with special reference to the 2017/18 FY. Gauteng contributed to the increasing trend to a minor degree.

When examining the distribution of occurrences by province for the 2015/16-2017/18 period, North West, KwaZulu-Natal, Western Cape and Gauteng contributed to over two-thirds of the total level crossing occurrence load.

PROVINCE	2015/16	2016/17	2017/18	Total
Eastern Cape	5	6	0	11
Free State	6	4	8	18
Gauteng	14	20	23	57
KwaZulu-Natal	11	22	18	51
Lesotho	0	0	0	0
Limpopo	5	5	6	16
Mpumalanga	10	20	9	39
North West	17	19	29	65
Northern Cape	4	3	3	10
Western Cape	15	20	30	65
Total	87	119	126	332

Table 5.1a: Level crossing occurrences by provinces for the period 2015/16 – 2017/18

5.2 Level crossing risk profile

Figure 5.2a shows the probabilities of different consequence classes that are expressed as FWI for level crossing occurrences. Each occurrence reported in the 2010/11 to 2017/18 financial years was attributed to a specific FWI-class, for example occurrences with no fatalities and/or injuries were assigned to the class 0, occurrences with 1 to 9 injuries to the class 0.1 - 0.9, and so forth. Regarding the level crossing risk profile, Figure 5.2a indicates that approximately two thirds of all occurrences will not result in harmed (injured or killed) persons. In almost 25% of the cases, it has to be expected that one or several persons will be injured. In over 6% of the cases, at least one fatally and two or more injured persons have to be expected. The probability that several persons will be fatally injured is slightly over 2%.







In the 2017/18 FY, the RSR investigated 15 level crossing occurrences in detail. Based on the findings of these investigations, root causes and contributing causes were determined. The results illustrated that in 13 of the cases investigated, the drivers of road vehicles were either not observing the road signage or were distracted or did not check whether a train is arriving or not. Only one case indicted that a technical failure (of the barrier) was a root cause. In all cases in which drivers of the road vehicles did not comply with the road signage or were not checking whether a train is in section, conditions of the road and reduced visibility of road signs due to overgrown vegetation (as an example) were contributing causes to the occurrences.

The results show, that in most cases, the behavior of the road vehicle driver is the root cause of the occurrence. However, factors such as insufficient maintenance of the road (including signs) and the vegetation contributed to the incorrect behaviors of road vehicle drivers.

5.3 RSR interventions

To address the risks associated with level crossing occurrences, the RSR initiated several interventions. Among these are the provincial level crossing technical committees that were established in 2015/16 and led by the RSR; a behavioural intervention study to understand the behavioural risks of motorists, pedestrians and train drivers when interacting with level crossings; and railway safety promotion and awareness interventions at high risk level crossings.

The behavioural intervention study was conducted in 2016/17 to identify the underlying causes of level crossing occurrences as a strategic intervention to inform both industry and RSR level crossing awareness and education initiatives. The study identified six common factors that contributes to level crossing occurrences:

- i. **Traffic characteristics:** Motorists drove primarily according to how other motorists drove. Pedestrians adjusted to the motorists, rather than the trains.
- ii. The road environment: Factors such as low visibility; the absence of dedicated pedestrian crossings; level crossings being part of major road junctions, poor maintenance on the level crossing equipment; inadequate signage as well as the distance to alternative crossing places, have all been evident as contributors to the at-risk behaviours observed.
- iii. **Subjective factors:** The combination of a lack of risk awareness and normalised violations defined how the railway lines were crossed irrespective of design, road traffic characteristics and volumes, and safety controls.
- iv. Education and understanding the law: The combination of insufficient education and law enforcement contributed to the behaviour observed at level crossings. The result was a lack of risk awareness and a propensity for motorists to violate road rules.
- v. **Socioeconomic and structural factors:** Socioeconomic and structural factors impact directly on road traffic volumes and the general road environment, creating conditions that lead to risk-prone behaviours.
- vi. **Culture:** The study indicated that the environmental conditions and structural factors did not support compliant behaviour, that factual knowledge and risk awareness were inadequate, and that the deterrents (whether positive reinforcement or punitive) were not strong enough. Road users violating the law appeared the norm rather than the exception. The fact that violations are the behavioural norm, indicates that this is a cultural issue.

Due to the variety of the causes and contributing factors of pedestrians' and motorists' behaviour at level crossings, a systems perspective was identified as a critical requirement for the development of safety intervention strategies. Behavioural changes can only be made by actively altering the weightings of the factors influencing decisions. Changing the prevailing culture via behavioural interventions is, therefore, dependent on a long-term level crossing strategy. Based on the key findings of the level crossing behavioural intervention study, the RSR identified the following interventions to address the risks the public is predisposed to when interacting with level crossings:

- Develop a systematic safety strategy for level crossings;
- Develop an education campaign targeting school children;
- Make provision for the inclusion of how to drive across a level crossing in the application of the K53 driver's test and the learner driver's test;
- Impose stricter fines for crossing level crossings illegally;
- Investigate why some motorists (with special attention to trucks near mines) stop at level crossings;
- Target role models (e.g. law enforcers) to set behavioural norms; and
- Develop traffic law requirements for pedestrians at level crossings.



Chapter 6 People struck by trains during movement of rolling stock





People struck by trains during movement of rolling stock

This chapter covers the safety risks related to people struck by trains and excludes pedestrian level crossing occurrences. Inclusive in this occurrence category are members of the public, railway employees and railway contractors. The occurrences in this category decreased by 10% compared to the previous financial year. This was accompanied by a substantial decrease in fatalities (17.1%) and a minor increase in injuries (0.4%). The majority of risk is borne by members of the public when interacting with a running line – this accounts for more than 95% of all the occurrences in this occurrence category. The focus of this chapter is, therefore, directed to occurrences in which a member of the public is struck by rolling stock on a running line.

2017/18 Headlines

- People struck by trains on running lines contributes the most to the overall number of fatalities caused by rail operations. The public accounted for 98.8% of the total fatalities and 98.4% of the total injuries reported in 2017/18 for this category of occurrences compared with the workforce (employees and contractors).
- Occurrences in this category decreased by 10% compared to those reported in 2016/17. Fatalities decreased by 17% whereas injuries increased by 0.4%.
- The overall level of harm for this occurrence category in 2017/18 was 359.9 expressed as FWI, compared to 456.3 FWI for 2016/17.
- Most of the people struck by trains occurrences occur in Gauteng (33%), Western Cape (29%) and KwaZulu-Natal (26%).
- The public is most at risk during the hours of 06h00-08h00 and 16h00-18h00.
- The RSR conducted six education and awareness campaigns in 2017/18. Four of these campaigns targeted schools where children used trains to commute to and from school. Railway safety was also promoted at six community events during 2017/18.
- To address potential risks to the workforce emanating from PSBT occurrences (such as post-traumatic stress disorder), the RSR investigated the psychological and physiological states of train crew (train drivers and assistants) who were involved in these occurrences.



6.1 Safety performance

Figure 6.1a illustrates the number of people struck by trains occurrences and their respective consequences (fatalities and injuries) for the 2010/11 to 2017/18 financial years. When examining this category of occurrences for this period, it is evident that no trend exists. The occurrences indicate strong annual fluctuations. However, Figure 6.1a does reveal that people struck by trains are most likely to result in fatalities. This observation is confirmed when calculating the probability of consequences arising from this type of an occurrence as evidenced in Fgure 6.2a. In contrast to most of the other safety operational occurrence categories, the harm (injury and/or fatality) tends to correlate with the number of people struck by trains.



Figure 6.1a: Number of people struck by trains occurrences and related fatalities and injuries time series

The three provinces that indicated the most harm resulting from the *People struck by trains during movement of rolling stock* occurrence category are as follows: Gauteng, Western Cape and KwaZulu-Natal. They collectively represented 88% of all the occurrences in this category for the 2017/18 FY. Figure 6.1b reveals that Gauteng reported the highest number of people struck by trains occurrences in 2017/18 (33%), followed by the Western Cape (29%) and KwaZulu-Natal (26%).





Figure 6.1b: Percentage distribution of people struck by trains occurrences by province for 2017/18

The time-of-day analysis indicates that the public is most at risk during 06h00-08h00 and 16h00-18h00. This is indicative of people going to work or school. The results suggest that this may be related to trespassing on the running line.



Figure 6.1c: 2017/18 Time-of-day analysis - People struck by train occurrences

6.2 People struck by trains risk profile



Figure 6.2a: Probability of consequence dimensions for people struck by train occurrences

Figure 6.2a shows the probabilities of different consequence classes that are expressed as FWI for people struck by trains. When compared with the risk profiles of other categories, for example level crossings (refer to section 5.2), the risk profile for people struck by trains exhibits a very different pattern. For Level crossings, most occurrences were attributed to the consequence class 0 (that is, no injuries, no fatalities). Each of the subsequent consequence classes showed an exponential decrease in numbers (see section 5.2a). In the case of people struck by trains, an opposite pattern is evident. The number of occurrences increases significantly, going from consequence class 0 to consequence class 1.0 - 1.9. This can be explained by the nature of the occurrences. Due to the high mechanical energy (weight and velocity of the train) and absence of a protective shell (such as a vehicle in the case of a collision between a train and a road vehicle on a level crossing), a person will, in most cases, be severely or fatally injured when struck by a train.

6.3 RSR interventions

Given the high number of fatalities and injuries recorded each year as a result of PSBT occurrences, the RSR investigated the psychological and physiological states of train crew (train drivers and assistants) who were involved in these occurrences. The extent to which the effects of PSBT occurrences manifest in train crew may significantly impact on safe railway operations and work performance in the medium- to long term. It was, therefore, deemed important to ensure that concurrent efforts are aimed at reducing PSBT occurrences and providing appropriate support to train crew to limit the effects and to reduce the impacts of these traumatic occurrences.

A review of operator's management of train crew's physiological health after PSBT occurrences indicated that provision was made for immediate medical and wellness assessments. However, deficiencies in the manner in which long term effects were being monitored and managed were identified, especially for risks associated with post-traumatic stress disorders (PTSD). Going forward, the following interventions will be undertaken to address the deficiencies that were identified:

- i. Operators should conduct detailed studies that can provide empirical data to be used to effectively manage the behavioural risks associated with PSBT occurrences;
- ii. Studies to identify risk factors associated with physiological and psychological PTSD patterns and trajectories (including lapsing-relapsing patterns or late-onset PTSD) should be conducted. The process of identifying risk factors has the potential for guiding early and effective interventions that may minimise the short and, particularly the long-term psychological consequences of PSBTs, which have been found to impose a greater risk than the short-term transient PTSD symptoms;
- iii. The control measures for PSBT-related personnel effects should be implemented with the aim of determining their effectiveness. This should include medical programmes and Employee Wellness Programmes (EWP), with a particular focus on the long-term effects on the personnel involved in PSBT occurrences, as well as those suffering recurrent PSBT exposure; and
- iv. A review of the medical and EWP programmes and general fitness for duty requirements following PSBT occurrences, should be based on the risks to personnel and the safety of operations.

Chapter 7 Platform-train interchange occurrences





Platform-train interchange occurrences

This chapter covers the safety risks related to PTI occurrences. The occurrences in this category increased by 30% compared to the number of occurrences reported in the 2016/17 FY. This was accompanied by a decrease in fatalities (63.6%) and an increase in injuries (32.8%). The majority of risk is borne by train passengers – this accounts for 99.9% of all the occurrences in this occurrence category.

2017/18 Headlines

- The total number of PTI occurrences recorded during the 2017/18 FY increased by 30% when compared to 2016/17. Passengers accounted for 99.9% of the total fatalities and injuries reported in 2017/18. Only one occurrence per annum involved rail employees and/or contractors from 2016/17 to date.
- PRASA Rail accounted for 98.5% and Shosholoza Meyl accounted for 1.5% of the total PTI occurrences reported in the 2017/18 FY.
- The overall level of harm for this occurrence category in 2017/18 was expressed as 77.6 FWI, compared to 65.5 FWI for 2016/17.
- Most of the PTI occurrences occurred in Gauteng (53%), Western Cape (22%) and KwaZulu-Natal (24%) for 2017/18.
- Passengers are most at risk during peak travel hours: 06h00-08h00 and 16h00-20h00 and on Fridays.
- To develop appropriate interventions to address PTI hazards and associated risks, the RSR undertook a study in 2016/17 to identify structural deficiencies between platforms and trains and to identify critical design aspects. This culminated in the development of anthropometric and biomechanical guidelines for application by railway operators to accommodate the entraining and detraining of persons with physical movement challenges such as the elderly, people with disabilities, pregnant women and children.
- The RSR conducted eight PTI safety awareness and education campaigns in 2017/18. Four of these campaigns targeted schools where children used trains to commute to and from school.

7.1 Safety performance

The PTI occurrences account for a significant number of occurrences recorded at train stations in South Africa. The total number of PTI occurrences recorded for 2017/18 was 744, representing an increase of 30% when compared to that recorded for the 2016/17 financial year. During the 2017/18 reporting, this category contributed to 16.6% of the overall recorded operational occurrences. The majority of these occurrences are attributed to PRASA, being the dominant passenger operator. PRASA is responsible for transporting more than 2 million passengers daily. PRASA accounted for 98.5% and Shosholoza Meyl accounted for 1.5% of the total PTI occurrences reported in the 2017/18 FY.



Figure 7.1a: Number of PTI occurrences and related fatalities and injuries time series

Figure 7.1a illustrates an increasing trend in which the number of injuries varies proportionally with the number of occurrences. During the 2017/18 reporting period, four fatalities and 737 injuries were reported as a result of PTI occurrences. The fatalities reported decreased by 60% compared to the 2016/17 reporting period as opposed to the number of injuries that increased by 32.6%.

7.1.1 Time of day analysis

The time of day analysis illustrated in Figure 7.1b indicates that most of the PTI occurrences tend to take place during the morning and afternoon peak hours. The morning peak times that recorded the highest number of occurrences is between 06h01-08h00 and 08h01-10h00 whereas the afternoon peak times is between 16h01-20h00. This pattern is indicative of overcrowding at stations during peak travel hours.





Figure 7.1b: Time-of-day frequency analysis for PTI occurrences

On examining the frequency with which these occurrences occur during the week, the analysis indicated that they were most likely to take place on Fridays. Further analysis of the data revealed a decrease in occurrences on Sundays. This pattern was also evident for the people struck by trains occurrence category. This analysis serves to confirm that overcrowding is a major contributing factor to this occurrence category.



Figure 7.1c: Day-of-week analysis for PTI occurrences

7.1.2 Provincial analysis

A further analysis of these occurrences was done in order to establish the provinces where these occurrences are taking place. Gauteng, KwaZulu-Natal and Western Cape are areas where a significant number of PTI occurrences were recorded in 2017/18. The country's major cities are located in these three provinces making this result quite evident. As in the case of people struck by trains, most of the PTI occurrences occur in Gauteng (53%). These are illustrated in figures 7.1d.



Figure 7.1d: Percentage distribution of PTI Occurrences by province for 2017/18

7.2 Risk profile for platform-train interchange occurrences

Figure 7.2a shows the probabilities of different consequence classes that are expressed as FWI for PTI occurrences. The risk profile of PTI occurrences is similar to that of people struck by trains. However, in contrast to people struck by trains, the reporting of this type of occurrence tends to be dependent on the severity of the injury as light injuries (for example shoulder graze) are seldom reported. The numbers of occurrences increases significantly from consequence class 0 to consequence class 0.9. In over 96% of all the reported PTI occurrences, at least one person was injured.



Figure 7.2a: Probability of consequence dimensions for PTI occurrences

7.3 RSR interventions

The RSR conducted a study in 2016/17 to identify existing structural deficiencies between platforms and the trains, and to identify critical design aspects of the PTI in order to develop anthropometric and biomechanical guidelines to be applied in train stations' design requirements. The anthropometric and biomechanical guidelines are applicable to railway technologies. The data collected at the train stations identified to have the highest PTI incidents in Gauteng, KZN and Western Cape regions showed that horizontal and vertical gaps between the platform floor level and the rolling stock entrance contributed to PTI occurrences. Also identified were the critical design aspects of the platform-train interchange.

Based on the outcomes of the study, the RSR developed anthropometric and biomechanical guidelines (applicable to any design requirement of South African railway facilities and technologies) to accommodate the entraining and detraining of persons with physical movement challenges such as the elderly, people with disabilities, pregnant women and children.

Chapter 8 Safety-related security incidents





Safety-related security incidents

This chapter covers the safety risks related to security incidents. Though security incidents are deemed criminal and primarily fall within the mandate of the SAPS and the Rapid Rail Police (RRP), safety and security are two interdependent concepts. When either is compromised, railway operations are most likely to be threatened.

2017/18 Headlines

- Security incidents increased by 21.3% in 2017/18 compared to the previous Financial Year.
- Theft of assets and malicious damage of property (vandalism) continue to plague the railway environment. Of all the operators, PRASA is most affected by these incidents.
- PRASA reported the most (50%) malicious damage to property in 2017/18.
- A significant proportion (73%) of personal safety at stations incidents occurred in Western Cape with 30.7% of all the security incidents reported under this sub-category being cases of "assault". This province also recorded the highest number of assault incidents for personal safety on trains in 2017/18.
- The highest numbers of fatalities stemming from security-related incidents were recorded in KwaZulu-Natal (36%) and Western Cape (36%). Western Cape also recorded the highest number of security injuries (60%).

8.1 Railway security performance

During 2017/18, the RSR recorded a total of 7 737 security incidents. This reflects a 21.3% increase compared to the total number of incidents reported to the RSR in 2016/17.



South African National Standards Category	2015/16	2016/17	2017/18
1: Theft of assets impacting on operational safety	3600	4379	4984
2: Malicious damage (vandalism) of property	1158	1162	1717
3: Threats of operational safety	2	0	*75
4: Train kidnapping or hijacking	0	0	0
5: Crowd-related incidents	0	0	13
6: Industrial action	1	8	25
7: Personal safety on trains	368	408	398
8: Personal safety at stations	305	312	401
9: Personal safety outside station platform area	86	109	124
TOTAL	5520	6378	7737

Table 8.1a: Security-related incidents recorded for 2015/16 - 2017/18

The time-series analysis of security incidents reflected in Table 8.1a indicates that the theft of assets and malicious damage (vandalism) of property continue to plague the railway environment. The former category contributed to 64.4% of all the security incidents recorded for 2017/18 whereas the latter contributed to 22.2% of the total load. Personal safety at stations accounted for 5.2% of the incidents recorded in 2017/18 and this was followed by personal safety on trains (5.1% of the total number of incidents). The percentage contribution towards these incidents by operators (with a special focus on TFR and PRASA is illustrated in Table 8.1b).

South African National Standards Category	TFR	PRASA	Other
1: Theft of assets impacting on operational safety	46%	54%	0%
2: Malicious damage (vandalism) to property	32%	50%	17%
3: Threats of operational safety	88%	*11%	1%
4: Train kidnapping or hijacking	0%	0%	0%
5: Crowd-related incidents	100%	0%	0%
6: Industrial action	80%	20%	0%
7: Personal safety on trains	2%	98%	0%
8: Personal safety at stations	4%	94%	1%
9: Personal safety outside station platform area	20%	79%	1%

Table 8.1b: Security incidents operator contribution (%) to the total number of incidents reported in 2017/18

* Incident data reported to the RSR under the SANS category Train kidnapping or hijacking has been recorded as Threats to operational safety in this Report, as the descriptions of the incidents pertained to threats to operational safety and not the SAPS definition of kidnapping and/or hijacking.

8.2 Detailed analysis

8.2.1 Theft of assets impacting on operational safety

During 2017/18, theft of assets accounted for 64% of the total recorded security incidents and increased by 13.8% compared to the 4 379 incidents recorded in 2016/17. A significant proportion (54%) of these incidents were recorded by PRASA.

Table 8.2a illustrates the 2017/18 distribution of *Theft of assets impacting on operational safety* by province. Indicated in this table is that a significant proportion of the recorded security incidents were found to have occurred in Gauteng, Western Cape and KwaZulu-Natal. This distribution pattern matches that observed for railway safety occurrence and FWI, that is, they are representative of the country's major cities where high commuter traffic volumes are evident.

Province	South African National Standards Theft of Assets Sub-Categories								Grand Total	
	*1-a	*1-b	*1-c	*1-d	*1-e	*1-f	*1-g	*1-h	*1-i	
Eastern Cape	1	0	5	0	1	0	38	0	5	50
Free State	2	2	8	0	5	0	57	6	4	84
Gauteng	165	195	325	17	270	14	1080	23	55	2 144
KwaZulu-Natal	34	16	71	4	60	7	574	8	19	793
Limpopo	1	0	12	4	45	1	15	2	2	82
Mpumalanga	20	30	18	1	131	4	226	11	16	457
North West	6	1	23	4	15	2	73	0	2	126
Northern Cape	1	2	2	1	1	1	52	2	4	66
Western Cape	321	80	159	5	31	3	539	13	31	1 182
Grand Total	551	326	623	36	559	32	2654	65	138	4 984

Table 8.2a: Distribution of Theft of assets impacting on operational safety by province for 2017/18

8.2.2 Malicious damage to property (vandalism)

Similar to the Theft of Assets Impacting on Operational Safety security incidents, PRASA Rail reported with the most malicious damage (50%) to property in 2017/18. Worth noting is that a significant proportion (17%) of operators other than TFR and PRASA Rail reported malicious damage to property in the same reporting period.

^{*} Refer to Appendix C for the description of the sub-categories

Province		South African National Standards Malicious Damage (Vandalism) to Property Sub-Categories							Grand Total	
	*2-a	*2-b	*2-с	*2-d	*2-е	* 2- f	*2-g	*2-h	*2-i	
Eastern Cape	2	0	2	0	2	0	6	0	5	17
Free State	1	1	1	0	0	0	12	0	0	15
Gauteng	167	85	69	30	51	0	180	2	7	591
KwaZulu-Natal	96	22	14	1	12	2	156	0	10	313
Limpopo	4	0	0	0	4	0	6	1	0	15
Mpumalanga	3	0	5	0	20	1	25	3	5	62
North West	3	0	7	0	3	0	8	0	3	24
Northern Cape	8	2	0	0	3	0	7	1	1	22
Western Cape	408	42	50	1	15	0	128	10	4	658
Grand Total	692	152	148	32	110	3	528	17	35	1717

Table 8.2b: Distribution of *malicious damage to property (vandalism)* per sub-category by province for 2017/18

Table 8.2b illustrates that a significant number of *malicious damage to property* incidents were recorded in Western Cape, followed by Gauteng and KwaZulu-Natal. The open nature of the railway network within the Republic may be a contributing factor in this case. Not surprisingly, a significant number of these incidents were recorded for the sub-category 2-a: "Malicious damage (vandalism) of rolling stock components in section" and sub-category 2-g: "Malicious damage (vandalism) of train control equipment (signaling) in section".

8.2.3 Personal safety at stations

Table 8.2c illustrates that 398 *Personal safety at stations* security incidents were recorded for 2017/18. A significant proportion (73%) of these incidents were found to have occurred in Western Cape with 30.7% of all the security incidents reported under this sub-category were cases of "assault" [7-d]. In Gauteng, "assault" incidents contributed 5% to the *Personal safety at stations* incidents, and 6% of the *Personal safety at stations* incidents were reported in KwaZulu-Natal.

* Refer to Appendix C for the description of the sub-categories

Province	South African National Standards Personal Safety at Stations Sub- Categories							Grand Total
	*7 - a	*7-b	*7-d	*7-f	*7-f	*7-g	*7-h	
Eastern Cape	0	0	2	0	0	0	0	2
Gauteng	0	1	20	19	1	13	1	55
KwaZulu-Natal	4	0	24	21	0	1	0	50
Western Cape	1	3	122	93	0	58	14	291
Grand Total	5	4	168	133	1	72	15	398

Table 8.2c: Distribution of personal safety on stations per sub-category by province for 2017/18

8.2.4 Personal safety on trains

Similar to the *Personal safety at stations* incident category, Table 8.2d indicates that assault appears to be a major problem on trains. Western Cape province recorded 83 such incidents [8-d] and Gauteng and KwaZulu-Natal reported 35 and 28 assault incidents respectively. Of concern is the single entry recorded in Mpumalanga where an employee was assaulted while performing railway duties. This is indicative of the unsafe nature of the railway environment.

Province	South Af	Grand Total					
	*8-a	*8-b	*8-d	*8-f	*8-g	*8-h	
Eastern Cape	0	0	0	2	0	0	2
Gauteng	3	5	39	35	13	2	97
KwaZulu-Natal	2	3	15	28	1	0	49
Limpopo	0	0	0	0	1	0	1
Mpumalanga	0	0	1	1	0	0	2
North West	0	0	0	1	0	0	1
Western Cape	4	3	83	92	52	15	249
Grand Total	9	11	138	159	67	17	401

Table 8.2d: Distribution of personal safety on trains per sub-category by province for 2017/18

* Refer to Appendix C for the description of the sub-categories

8.3 Injuries and fatalities

Figure 8 indicates that 22 fatalities and 552 injuries were recorded for security incidents in 2017/18. These figures are reflective of an increasing trend in fatalities and injuries since 2012/13.



Figure 8: Injuries and fatalities for safety security incidents for 2010/11 to 2017/18

When examining the provincial distribution of fatalities and injuries for 2017/18, the data indicates that the highest number of fatalities stemming from security incidents were recorded in KwaZulu-Natal (36%) and Western Cape (36%). Western Cape also recorded the highest number of security injuries (60%) followed by Gauteng (29%) of the total recorded injuries. The provincial distribution of security fatalities and injuries correlates with the assault incidents reported under the personal safety at stations and stations categories.

Province	Fatalities % contribution	Injuries % contribution
Eastern Cape	0%	1%
Free State	0%	0%
Gauteng	27%	29%
KwaZulu-Natal	36%	11%
Limpopo	0%	0%
Mpumalanga	0%	0%
North West	0%	0%
Northern Cape	0%	0%
Western Cape	36%	60%
Grand Total	100%	100%

Table 8.3: Fatalities and injuries as a result o	of security incidents for 2017/18
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8.4. The Rapid Rail Police – South African Police Services

The primary mandate of the RRP is to ensure that there is security within the railway environment. The RRP gathers security incident data through the Crime Administration System (CAS) via the national police stations located country-wide. Through the entries on the CAS system, the RRP gathers intelligence on the security challenges experienced within the railway environment. The RSR in association with the SAPS is committed to addressing security incidents within the railway environment.

The challenge currently experienced by both the RSR and RRP is that certain incidents are being reported to either the RSR or RRP depending on preference of the reporting parties. As a result, the total number of recorded incidents vary, but there are constant efforts in place to ensure that such discrepancies are managed.

The RRP annual statistics indicates the following RRP successes/arrests in deterring unsafe passenger behaviors [illustrated with *] that have the potential to compromise passenger and operational railway safety:

Crime Category: Contravention of the Legal Succession Act	2016/17	2017/18
Smoking in train	202	193
*Boards or leaves a moving train	269	115
*Keeps train doors open	105	42
*Travels between the coaches	151	23
Travel where not allowed (Metro-plus with Metro ticket)	2	17
*Performs an act that can injure or cause death or damage a train	2	25
*Illegally crosses the railway line	19 329	15 615
*Commits an act that hinders the operation / use of the train	0	0
*Removes from or put objects on the tracks	36	0
*Hawking without authority	18	10
*Allows / drives animals into rail reserve	0	0
Completes train trip without ticket / does not produce one on request	9	7
Travel without a valid train ticket	3 728	3 627
**Cable theft	2 686	2 826
**Theft infrastructure	635	934
Total	27 172	23 434

Table 8.4a: RRP 2016/17 and 2017/18 successes (arrests) in the railway environment

** Crime category: Other serious crimes

Table 8.4a indicates a general decrease in arrests made for all the sub-categories pertaining to the Contravention of the Legal Succession Act when comparing the current reporting period with the previous financial year. However, more arrests for cable theft and infrastructure theft were executed in 2017/18 when compared with the previous financial year. Despite this success, cable theft and theft of infrastructure remain a serious concern as they were indicated as root causes for collisions between rolling stock as well as derailments on running lines.

Table 8.4b: RRP 2016/17 and 2017/18 successes (arrests) pertaining to personal safety in the railway environment

Crime Category: Crimes against the person	2016/17	2017/18
Murder (including farm murders)	73	67
Attempted murders (including farm murders)	66	65
Sexual offenses (including rape and attempted rape and sexual assault)	79	94
Assault GBH	222	157
Common assault	304	236

Table 8.1a illustrates a general increase in the number of personal safety incidents reported since 2015/16. The greatest number of incidents reported in 2017/18 pertaining to personal safety relates to personal safety at stations (401), where assault was the major contributing factor in these incident reports. Table 8.4b indicates a decrease in the number of arrests made for assault cases when comparing 2017/18 with 2016/17. More arrests were made for sexual offenses in 2017/18 than in the previous reporting period.





Appendix A

State of safety industry dialogues





State of safety interventions

Annually, the RSR hosts an industry dialogue on the outcomes of ASoSR at which the country's railways state of safety is discussed with all relevant rail stakeholders, including operators, commuter forums, unions and the media. On 20 November 2017, the RSR launched the ASoSR 2016/17 and delegates gathered for the roundtables that focused on the RSR's five strategic focus areas, namely: derailments, collisions, level crossings, platform-train interchange occurrences and people struck by trains. The discussions focused on the main causes of the occurrences as well as potential solutions to minimise the occurrences.

It was widely recognised and accepted that a need exists for different structures to be established in the rail industry to discuss safety and to collaborate on reducing railway occurrences as well as provide railway safety education and awareness interventions. In order to establish such structures, all affected stakeholders within the railway industry, municipalities, government entities and communities should commit to working together and implement action plans that would address the risks associated with railway safety occurrences. As these problems are complex in nature, they need to be understood from multiple perspectives and require multi-disciplinary approaches and professional disciplines to address the risks associated with them.


To date, six industry dialogue sessions were held following the launch of the ASoSR 2016/17 on 20 November 2017. Tabulated below are the resolutions adopted by industry in addressing some of the most urgent occurrence risk factors.

The attendees took some time discussing issues of concern and proposed solutions to reduce occurrences for each topic as listed below:

Derailments

The identified issues of concern and proposed solutions for derailments are as follows:

ISSUES OF CONCERN	PROPOSED SOLUTION
Broken Rail (Inadequate Asset Monitoring)	
 Longitudinal stresses on the rail Position of defect (kick outs, slacks, rail crown defects, etc.) Frequency of ultrasonic testing Location of defects vs maintenance facilities Poor welding (quality, testing, training) Flat wheels 	 Risk based frequency of Infrastructure Monitoring and Interventions Internal Compliance Auditing Quality of work performed Independent verification
Structure Instability	
Adverse weather conditions	 Risk based frequency of Infrastructure Monitoring and Interventions Alerts from weather authorities to Industry Operation Control Centre proactive response Design for future changes in weather patterns
Human Error	
 Points not set correctly Unlocked points Half-cocked points (manually operated) Inadequate lubrication of points Inappropriate Train Handling (e.g. SPADS, non-adherence to speed limits, etc.) Errors in maintenance of railway assets (work force incompetence, workload, lack of supervision, etc.) 	 Training and Skills development Improved supervision Adequate management of employee fitness for duty Filling of safety related grades vacancies

ISSUES OF CONCERN	PROPOSED SOLUTION		
Theft and Vandalism			
 Socio-economic dynamics Porous/unsecured rail reserve boundaries Law enforcement (prosecution rate and conviction) 	 Utilisation of technology (e.g. drones) Improved Law Enforcement (punitive measures to be increased) Crime Intelligence (Railway Police capability) Early detection systems & target hardening. Use a low theft/resale value material 		
	Participation in the Non-Ferrous Theft Combating Committee		
Supply Chain Management			
Supply Chain Management challenges due to lack of continuity in leadership			

Level crossings

The identified issues of concern and proposed solutions for level crossings are as follows:

ISSUES OF CONCERN		PROPOSED SOLUTIONS	
Мо	torists behaviour		
•	Motorists do not stop at level crossings	•	Enforce stopping at level crossings
		•	Research "At Risk behaviour" of motorists at level crossings
		•	Facilitate claiming from the third party for the damages
Мо	torists driver licensing		
•	Current motorist driver licensing criteria does not in- clude level crossings education.	•	The practical evaluation to include driving over a level crossing and be simulated where it is not available
Ou	tdated Level Crossings and Increased Urbanisation		
•	Level crossings did not evolve as the traffic volumes increased	•	Develop a relationship between road authorities and infrastructure owners
		•	Railway stakeholders and road authorities must review the spatial planning with authorities enforcing the city by-laws
Le	vel Crossing elimination		
•	Ineffective controls for pedestrians and road vehicle users at high risk level crossings	•	Certain level crossings (i.e. high risk, inactive, underutilised) need to be prioritised for elimination
•	No comprehensive risk assessment conducted	•	Railway operators and authorities to assist with the closing
•	Inadequate funding	•	thereof Explore alternative means of eliminating level crossings
 Approach taken to eliminate did not achieve the intended results 	Approach taken to eliminate did not achieve the		protection
	•	Explore the feasibility of establishing a level crossing elimination fund to be administrate the fund	

ISSUES OF CONCERN	PROPOSED SOLUTIONS		
Maintenance (Inadequate Asset Monitoring)			
• Level crossing assets (booms, flashing lights, etc.) not constantly monitored	 Risk based monitoring and intervention on infrastructure and its surrounding 		
• Level crossing surrounding (signage, foliage, illegal structures, etc.) not regularly monitored			
Theft and vandalism			
Assets not protected against theft and vandalism	Utilisation of technology (e.g. drones)		
	 Improved Law Enforcement (punitive measures to be increased) 		
	Crime Intelligence (Railway Police capability)		
	Early detection systems & target reinforcement		
Visibility			
Trains are not visible on level crossings at night time.	 Implement visibility measures including artificial lighting, reflective markings, vegetation clearance, etc. 		

Platform train interchange (PTI)

The identified issues of concern and proposed solutions for platform-train interchange are as follows:

ISSUES OF CONCERN	PROPOSED SOLUTIONS		
Open loop regulation – Forward feed with	out any feedback on achieved success.		
 Impact of Standards and Regulations not being tracked. 	 Closed loop regulation: Introduce a feedback mechanism as a way of measuring how effective the introduced regulations are wrt Station/PTI Standards. 		
Lack of track maintenance (Station & Mainline)			
Dependency on outside interest for solutions	Owner's engineers to ensure interest of the owner		
Lack of proper asset register and no specification	 Full implementation of National Information Monitoring System (NIMS) Asset Management 		
	Deploy ISO 55000 (Asset Management)		
Old infrastructure and station buildings			
Heritage legislation	Better communication between the Heritage Body / RSR / Operator		

ISSUES OF CONCERN	PROPOSED SOLUTIONS		
 Outdated / Inadequate standards Outdated / Inadequate standards (e.g. track maintenance standard/manual last updated in 2000) 	Update the standards to manage human flow		
Equipment Failure			
 Train movement control (Signalling) Train schedule delays Outdated systems Late delivery of new projects Vandalism and theft Interoperability 	 Engineering specifications are not alive to the realities of the society Technological Interoperability 		
ОНТЕ			
Cable theftLine tensioners vandalismContact line to track centre vertical alignment	Introduction of a low theft value wireFixed track geometryA-grade maintenance of geometry track		
Communication			
Only available in station / platform	 On demand train information Integrate train movement to communications Mind the gap campaign 		
Telecommunication			
Cable theft and vandalism	In-cab signalling		
Rolling Stock			
Overcrowding	In country verification		
Train firesTrain delays	 Promote local technology (crowd control, ticketing, etc.) Involve the likes of Rail Road Association in discussions with SABS and other relevant bodies in an effort to avert economic sabotage, insecurity, etc. 		
Perway			
 In station geometry Mainline geometry Ineffective drainage Sink hole challenges Universal access 	 Fixed geometry track Fix temporary platform without occupation Work methods based on off-peak restoration A-grade maintenance of geometry track Focus on drainage – maintenance strategy Geotech strategy Best practice 		

ISSUES OF CONCERN	PROPOSED SOLUTIONS	
Fare Evasion		
No current commuter movement intelligence	 Mass video recording in stations Human density Loyalty program for self-reporting of location Engage private sector for loyalties / partnerships 	
Supply Chain Management		
Supply Chain Management challenges due to lack of continuity in leadership		

People struck by trains (PSBT)

The identified people struck by train issues of concern and proposed solutions are as follows:

IS	SUES OF CONCERN	PR	ROPOSED SOLUTION
•	 Poor planning: Municipality, industry and law enforcement (Town Planning and new 		Holistic approach workshop with key role players with decision making powers to establish and commit to an integrated plan to reduce PSBT
	cities development).	•	All key role players to be consulted at the initial phases of all new developments and sign off by participants
		•	New developments to be approved by all key role players
		•	RSR to be engaged on all new developments close to railway line
•	 Lack of alignment between the different tiers of government. 		Convene a workshop between NPA, TFR, RSR & PRASA and all stakeholders to address unique challenges faced by operator
•	Justice system does not support rail system		Convene a workshop between NPA, TFR, RSR & PRASA and all stakeholders to address unique challenges faced by operator
•	Open system (human flow)	•	TFR and PRASA to close the system and in consultation with Municipalities provide street to street access (pedestrian bridges)
		۰	RSR to approve designs of all new fencing projects
•	Possible suicides/murder	•	RSR to be engage with SAPS / RRP to address this issue
•	Culture of non-compliance	•	Enhance education and awareness through partnership with key role players
		•	Exercise enforcement mandate
•	Lack of security	•	Visible security and intelligence to deter and address vandalism and theft
		•	Active partnerships with Community Policing Forum, Rapid Rail Police and other law enforcement agencies

Collisions

The identified issues of concern and proposed solutions for collisions are as follows:

ISSUES OF CONCERN	PROPOSED SOLUTION	
Operating in degraded mode (abnormal working)		
Accountability for repeat offenders	Incentivising career specialist	
	Reward excellence – industry / operators	
Communication between TCO and Train Drivers	CSM-CA as a tool Implementation of the CSM-RA and CSM - Supervision phases	
Non-compliance with policies, procedures and	Review of old policies and procedures	
execution	Increased supervision	
	Implementation of the CSM-RA and CSM - Supervision phases	
Induction of Rail Industry Boards		
	Induction of Rail Industry Boards by RSR to appreciate the importance of safety	
Categorisation of collisions		
	 Categorisation of collisions – Criteria for data to give meaning to the numbers (severity) 	

Appendix B

RSR operational occurrence interventions





RSR operational occurrence interventions

Operational Occurrence Focal Area	Province	Date	Nature of Intervention	Intervention Objectives
All operational occurrence categories	KwaZulu-Natal	May 2017	Stakeholder Breakfast	To encourage effective communication with stakeholders and maintain relation-ship
All operational occurrence categories	KwaZulu-Natal	May 2017	Annual Railway Safety Conference	To promote the RSR as the authority on railway and to make railway industry stakeholders aware of operational safety risks and challenges
Category D-a	Gauteng	June 2017	Bosplaas level crossing	To promote the RSR as the authority on railway safety and effectively educate the public (road vehicle users and pedestrians) on safe railway behaviour.
Category D-a Category E-a Category H-a Category H-b	Western Cape	July 2017	Community Safety Awareness Campaign and Gospel Extravagan- za	To encourage behavioural changes among train passengers and the public to significantly reduce occurrences
Category D-a Category E-a Category H-a Category H-b	Mpumalanga	July 2017	Barberton Prison Mande- la Day Event	To encourage behavioural changes among train passengers and the public to significantly reduce occurrences
Category D-a Category E-a Category H-a Category H-b	Limpopo	July 2017	Mandela Day event	To encourage behavioural changes among train passengers and the public to significantly reduce occurrences
Category D-a	North West	August 2017	Luka level crossing	To promote the RSR as the authority on railway safety and educate the public (road vehicle users and pedestrians) on safe railway behaviour.
Category D-a Category E-a Category G Category H-a Category H-b	Gauteng	October 2017	Commuter Forum Focus Groups	To engage with learners to gain an understanding on what leads to unsafe behaviour and what are the possible solution
Category E-a	Eastern Cape	August 2017	EC Safety Campaign Sports Tournament	To promote the RSR as the authority on railway safety and effectively educate the target audiences on railway safe behaviour

Category D-a Category G Category E-a Category H-a Category H-b	Eastern Cape	August 2017	School Debate Competition	To promote the RSR as the authority on railway safety and effectively educate the target audiences on railway safe behavior with a special focus on train surfing
Category D-a	Gauteng	October 2017	Dobsonville Level Cross- ing	To promote the RSR as the authority on railway safety and effectively educate the target audiences on railway safe behaviour
Category D-a	Gauteng	October 2017	Mabopane Level Cross- ing	To promote the RSR as the authority on railway safety and effectively educate the target audiences on railway safe behaviour
Category D-a	Gauteng	October 2017	Babelehi Level Crossing	To promote the RSR as the authority on railway safety and effectively educate the target audiences on railway safe behaviour
Category E-a Category H-a Category H-b	Gauteng	December 2017	Mall Activation	To promote the RSR as the authority on railway safety and effectively educate the target audiences on railway safe behaviour.
Category D-a	North West	December 2017	Boshoek level crossing	To promote the RSR as the authority on railway safety and effectively educate the target audiences on railway safe behaviour
Category D-a Category E-a Category G Category H-a Category H-b	North West	January 2018	Back to School Safety Awareness Campaign	To engage with learners to gain un under- standing on what leads to unsafe behaviour and what are the possible solution.
Category D-a Category E-a	KwaZulu-Natal	January 2018	Shova Kalula National Bicycle Programme	To motivate for behaviour change among commuters, motorists and pedestrians to significantly reduce occurrences
Category D-a Category E-a Category G Category H-a Category H-b	Western Cape	February 2018	School Education Pilot Programme	To motivate for behaviour change to learners to significantly reduce occurrences and communicate dangers of unsafe behaviors and consequences

Category D-a Category E-a Category G Category H-a Category H-b	North West	March 2018	School Debate Competition	To motivate for behaviour change to learners to significantly reduce occurrenc- es and communicate dangers of unsafe behaviours and consequences
Category D-a	Western Cape	March 2018	Kenilworth level crossing	To promote the RSR as the authority on railway safety and effectively educate the target audiences on railway safe behaviour
Category D-a	Western Cape	March 2018	Muldersvlei level crossing	To promote the RSR as the authority on railway safety and effectively educate the target audiences on railway safe behaviour
Category D-a	Free State	March 2018	Geneva level crossing	To promote the RSR as the authority on railway safety and effectively educate the target audiences on railway safe behaviour
Category E-a Category H-a Category H-b	Kwa-Zulu Natal	March 2018	Promoting railway safety: 50 Mile Walk	To promote safety awareness and profile the organisation (visibility)
Category H-a Category H-b	Gauteng	March 2018	Station safety awareness campaign	To promote the RSR as the authority on railway safety and effectively educate the target audiences on railway safe behaviour.
Category H-a Category H-b	Gauteng	March 2018	Station safety awareness survey	To promote the RSR as the authority on railway safety and effectively educate the target audiences on railway safe behaviour.

Appendix C

Sans 3000-1 Railway Occurrence Categories





Sans 3000-1 Railway Occurrence Categories

	OPERATIONAL OCCURRENCE CATEGORIES
CATEGORY	DESCRIPTION
CATEGORY A	COLLISIONS DURING MOVEMENT OF ROLLING STOCK
A-a	Collision between rolling stock on a running line
A-b	Collision of rolling stock with an obstruction on a running line (including road vehicles colliding with rolling stock)
A-c	Collision with a stop block on a running line
A-d	Collision of rolling stock other than on a running line
A-e	Collision of rolling stock with an obstruction other than on a running line
A-f	Collision with a stop block (other than on a running line)
CATEGORY B	DERAILMENTS DURING MOVEMENT OF ROLLING STOCK
B-a	Derailment of rolling stock on a running line
B-b	Derailment of rolling stock on a line other than a running line
B-c	Derailment during tippler activities
CATEGORY C	UNAUTHORIZED MOVEMENTS (ROLLING STOCK MOVEMENT EXCEEDING THE LIMIT OF AUTHORITY)
C-a	Signal passed at danger (SPAD) on a running line
C-b	Signal passed at danger (SPAD) on any other line
C-c	Physical token passed on a running line
C-d	Physical token passed on any other line
C-e	Verbal authority exceeded on a running line
C-f	Verbal authority exceeded on any other line
C-g	Written authority exceeded on a running line
C-h	Written authority exceeded on any other line
CATEGORY D	LEVEL CROSSING OCCURRENCES
D-a	Collision between rolling stock and a road vehicle(s) (including motor vehicles, bicycle or animal-drawn vehicles) at a recognized level crossing on a running line
D-b	Collision between rolling stock and a road vehicle(s) (including motor-powered, bicycle or animal-drawn vehicles)) on any line other than a running line (including yards, sidings and private sidings) at a recognized level crossing
D-c	A person(s) struck by rolling stock at a recognized pedestrian level crossing
D-d	A person(s) struck by rolling stock at a recognized road level crossing

CATEGORY E	PERSONS STRUCK DURING MOVEMENT OF ROLLING STOCK (OTHER THAN AT LEVEL CROSSINGS)
E-a	Occurrence where a member of the public is struck by rolling stock on a running line
E-b	Occurrence where an employee is struck by rolling stock on a running line
E-c	Occurrence where a contractor or contractor's employee is struck by rolling stock on a running line
E-d	Occurrence where a member of the public struck by rolling stock on a line other than a running line
E-e	Occurrence where an employee is struck by rolling stock on a line other than a running line
E-f	Occurrence where a contractor or contractor's employee is struck by rolling stock on a line other than a running line
CATEGORY F	PEOPLE RELATED OCCURRENCES: TRAINS OUTSIDE STATION PLATFORM AREAS (IN SECTION)
F-a	Occurrence where a person fell or was pushed from inside a moving or stationary train
F-b	Occurrence where an employee fell or was pushed from inside a moving or stationary train
F-c	Occurrence where a contractor or contractor's employee fell or was pushed from inside a moving or stationary train
CATEGORY G	PASSENGER RELATED OCCURRENCES: TRAVELLING OUTSIDE DESIGNATED PASSENGER AREA
G-a	Category G occurrences covers the number of occurrences as a result of passengers travelling outside the designated passenger area of the train
CATEGORY H	PEOPLE RELATED OCCURRENCES: PLATFORM-TRAIN INTERCHANGE
H-a	Occurrence where a passenger fell between the train and the platform while entraining/detraining a stationary or moving train
H-b	Occurrence where a passenger fell on the platform while entraining/detraining a stationary or moving train
H-c	Occurrence where an employee fell between the train and the platform while entraining/detraining a stationary or moving train
H-d	Occurrence where an employee fell on the platform while entraining/detraining a stationary or moving train
H-e	Occurrence where a contractor or contractor's employee fell between the train and the platform while detraining a stationary or moving train
H-f	Occurrence where a contractor or contractor's employee fell on the platform while entraining/detraining a stationary or moving train
CATEGORY I	PEOPLE RELATED OCCURRENCES: STATION INFRASTRUCTURE
l-a	Occurrence resulting in injuries and fatalities to public due to infrastructure defects in a public area of the station
l-b	Occurrence resulting in injuries and fatalities to passengers due to infrastructure defects in a passen- ger area of the station
l-c	Occurrence resulting in injuries and fatalities to an employee due to infrastructure defects in a public area of the station
l-d	Occurrence resulting in injuries and fatalities to an employee due to infrastructure defects in a passenger area of the station

l-e	Occurrence resulting in injuries and fatalities to a contractor or contractor's employee due to infrastructure defects in a public area of the station
l-f	Occurrence resulting in injuries and fatalities to a contractor or contractor's employee due to infrastructure defects in a passenger area of the station
CATEGORY J	ELECTRIC SHOCK OF PEOPLE OCCURRENCES
J-a	Electrical shock to a member of the public on the network infrastructure
J-b	Electrical shock to an employee on the network infrastructure
J-c	Electrical shock to a contractor or contractor's employee on the network infrastructure
J-d	Electrical shock to the member of the public including passengers while on or in rolling stock
J-e	Electrical shock to an employee while positioned on or part of rolling stock
J-f	Electrical shock to a contractor or contractor's employee while positioned on or part of rolling stock
J-g	Electrical shock to the member of the public in the public area of a station
J-h	Electrical shock to an employee in the public area of a station
J-i	Electrical shock of a contractor or contractor's employee in the public area of a station
J-j	Electrical shock to the member of the public in the passenger area of a station
J-k	Electrical shock to an employee in the passenger area of a station
J-I	Electrical shock of a contractor or contractor's employee in the passenger area of a station
CATEGORY K	SPILLAGE/LEAKAGE, EXPLOSION OR LOSS OF DANGEROUS GOODS
K-a	Spillage or leakage of dangerous goods en-route
K-b	Spillage or leakage of dangerous goods during shunting operations
K-c	Spillage or leakage of dangerous goods while staged
K-d	Missing consignment of dangerous goods
K-e	Theft of dangerous goods
K-f	Explosion of dangerous goods
CATEGORY L	FIRE OCCURRENCES
L-a	Fires on a fixed operational asset (e.g. station buildings, in a tunnel, in a relay room and in a sub- station)
L-b	Fire of freight
L-c	Fire of rolling stock
L-d	Veld fires that threaten operational safety
	SECURITY-RELATED INCIDENT CATEGORIES
CATEGORY 1	THEFT OF ASSETS IMPACTING ON OPERATIONAL SAFETY
1-а	Theft of rolling stock components in section
1-b	Theft of rolling stock components in yards (staged)
1-c	Theft of civil infrastructure components in section
1-d	Theft of civil infrastructure components in yards and sidings
1-e	Theft of overhead traction equipment in section
1-f	Theft of overhead traction equipment in yards and sidings

1-g	Theft of train control equipment (signaling) in section
1-h	Theft of train control equipment (signaling) in yards and sidings
1-i	Theft of ancillary equipment including public address systems, information boards, CCTV
CATEGORY 2	MALICIOUS DAMAGE (VANDALISM) TO PROPERTY IMPACTING ON OPERATIONAL SAFETY
2-a	Malicious damage (vandalism) of rolling stock components in section
2-b	Malicious damage (vandalism) of rolling stock components in yards and sidings (staged)
2-c	Malicious damage (vandalism) of civil infrastructure components in section
2-d	Malicious damage (vandalism) of civil infrastructure components in yards and sidings
2-e	Malicious damage (vandalism) of overhead traction equipment in section
2-f	Malicious damage (vandalism) of overhead traction equipment in yards and sidings
2-g	Malicious damage (vandalism) of train control equipment (signaling) in section
2-h	Malicious damage (vandalism) of train control equipment (signaling) in yards and sidings
2-i	Malicious damage (vandalism) of ancillary equipment including public address systems, information boards, CCTV
CATEGORY 3	THREATS OF OPERATIONAL SAFETY
3-а	A bomb threat to network
3-b	A bomb threat to station
3-с	A bomb threat to rolling stock
3-d	Threats due to electrical power outages
3-е	Threats other than bomb and power outage threats
CATEGORY 4	TRAIN KIDNAPPING OR HIJACKING
4-a	Kidnapping or hijacking of passenger trains
4-b	Kidnapping or hijacking of freight trains
4-c	Kidnapping or hijacking of other rolling stock
CATEGORY 5	CROWD-RELATED OCCURRENCES
5-а	Crowd related occurrence and includes stampede action
CATEGORY 6	INDUSTRIAL ACTION
6-а	Industrial action that causes a threat to security or safe railway operations or to security
CATEGORY 7	PERSONAL SAFETY ON TRAINS
7-а	Murder
7-b	Attempted murder
7-c	Rape
7-d	Assault
7-e	Indecent assault
7-f	Aggravated robbery

7-g	Common robbery
7-h	Theft
7-i	Bomb explosion
CATEGORY 8	PERSONAL SAFETY ON STATIONS
8-a	Murder
8-b	Attempted murder
8-c	Rape
8-d	Assault
8-e	Indecent assault
8-f	Aggravated robbery
8-g	Common robbery
8-h	Theft
8-i	Bomb explosion
CATEGORY 9	PERSONAL SAFETY OUTSIDE STATION PLATFORM AREA (IN SECTION BETWEEN STATIONS, INCLUDING YARDS, SIDINGS AND DEPOTS)
9-a	Murder
9-b	Attempted murder
9-c	Rape
9-d	Assault
9-е	Indecent assault
9-f	Aggravated robbery
9-g	Common robbery
9-h	Theft
9-i	Bomb explosion

Appendix D

Operational safety occurrences (2015/16 - 2017/18)





Operational safety occurrences (2015/16 - 2017/18)

OPERATIONAL OCCURRENCES	2015/16	2016/17		2017/1	8	
Category	ALL	ALL	TFR	PRASA RAIL	OTHER	ALL
A-a	6	8	4	2	1	7
A-b	1000	924	870	42	26	938
A-c	2	4	0	0	2	2
A-d	33	26	14	0	13	27
A-e	43	32	18	0	15	33
A-f	16	12	15	1	4	20
Total [A]	1100	1006	921	45	61	1027
B-a	114	119	79	19	21	119
B-b	285	209	136	23	126	285
B-c	21	58	19	0	27	46
Total [B]	420	386	234	42	174	450
C-a	84	78	50	26	11	87
C-b	10	6	7	0	1	8
C-c	0	0	0	0	0	0
C-d	0	0	0	0	0	0
C-e	0	0	0	0	0	0
C-f	0	0	0	0	0	0
C-g	0	0	0	0	0	0
C-h	0	0	0	0	0	0
C-i	0	0	0	0	0	0
C-j	0	0	0	0	0	0
Total [C]	94	84	57	26	12	95
D-a	83	110	85	19	10	114
D-b	3	4	5	0	2	7
D-c	0	0	1	0	1	2
D-d	1	5	3	0	0	3

Total [D]	87	119	94	19	13	126
E-a	531	642	182	387	8	577
E-b	3	5	0	1	0	1
E-c	3	2	1	2	0	3
E-d	1	0	3	0	1	4
E-e	3	2	2	0	1	3
E-f	0	0	0	0	0	0
Total [E]	541	651	188	390	10	588
F-a	335	324	2	163	4	169
F-b	2	1	0	0	0	0
F-c	0	0	0	0	0	0
Total [F]	337	325	2	163	4	169
G-a	131	140	0	160	0	160
Total [G]	131	140	0	160	0	160
H-a	101	74	0	60	5	65
H-b	556	498	0	672	6	678
H-c	1	1	0	0	0	0
H-d	0	0	0	0	0	0
H-e	0	0	0	0	0	0
H-f	0	0	0	1	0	1
Total [H]	658	573	0	733	11	744
l-a	0	0	0	0	0	0
l-b	129	111	0	112	4	116
l-c	1	0	0	0	0	0
l-d	0	0	0	0	0	0
l-e	0	0	0	0	0	0
l-f	0	0	0	0	0	0
Total [l]	130	111	0	112	4	116
J-a	9	16	6	4	0	10
J-b	1	4	1	1	1	3
J-c	3	0	1	1	0	2
J-d	14	9	1	28	1	30
J-e	0	1	0	0	0	0
J-f	0	0	0	0	0	0
J-g	0	0	0	1	0	1

.l-h	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
J-J	0	0	0	0	0	0
J-k	0	0	0	0	0	0
J-I	0	0	0	0	0	0
Total [J]	27	30	9	35	2	46
K-a	2	6	19	0	0	19
K-b	0	0	0	0	0	0
K-c	218	203	187	0	0	187
K-d	0	0	0	0	0	0
K-e	2	0	6	0	0	6
K-f	1	0	0	0	0	0
Total [K]	223	209	212	0	0	212
L-a	32	28	46	8	1	55
L-b	0	1	30	0	0	30
L-c	149	103	46	77	14	137
L-d	321	300	521	2	0	523
Total [L]	502	432	643	87	15	745
Grand Total	4250	4066	2360	1812	306	4478

Security-related incidents operational occurrences for the period 2015/16 – 2017/18 for each of the sans 3000 occurrence reporting categories and subcategories

SECURITY-RELATED INCIDENTS	2015/16	2016/17	2017/18										
Category	ALL	ALL	TFR	PRASA RAIL	OTHER	ALL							
1-a	229	362	110	439	2	551							
1-b	131	174	94	230	2	326							
1-c	383	282	213	407	3	623							
1-d	14	19	20	12	4	36							
1-e	298	212	397	161	1	559							
1-f	14	2	23	9	0	32							
1-g	2407	3140	1258	1392	4	2654							
1-h	12	9	53	12	0	65							
1-i	112	179	111	26	1	138							
Total [1]	3600	4379	2279	2688	17	4984							
2-a	421	373	107	327	258	692							
2-b	100	90	11	138	0	149							
2-c	125	82	54	62	32	148							
2-d	48	28	4	21	7	32							
2-е	52	39	82	28	0	110							
2-f	3	2	3	0	0	3							
2-g	384	519	252	276	0	528							
2-h	1	1	10	7	0	17							
2-i	24	28	31	4	0	35							
Total [2]	1158	1162	554	863	297	1714							
3-а	0	0	0	0	0	0							
3-b	0	0	0	0	0	0							
3-с	0	0	0	0	0	0							
3-d	1	0	11	0	0	11							
3-е	1	0	55	0	1	56							
Total [3]	2	0	66	0	1	67							
<u>4-a</u>	0	0	0	8	0	8							
4-b	0	0	3	0	0	3							
4-c	0	0	0	0	0	0							
Total [4]	0	0	3	8	0	11							
5-a	0	0	13	0	0	13							
Total [5]	0	0	13	0	0	13							
6-a	1	8	20	5		25							
Total [6]	1	8	20	5	0	25							
7-a	2	3	1	4	0	5							
7-b	1	1	0	4	0	4							
7-c	0	2	0	0	0	0							

7-d	191	191	0	168	0	168
7-е	0	0	0	0	0	0
7-f	101	105	2	132	0	134
7-g	61	90	2	70	0	72
7-h	12	16	1	14	0	15
7-i	0	0	0	0	0	0
Total [7]	368	408	6	392	0	398
8-a	4	6	1	8	0	9
8-b	11	8	1	10	0	11
8-c	1	1	0	0	0	0
8-d	117	99	2	134	2	138
8-e	0	0	0	0	0	0
8-f	106	127	11	148	0	159
8-g	54	62	2	63	2	67
8-h	12	9	0	15	2	17
8-i	0	0	0	0	0	0
Total [8]	305	312	17	378	6	401
9-a	5	6	0	8	0	8
9-b	5	8	2	10	0	12
9-c	1	0	0	1	0	1
9-d	20	18	2	18	1	21
9-e	0	0	0	0	0	0
9-f	44	67	17	48	0	65
9-g	11	10	2	11	0	13
9-h	0	0	2	2	0	4
9-i	0	0	0	0	0	0
Total [9]	86	109	25	98	1	124
Grand Total	5520	6378	2983	4432	322	7737

Appendix E

SANS 3000 fatalities and injuries (2010/11 - 2017/18)





SANS 3000 fatalities and injuries (2010/11 - 2017/18)

Operational Occurrences		Calegory	A-a	A-b	A-c	P-A	A-e	A-f	Total	FWI [A]	B-a	B-b	ЧС	Total	FWI [B]	C-a	C-b	ပိ	Р С	မ ပ	C-f	C-g	C-h	ت	Ŀ	Total	FWI [C]	D-a	D-b	D-c	Р-q	Total
_ ω_		Lalo																														4
2010/11									4 16-	20,4				12	13,1											0						4 13
		S S							4																							4
2011/12									2	118,2				—	4,3											0						13
		Sel D							162					33												0						48
2012/1:		alailles							0	42				0	2,2											0						38
~		Since the second							420					22												0						73
2013/1		alailieo							0	2,7				0	1,4											0						18
4		sentin lin							27					14												0						66
2014/1	otoliti oo	alalites							0	15,7				0	1,2											0						17
15		Salinfi							157					12												0						88
2015/1	- otolisioo	Lalalilles	£	17	0	0	0	0	22	88,1	0	0	0	0	2,6	0	0	0	0	0	0	0	0	0	0	0	0,1	5	0	0	-	
٥			651	7	0	e	0	0	661		20	9	0	26		-	0	0	0	0	0	0	0	0	0	~		27	0	0	0	28
2016/1		alallies	2	0	0	0	0	0	2	64,9	e	0	0	8	4,3	0	0	0	0	0	0	0	0	0	0	0		9	-	0	0	
~		H Inter	623	2	0	4	0	0	629		12	-	0	13		0	0	0	0	0	0	0	0	0	0	0		57	0	0	5	62
	TFR	atalities	0	0	0	0	0	0	0	0,4	2	0	0	2	2,4	0	0	0	0	0	0	0	0	0	0	0		31	0	-	0	32
		njuries Fa	2	-	0	-	0	0	4		2	2	0	4		0	0	0	0	0	0	0	0	0	0	0		313	3	0	3	319
	PRASA	atalities Ir	-	0	0	0	0	0	-	39,3	0	0	0	0	1,5	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	
2017/18		njuries Fa	378	5	0	0	0	0	383		15	0	0	15		0	0	0	0	0	0	0	0	0	0	0		12	0	0	0	12
	OTHER	atalities Ir	0	0	0	-	0	0	-	1,5	2	-	0	e	3,3	0	0	0	0	0	0	0	0	0	0	0		1	0	-	0	2
		njuries Fa	0	3	0	2	0	0	5		0	3	0	e		0	0	0	0	0	0	0	0	0	0	0		4	-	0	0	
	TOTAL	talities In	-	0	0	-	0	0	2	41,2	4	-	0	5	7,2	0	0	0	0	0	0	0	0	0	0	0		32	0	2	0	34
		ijuries	380	6	0	e	0	0	392		17	2	0	22		0	0	0	0	0	0	0	0	0	0	0		329	4	0	e	336

9	239	-	-	-	2	0	244	,4 ,	152	0	0	152	2	140	140	•	62	674	0	0	0	-	737	7	0	113	0	0	0	0	113	က္
67	336	0	с	з	-	0	343	367	18	0	0	18	33	25	25	ŝ	2	2	0	0	0	0	4	17	0	0	0	0	0	0	0	11
	5	0	0	0	-	0	9		4	0	0	4		0	0		5	9	0	0	0	0	7		0	3	0	0	0	0	ю	
2,5	2	0	0	-	0	0	e	3,6	0	0	0	0	0,4	0	0	0	0	0	0	0	0	0	0	1,1	0	0	0	0	0	0	0	0,0
	155	-	0	0	0	0	156	 	146	0	0	146		140	140		57	668	0	0	0	-	726		0	110	0	0	0	0	110	
1,2	226	0	с	0	0	0	229	244,	18	0	0	18	32,6	25	25	39	2	2	0	0	0	0	4	76,6	0	0	0	0	0	0	0	11
	79	0	-	-	-	0	82		2	0	0	2		0	0		0	0	0	0	0	0	0		0	0	0	0	0	0	0	
63,9	108	0	0	2	-	0	111	119,2	0	0	0		0,2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	234	4	2	0	0	0	240		314	-	0	315		121	121		65	490	0	0	0	0	555		0	104	0	0	0	0	104	
13,2	412	1	0	0	-	0	414	438	17	0	0	17	48,5	20	20	32,1	ω	2	-	0	0	0	Ŧ	66,5	0	2	0	0	0	0	2	12,4
	175	0	.	-	3	0	180		334	2	0	336		118	118		92	559	0	0	0	0	651		0	125	-	0	0	0	126	
8,8	365	3	2	0	0	0	370	388	11	0	0	7	44,6	17	17	28,8	9	3	-	0	0	0	10	75,1	0	0	0	0	0	0	0	12,6
							250					320			134								569								156	
23,8							110	435				2	34		21	34,4							80	64,9							0	15,6
							201 2					94			80								89								83	
24,6							94 2	414,1				4	23,4		16	24							7	75,9							0	18,3
							31 3					1											53								⁷ 6	
45,3							55 2	378,1				0	7,7		Ξ.	29,6							8	93,3							0	7,6
							33					90			0								1								5	
17,8							4	372,3					13,6		~~~	15								97,7							9	6,5
							354					e											20								0	
7,4							199	13,9				88	8,		78	9,8							618	7,8							22	2,4
ίΩ							364	33					æ		12	÷							16	7							9	÷
[d] IM	E-a	E-b	о Ш	р Ш	е Ш	Εf	Total	WI (E)	F-a	Ч-Ч	о Ц	Total	WI [F]	G-a	Total	WI [G]	H-a	Р Ч	ч Н	막	Че	₽-f	Total	(H]	l-a	l-b	-c -	p-	e-	-f	Total	[i] IM-
Ē								Ē					Ē			Ē								Ĩ.								ĨĹ.

e data for 2015/16 to 2017/18: Data in RSR Occurrence database	e data for 2010/11 to 2014/15: Data obtained from previous ASoS reports (data in occurrence database incomplete, depending on category 5 - 30 % occurrences
Occurrence data for 2	Occurrence data for 2

are not in file)

2	-	2	18	0	0	-	0	0	0	0	0	24	4	0	0	0	0	0	0	0		0	-	5	-	7	2	2167	7
80	-	0	14	0	0	0	0	0	0	0	0	23	25	0	0	0	0	0	0	0	0	0	0	0	0	0	, 0	454	670
0	0	0	2	0	0	0	0	0	0	0	0	2	5	0	0	0	0	0	0	0		0	0	0	0	0		39	ດຼ
0	0	0	0	0	0	0	0	0	0	0	0		:'O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	12
-	0	-	14	0	0	-	0	0	0	0	0	17	7	0	0	0	0	0	0	0		0	0	5	0	5	10	1710	0
с	-	0	14	0	0	0	0	0	0	0	0	18	19,	0	0	0	0	0	0	0	0	0	0	0	0	0	0,{	295	46
-	-	-	2	0	0	0	0	0	0	0	0			0	0	0	0	0	0	0		0		0	-	2		418	œ
5	0	0	0	0	0	0	0	0	0	0	0		5,5	0	0	0	0	0	0	0		0	0	0	0	0	0,2	150	191,
ი	3	0	5	0	0	0	0	0	0	0	0	17		0	0	-	0	0	0	-		0	0	22	0	22		2079	6
12	-	0	4	-	0	0	0	0	0	0	0	18	19,7	0	0	0	0	0	0	0	0,1	0	0	0	-	-	3,2	495	702,
5	-	-	2	0	0	0	0	0	0	0	0			0	0	0	0	0	0	0		0	0	176	-	177		2313	
4	0	2	13	0	0	0	0	0	0	0	0	19	19,9	0	0	0	0	0	0	0		0	0	0	0	0	17,7	455	686,
												20								29						31		1746	(0)
												15	17							0	2,9					0	3,1	473	647,0
												15								0						29		1498	~
												16	17,5							0	0					-	3,9	456	605,8
												ω								0						41		1787	
												∞	8,8							0	0					0	4,1	440	618,7
												26								0						30		2510	
												12	14,6							0	0					0	3	412	663
												~														0		34	
													11,8								0					5	5	15	610,4
												10								0						0		45	
J-a	d-L	Ъ-с	р-Г	J-e	Ъ-f	Ъ-С	Ч-Г	: - 7	 -	ЧЧ	-r	Total	FWI [J]	K-a	K-b	K-c	K-d	K-e	K-f	Total	FWI [K]	L-a	L-b	с Г	L-d	Total	FWI [L]	Grand Tota	FWI [Total]

98 RSR State of Safety Report 2017/18

Appendix F Application of FWI in assessing railway safety risks





Application of FWI in assessing railway safety risks

The EU's Railway Safety Directive (Directive 2004/49/EC) expresses a common philosophy on railway safety. It shows directionality, stating that, "Safety levels in the Community rail system are generally high, in particular compared to road transport... In line with technical and scientific progress, safety should be further improved, when reasonably practicable and taking into account the competitiveness of the rail transport mode". Based on that philosophy, the EU has set out common Safety Targets (CSTs) each of its member states can accomplish in terms of the risk categories shown below:

Risk Category	CST Value (×	10 ⁻⁹)	Measurement Units					
Pick to possongers	CST 1.1	170	Passenger FWSI / Passenger train-km					
Risk to passengers	CST 1.2	CST 1.2 1.65 Passenger FWSI / Passe						
Risk to employees	CST 2	77.9	Employee FWSI / Train-km					
Risk to level crossing users	CST 3.1	710	Level crossing user FWSI / Train-km					
Risk to "others"	CST 4	14.5	Others FWSI / Train-km					
Risk to unauthorized persons on railway premises	CST 5	2,050	Unauthorized person FWSI / Train-km					
Risk to whole society	CST 6	2,590	Whole society FWSI / Train-km					

Common Safety Targets

FWSI is the converted number of fatalities

Common safety targets (CSTs) are quantitative measures of risk allowing assessment of whether the current safety levels of the railways in the EU Member States are at least maintained. In the long term, they could also help to drive efforts to reduce the current differences in railway safety performance. The CSTs are EU- wide maximum risk values. The national reference values (NRVs) are the maximum risk levels set for individual Member States. The risk level is measured in terms of the number of weighted fatalities and serious injuries per train-km. There are risk categories for passengers, employees, level-crossing users, unauthorised persons on railway premises, others and those applied to society as a whole.

CSTs are indexes based on the number of casualties, so the smaller the value is, the higher safety can be regarded to be. First, for each of risk categories, the National Reference Values (NRVs) of individual EU member states and the European Average Value (EAV) for the specified period (from 2004 to 2009) is calculated. Comparing the maximum NRV of individual member states with the value equal to ten times the EAV, the smaller value is adopted as the CST. When the NRV is higher than the CST, the CST is applicable as the NRV for that state. Consequently, the actual target of individual EU member states is to achieve their own NRVs. As the NRV is the weighted average value of the standardized number of causalities based on the results in the specified period, it can be considered to be an index showing railway safety of each EU member state.

Notes





HEAD OFFICE (CENTURION):

+27 12 848 3000, Lake Buena Vista Building, No.1 Gordon Hood Avenue, Centurion, 0157, SOUTH AFRICA

JOHANNESBURG:

+27 12 848 4000, 2nd Floor, Metropolitan Building, Block A, No.8 Hillside Road, Parktown, Johannesburg, 2196, SOUTH AFRICA

CAPE TOWN:

+27 87 806 5180, 20th Floor, 9 Riebeeck Street (Lower Burg Street) Atterbury House, Cape Town, 8000, SOUTH AFRICA

DURBAN:

+27 87 806 5219, Office 101A, 1st Floor, Ridgeview Umhlanga Building, No.1 Nokwe Avenue, Ridgeside, Umhlanga Ridge, Durban, SOUTH AFRICA

PORT ELIZABETH:

+ 27 87 701 0618, No.1 Caithness Road, Walmer, Port Elizabeth, 6070, SOUTH AFRICA

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