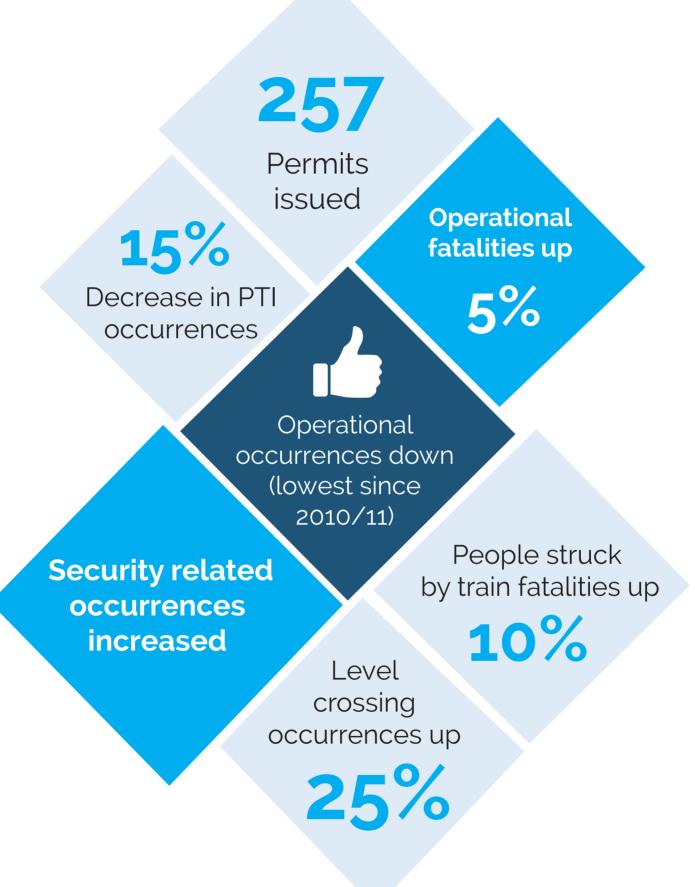




## At a glance



## Table of contents

List of abbreviations	7
Foreword	11
Executive summary	12
Introduction	14
Overview of the RSR	15
Overview of the railway industry	17
Number of railway operators	18
Railway traffic volumes	19
Reporting safety and security in the South African railway industry	21
Railway industry compliance to occurrence and incidents reporting	23
Railway safety performance comparison	24
Operational occurrence analysis	25
Operational occurrence trends per operator	35
Fatalities and injuries resulting from operational occurrences	38
Security-related incidents	42
Rapid Rail Police successes	46
Fatalities and injuries as result of security-related incidents	47
Key Strategic focus areas	49
Running line collisions between rolling stock	51
Running line derailments	52
Level crossing occurrences	53
People struck by trains	54
Platform train interface	56
Trend per train kilometre	57
Cost of risk analysis	59
South African rail corridor analysis	65
Cost of risk on some of the main Transnet Freight Rail main corridors	66
Cost of risk in PRASA metros	70
South Africa railway operational occurrence – root cause analysis	75
Inspections, audits and investigations	76
Root cause analysis	77
Preventative actions	81
The RSR regulatory framework instruments at work	81
Education and awareness	83
RSR technical training	84
Offences and penalties	84
Conclusion	85
References	86
Appendix A: SANS 3000: 1 (2009) Operational Occurrence and Safety-Related Incidents Detailed	
Categories	87
Operational occurrence categories	88
Security related incident categories	91
Appendix B: 2016/17 Operational occurrences per category and sub-category	a3

# Figures

Figure 1: 2016/17 Permits Issued per RSR Region in the 2016/17 FY	18
Figure 2: 2010/11 - 2016/17 TFR million train km/billion ton km trend	19
Figure 3: 2010/11 - 2016/17 PRASA million train km/million passenger train km trend	20
Figure 4: 2010/11 - 2016/17 Gautrain million train km/million passenger train km trend	20
Figure 5: 2010/11 - 2016/17 Occurrence reports submission percentage trend	23
Figure 6: 2010/11 - 2016/17 Overall railway safety performance trendstends	
Figure 7: 2016/17 Top five contributing operational occurrences	27
Figure 8: 2016/17 Operational occurrences provincial distribution	
Figure 9: 2016/17 Geographic display of all operational occurrences (all operators)	28
Figure 10: 2016/17 Geographic display: Collisions	
Figure 11: 2016/17 Geographic display: Derailments	31
Figure 12: 2016/17 Geographic display: Level crossing occurrences	32
Figure 13 : 2016/17 2016/17 Geographic display: Operational train firesfires	33
Figure 14 : 2016/17 Geographic Display: People related occurrences (people struck by trains,	
platform train interface	34
Figure 15: 2016/17 Distribution of occurrences per operator	35
Figure 16: 2016/17 Geographic display of all operational occurrences - PRASA	36
Figure 17: 2016/17 Geographic display of all operational occurrences - Transnet	37
Figure 18: 2010/11 - 2016/17 Fatalities and injuries	38
Figure 19: 2016/17 Fatalities per operational occurrence category	39
Figure 20: 2016/17 Injuries per operational occurrence category	39
Figure 21: 2016/17 Geographic distribution of operational occurrence fatalities and injuries	41
Figure 22: 2016/17 Security-related incident distribution	43
Figure 23: 2016/17 Security-related incidents per operator	43
Figure 24: 2016/17 Geographic distribution of security-related incidents	45
Figure 25: 2016/17 Fatalities and injuries due to security-related incidents	47
Figure 26: 2016/17 Fatalities per security-related category	48
Figure 27: 2016/17 Injuries per security-related category	48
Figure 28: Strategic focus annual occurrence totals comparison 2013/14 - 2016/17	50
Figure 29: 2016/17 Running line derailments per province	52
Figure 30: 2013/14 - 2016/17 Mainline level crossing occurrence trend	53
Figure 31: 2016/17 Mainline level crossing provincial distribution	54
Figure 32: 2010/11 - 2016/17 Main places of people struck by trains	55
Figure 33 : 2010/11 - 2016 <mark>/</mark> 17 Fatalities per million train kmkm	57
Figure 34 : 2010/11 - 2016/17 Collisions per million train kmkm	58
Figure 35 : 2010/11 - 2 <mark>0</mark> 16/17 Derailments per million train kmkm	58
Figure 36 : 2010/11 - 2016/17 Level crossings per million train kmkm	58
Figure 37: 2010/11 - 2016/17 Main cost drivers	60
Figure 38: Systemic cost of risk (freight rail example, but equally valid for passenger rail)	61
Figure 39: Railway occurrence counts and cost for the value of freight transported per major corrido	or
showing an <mark>ar</mark> bitrary 0.1% Cost of risk threshold (red line) for 2015/16	62
Figure 40: Railway occurrence counts and cost for the value of freight transported per major corrido	or
showing an arbitrary 0.1% Cost of risk threshold (red line) for 2016/17	
Figure 41: Systemic cost of risk for the major corridors in South Africa in asymptotic sequence	
Figure 42: Time series of railway occurrence cost vs. the value of freight transported for the iron ore	,
export corridor showing an arbitrary 0.1% cost of risk threshold (red line)	67

Figure 43: Time series of railway occurrence cost vs. the value of freight transported for the	_
manganese export corridor showing an arbitrary 0.1% cost of risk threshold (red line)	67
Figure 44: Time series of railway occurrence cost vs. the value of freight transported for the	
Gauteng – W <mark>es</mark> tern Cape corridor showing an arbitrary 0.1% cost of risk threshold (red line)	
Figure 45: Time series of railway occurrence cost vs. the value of freight transported for the coal expo	
corridor showing an arbitrary 0.1% cost of risk threshold (red line)	
Figure 46: Time series of railway occurrence cost vs. the value of freight transported for the Gauteng	
KwaZulu-Natal corridor showing an arbitrary 0.1% cost of risk threshold (red line)	
Figure 47: PRASA cost-benefit analysis all PRASA metropolitan municipalities in 2016/17	. 71
Figure 48: PRASA cost-benefit analysis for all PRASA metropolitan municipalities in 2015/16	. 71
Figure 49: PRASA cost-benefit analysis all PRASA metropolitan municipalities in 2016 scaled to 2015	.72
Figure 50: PRASA cost-benefit analysis for five major metropolitan municipalities in 2015/16	.72
Figure 51: PRASA cost-benefit analysis for five major metropolitan municipalities in 2016/17	.73
Figure 52: PRASA cost-benefit analysis for six district and metropolitan municipalities in 2015/16	.74
Figure 53: PRASA cost-benefit analysis for six district and metropolitan municipalities in 2016/17	.74
Figure 54: RSR intervention graph trend	76
Figure 55: 2016/17 RSR investigation root-cause findings	.77
Tables	
Table 1: 2010/11 - 2016/17 traffic volumes	19
Table 2: SANS Categories for operational occurrences and safety-related incidents	.22
Table 3: 2013/14 - 2016/17 Operational occurrences per annum	.26
Table 4: 2016/17 Main areas affected by operational occurrences	.29
Table 5: 2016/17 Provincial distribution of occurrence fatalities and injuries	40
Table 6: 2013/14 to 2016/17 Security-related incidents	.42
Table 7: 2016/17 Top 10 places per operator affected by safety-related incidents	.44
Table 8: 2016/17 RRP security-related successes	.46
Table 9: 2016/17 Places which recorded most security-related fatalities and injuries	47
Table 10: 2016/17 Running line collisions per province	51
Table 11: 2010/11 - 2016/17 People struck by trains timeframes	55
Table 12: 2016/17 PTI areas of concern	. 56
Table 13: Long term average railway occurrence bubble-size count for each corridor	66
Table 14: RSR Investigation Root Cause findings	. 78
Table 15: Root causes as identified by operator investigations	
	.83

### List of abbreviations

**BOC** Bombela Operating Company

**BOI** Board of Inquiry

**CEO** Chief Executive Officer

**DoL** Department of Labour

**DoT** Department of Transport

FY Financial Year

Km Kilometre(s)

MoU Memorandum of Understanding

NATMAP National Transport Master Plan 2050

NDP National Development Plan

**OHTE** Overhead traction equipment

**PRASA** Passenger Rail Agency of South Africa

RRP Rapid Rail Police

**RSR** Railway Safety Regulator

SADC Southern African Development Community

SANS South African National Standard

SAPS South African Police Services

SMS Safety Management System

SPAD Signal Passed at Danger

**SOSR** State of Safety Report

TE Transnet Engineering

**TFR** Transnet Freight Rail

THE ACT National Railway Safety Regulator Act No 16 of 2002, as amended

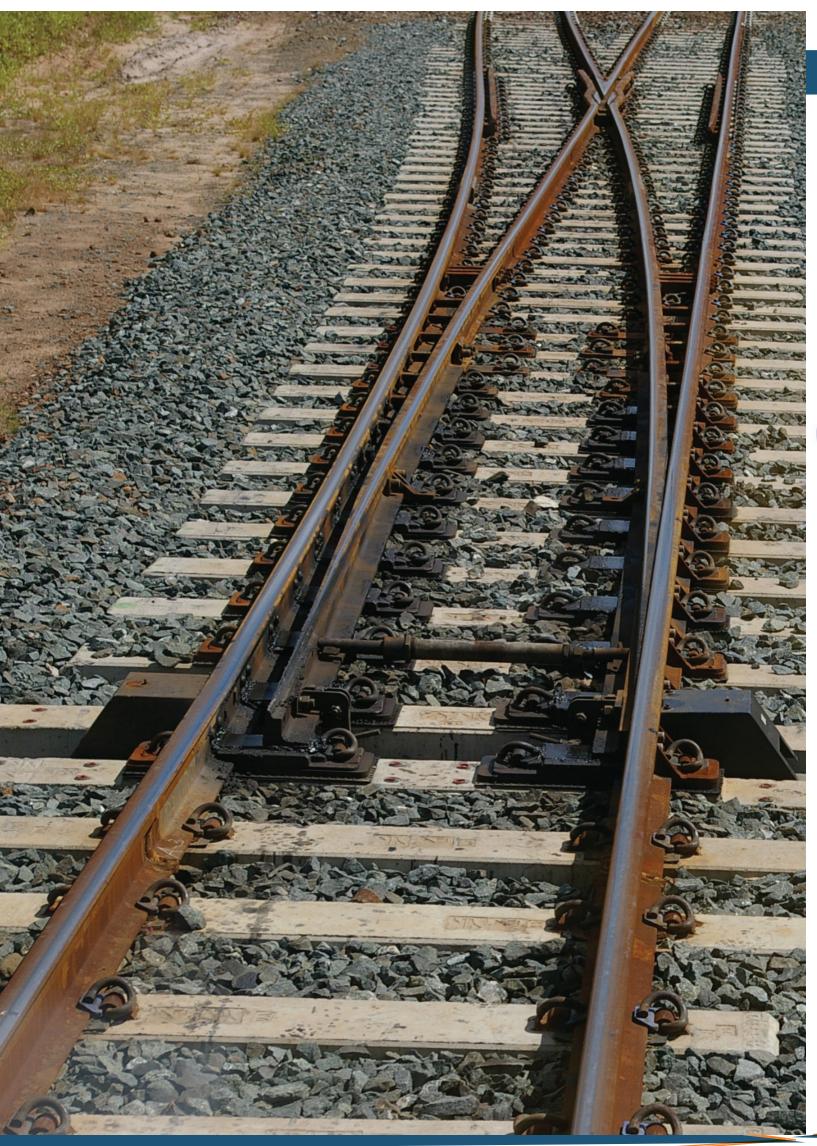
**THE MINISTER** Minister of Transport

**TNPA** Transnet National Port Authority

**TPT** Transnet Port Terminals







#### **Foreword**

Rail is the bedrock of the South African public transport system because of its unique strength to move large amounts of people and freight, thus contributing immensely to the socio-economic needs of the country.

It is worth emphasising that safe railway operations are at the top of the RSR's regulatory agenda, particularly because of the Regulator's imperative task of promoting rail as a safe and reliable mode of transport. Given the importance of rail transport, the RSR's mandate has increasingly become vital, warranting it to redouble efforts in ensuring safety.

With that said, one can confidently say that the RSR has continually rose to the occasion in as far as rail safety is concerned. The 2016/17 State of Safety Report continues to shed light on the risk-based approach of the RSR in terms of its strategic objective of significantly reducing occurrences towards achieving the vision of zero occurrences. In addition, the RSR conducted a cost of risk analysis of the important freight and passenger corridors, allowing the Regulator to identify the high risk corridors and areas for specific risk-mitigation attention during the 2017/18 reporting period.

The introduction of an occurrence per million-train kilometre analysis in line with international practice sets the scene for further in-depth analysis and risk identification in future. This analysis, combined with the costs of risk, as well as the outcome of the 2017/18 safety risk profile modelling project, aims to enable operators to refine their own risk identification and associated risk mitigation actions towards significantly reducing the root causes of operational occurrences.

An analysis of root causes of investigation outcomes of both the RSR and operators highlight the overwhelming contribution of human factors. Aspects such as understaffing of safety critical grades, poor levels of supervision, communication deficiencies, when combined with other root causes such as theft and vandalism, signalling and infrastructure defects, remain areas of concern.

The RSR has stepped up its response to these challenges and as such aims to expedite its decentralisation and augment safety assurance activities, the regulatory framework and education and awareness campaigns. This is in line with the in-depth analysis of occurrence data and trends, which will help to increase the pace towards achieving its ultimate vision of zero occurrences.

It is my privilege to present this 2016/17 State of Safety Report as a true and accurate reflection of the success achieved, but more importantly highlight the areas of concern which will require even greater focus in order to promote rail as the preferred mode of transport for all.

Mr Nkululeko Poya

RSR CEO

## **Executive summary**

The National Transport Master Plan 2050 (NATMAP) is clear about the public transport system required to propel economic growth and development in South Africa forward. It calls for efficient public transport as a critical component of national and global economic development. Large-scale investment projects in all spheres of the railway industry ranging from rolling stock, infrastructure such as stations, signalling, overhead traction equipment and safety upgrades are underway by major role players in the industry. Such projects, though aimed at increasing the attractiveness of rail transport, have also increased the focus on safety. For the RSR to achieve its vision of zero occurrences, it is important that the rail industry and the Regulator speak and act as one by focusing on risk management to reduce occurrences. The annual State of Safety report is part of the RSR's efforts to provide its stakeholders with a thorough overview of railway safety developments in South Africa.

During 2016/17, 98% of operators complied with the reporting requirements as per the RSR Act. This is a steady compliance increase from the 2010/11 reporting period. An analysis of the data reported and verified with relevant operators indicates a continued decrease in operational occurrences during the 2016/17 reporting period. A total number of 4 066 operational occurrences in comparison with 4 250 operational occurrences in the previous reporting period indicates a 5% decrease. This figure is the lowest total number of operational occurrences for the period since 2010/11. In stark comparison, 6 379 security-related incidents were recorded representing an increase of 13% compared to 2015/16. Tragically, the occurrences resulted in 495 fatalities and 2 079 people injured. This represents a 5% drop in the number of operational occurrences, with an 8% increase in fatalities, and 10% decrease in the number of injuries. Despite the general improvement, there has been no progress in reducing the number of some types of occurrences. The number of level-crossing occurrences, people struck by train, occurrences in which people travel outside the train (so-called "train surfing") and electric shock occurrences increased in the same period.

The provincial distribution of operational occurrences is, therefore, as per the previous years, mostly in Gauteng (29%), KwaZulu-Natal (27%) and Western Cape (19%). Transnet (TFR in particular) and PRASA Rail once again accounted for 97% of all operational occurrences reported to the RSR. The contributions of these two operators remained the same as the previous reporting period; Transnet contributed 52% and Prasa Rail to 45% of all operational occurrences.

The continued and increasing theft of overhead electric cables or signalling/infrastructure equipment results in abnormal train operations, with increased risk exposures and which may result in operational occurrences such as train collisions or derailments. TFR account for 43% and Prasa Rail 57% of all safety-related occurrences. The theft of assets constitutes 69% of all security-related incidents, and more than 52% of such incidents happen within the Transnet environment. PRASA bears the brunt of acts of vandalism, especially malicious acts of arson. The RRP have increased their visibility during the reporting period and have also increased their focus on arresting those who are contravening the law within the rail environment. A total of 169 firearms and 7 592 kg of cable with a value of R749 580 and R1 051 205 respectively were recovered during RRP operations.

According to international best practise, risk in railway safety, when expressed in the number of outcomes per exposure, is possibly the best measure of the safety level. International safety risk models measure the trend of fatalities per million, train km, as well as the specific rate of identified high impact occurrences per million train km. This year marks the first round of inclusion of this type of analysis, and will be expanded even more in future



reporting periods, as the RSR has embarked on establishing safety risk model and risk profiles for operators during the 2017/18 FY.

Since 2010, on average, the South African railway system experiences one (extrinsic) railway incident and one (intrinsic) operator occurrence every sixteen minutes. The vexing question is why this frequency of railway occurrences remains so consistently high despite all the grand efforts of the RSR and the licensed operators to reduce them.

It is conceivable that an element of systematic cost of risk lies embedded in the data and the RSR will continues to pursue the root causes. As was the case in the previous reporting period, close to 60% of all occurrences investigated were because of a human factor-related root cause. Perway defects contributed to 23% and rolling stock-related causes added another 10% to the findings.

In order execute its legislative mandate, The Regulator develops, implement and enforce various legislative tools which are inclusive of, railway safety standards, railway safety regulations, compulsory notices, guidance notices, to mention a few. During the review

period, two regulations have been compiled for publication in the government gazette by the DoT for public comments. The published regulations are; the Draft Security Matters Regulations, 2017 and The Draft Regulations Regarding Infrastructure or Activity Affecting Safe Railway Operations, 2017.

In addition, the RSR stepped onto unchartered grounds when it launched the first set of the Regulator Standards in December 2016. There are four Regulator Standards that were launched i.e. Fatigue Management (FM); Wheels, Axles and Bearings; Railway Stations and Occurrence Management. These standards serve as an amplification of the existing SANS 3000 series of standards

As a result of the Memorandum of Agreement signed between the RSR and UP on 14 November 2016, an RSR Chair in Railway Safety was established in the Faculty of Engineering, Built Environment and Information Technology at the University of Pretoria. Among other benefits and areas of cooperation (see cooperation rationale here below), the RSR chair in Railway Safety allows candidates to participate in railway safety related research and training.

#### Introduction

The National Transport Master Plan 2050 (NATMAP) is clear about the public transport system required to propel economic growth and development in South Africa forward. It calls for efficient public transport as a critical component of national and global economic development. The focus is on public transport that is integrated, efficient and that promotes sustainable economic growth. It must also support a healthier lifestyle, provide safe and accessible mobility options as well as socially include all communities, while preserving the environment. Safety is, therefore, critical in ensuring the success and sustainability of such a transport system.

The National Development Plan (NDP) not only sees rail as the bedrock of transport infrastructure development, but recognises its role as an investment lever to transform the economy due to its natural strength as a heavy duty and high-speed carrier, especially in high-volume traffic corridors.

The RSR was established in 2002 with the enactment of the National Railway Safety Regulator Act No 16 of 2002. To ensure that rail is positioned as the cornerstone of South Africa's integrated transport system, it is imperative that rail safety matches the aspirations of the NDP and most importantly, the Constitution of the Republic of South Africa. In terms of the Preamble of the Act, safe railway operations are fundamental to the safety of all persons and the environment and promote the use of railways as a mode of efficient transportation. In line with the mandate of the RSR, the five strategic focus areas

of the RSR gives prominence to high-risk areas, using the 80/20 principle as well as the Regulator's maturing risk approach to regulate railway safety.

2016/2017 reporting period has The been characterised by the largest and comprehensive investment developments in the South African railway landscape since the dawn of the country's democracy in 1994. Large-scale investment projects in all spheres of the industry ranging from rolling stock, infrastructure such as stations, signalling, overhead traction equipment and safety upgrades are underway by major role players in the industry. Such projects, though aimed at increasing the attractiveness of rail transport, have also increased the focus on safety.

For the RSR to achieve its vision of zero occurrences, it is important that the rail industry and the Regulator speak and act as one by focusing on risk management to reduce occurrences. As a custodian of the Act, the RSR is, in terms of Section 5 of the Act, entrusted with the responsibility of overseeing safety of railway transport, thereby playing a vital role in ensuring that all those who operate, travel by, or are near railway operations in South Africa, do so in a safe and reliable manner.

This State of Safety Report (SOSR), therefore, provides insight into the results of the evaluation of the safety performance over the period 01 April 2016 to 31 March 2017 and is produced in accordance with Clause 20 (1) of the Act, which stipulates that the RSR shall produce an annual report on the safety of workers, the public and the environment associated with railway operations.



#### Overview of the RSR

Monitoring safety performance is one of the key tasks of the RSR. The Regulator collects, processes and analyses different sets of data to support recommendations on actions to be taken. By continuously monitoring and analysing safety performance, the RSR provides oversight on rail safety.

A critical component of safety assessments is the availability of sufficient data to compare performance to the stated goals. In addition, it is important to know the impact and economic cost of an accident in order to determine the level of acceptable risk.

The SOSR is part of the RSR's efforts to provide its stakeholders with a thorough overview of railway safety developments in South Africa. In accordance with the RSR Act, the Report has been published on annual basis since 2006.

The RSR has a critical role to play by ensuring that the provision of rail transport is done with safety at the forefront of all operations. In line with this mandate, the mission of the RSR is "to oversee and promote safe railway operations through appropriate support, monitoring and enforcement, guided by an enabling regulatory framework".

There is established literature and well-developed methodologies for safety performance assessment. Typically, these methods begin with assessing whether safety goals and objectives are clearly articulated, and then assess performance against these objectives. The RSR, in executing its primary mandate to oversee railway safety, utilises several levels of legislation on rail safety, including the Act, regulations, standards, determinations and protocols.

The role of the RSR can be described as twofold in nature. The primary role is to provide safety oversight and to ensure safety in railway operations.

The secondary role is that of supporting the overseeing of security matters, and occupational health and safety matters that impact or may have an impact on safe railway operations. The supporting role in occupational health and safety and security is fulfilled through cooperation with relevant organs of state and other stakeholders through the implementation of MoUs with among others, the SAPS and the DoL.



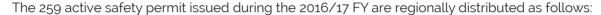




## Overview of the railway industry

#### Number of railway operators

A primary regulatory function of the RSR is issuing safety permits to railway operators. In line with Section 2 and Section 22 of the Act, the RSR granted 259 safety permits to operators who complied with the requisite regulatory requirements. As in the past, Transnet (including TFR as the largest subsidiary) and PRASA are the two largest railway operators in South Africa. The BOC, trading as Gautrain, is the third significant operator in the country. The other operators comprise rail entities at the ports, cross-border operations, tourism, rail heritage and surface operators on mines. In addition, municipal sidings and service lines – which provide access from the national network to private sidings for numerous operators in the agricultural, manufacturing and petro-chemical sectors – were also provided with the necessary operating safety permits.



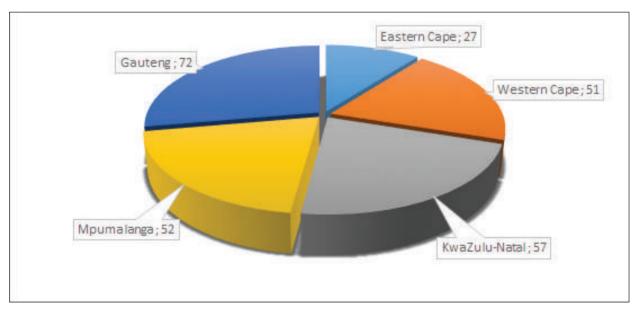


Figure 1: Permits issued per RSR region in the 2016/17 FY

The various railway operators (train, network and station) are grouped and issued with annual safety permits as follows:

Group A	Group B	Group C
500 000 tons or more of	Railway operators that transport between 200 000 tons and 500 000 tons of general goods, less than 50 000 tons of dangerous goods or tourists	transport less than 200 000
36%	29%	35%

#### Railway traffic volumes

Traffic volumes for the reporting period 2016/17, as submitted to the RSR by Transnet, PRASA Rail and BOC as Gautrain, can be presented as follows:

Operator/year	10/11	11/12	12/13	13/14	14/15	15/16	16/17
TFR (million train km)	45.9	46.3	46	46.9	47.03	39.04	39.14
TFR (billion-ton km)	117.9	126.5	132.4	134.6	144.7	138.4	143.46
PRASA (Million train km)	26.3	19.9	24.53	24.97	23.9	22.2	21.40
PRASA (million passenger km)	12 232	13 651	16 735	14 269	13 670	11 854	9 872
Gautrain (million train km)	0.48*	2.515	4.380	4.849	5.279	5.220	5.166
Gautrain (million passenger km)	0.46*	2.312	3.988	4.350	4.680	4.628	4.580

**Table 1**: 2010/11 - 2016/17 traffic volumes

(Note\* Two quarters only)

When considering the annual train kilometres per operator over the entire period from 2010/11 to 2016/17, the analysis below indicates an interesting trend for each of the operators:

**Transnet:** The graph indicates a decreasing trend in million train km since the period 2010/11 from more than 45 million train km to just over 39 million train km in 2016/17. Even though a slight increase was reported until 2013/14 and again during this reporting period, the overall performance is still well below the initial 45 million train km. In comparison, however, the billion-ton km trend shows a steady increase over the same review period from 2010/11 to 2016/17. This could be viewed as an increase in productivity in line with the Transnet Market Demand Strategy (MDS), which aims to be "on time and full". Also interesting to mention, as noted in an IOL Business Report article dated 11 April 2017, the increase in billion-ton km in the current reporting period from the period 2015/16 could be due to increased availability during the current FY. The article indicates that though South Africa's bulk export volumes increased by 27.4% year-on-year in March 2017 to 14 million tons, the 861km rail link between Sishen and Saldanha was closed for some days in March 2016 for maintenance. TFR also carried out maintenance on the rail link between the Mpumalanga coal mines and the coal export terminal of Richards Coal Bay Terminal (PREUSS, 2017).

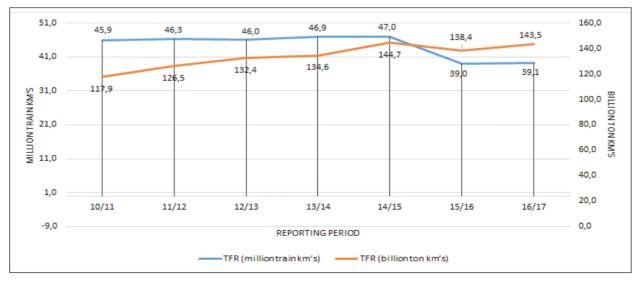


Figure 2: 2010/11 - 2016/17 TFR million train km/billion ton km trend

**Prasa Rail:** The graph illustrates the effects of a prolonged period of decreasing availability of rolling stock, infrastructure maintenance and criminal acts of vandalism and theft on PRASA Rail. It is noticeable that both the million train km and million passenger km have steady decreased over the period from 2010/11 to the current reporting period 2016/17.

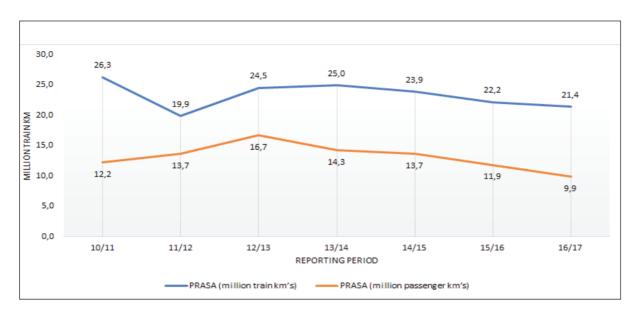


Figure 3: 2010/11 - 2016/17 PRASA million train km/million passenger train km trend

**Gautrain:** The Gautrain performance graph\_indicates a steady increase in both million train km and million passenger km. The reduction from the 2014/15 period to the last two periods, is attributed to a change in various operational activities over the period, such as:

- A number of special events with additional eight-car train sets over and above the scheduled trains, for example Eco mobility month in October 2015.
- Trains were scheduled with 20-minute headways in off-peaks with 3 X 8 cars during special events.
- Gautrain provided late service with reduced headway for trains allocated to specific social events for example the Eminem concert in February 2014.
- Withdrawal of trains during the service, that is, return of four-car train sets after the after peaks and re-insert them back at the start of afternoon peak.

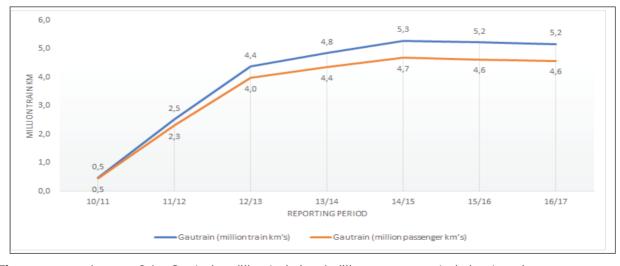
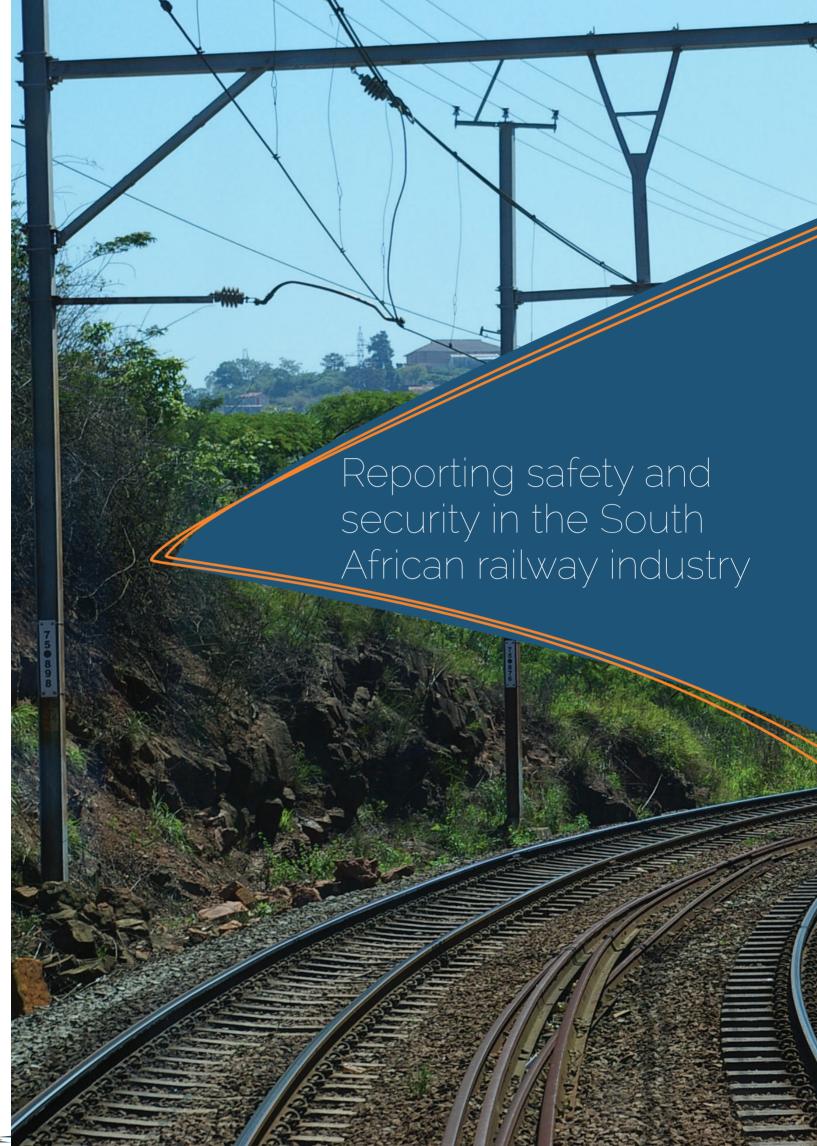


Figure 4: 2010/11 - 2016/17 Gautrain million train km/million passenger train km trend



## Reporting safety and security in the South African railway industry

Section 37 of the Act stipulates that "an operator must report to the CEO the category and type of all railway occurrences in the manner and form prescribed by the Minister". A set of clearly defined categories for recording and reporting of data are contained in the South African National Standard (SANS 3000-1 2009) - Railway Safety Management, Part 1: General. The table below comprises the major categories, which are divided into sub-categories, that is operational occurrences and safety-related incidents; as well as the main categories:

	onal occurrences happen resulting from unsafe or system faults within railway operations.  R fulfils a primary role in preventing or at least significantly reducing such occurrences
Α	Collisions during movement of rolling stock
В	Derailments during movement of rolling stock
С	Unauthorised Movements such as signal pass at danger
D	Level crossing occurrences
Е	People struck by trains during movement of rolling stock
F	People-related occurrences: trains in section
G	Passenger- related: travelling outside train
Н	People-related: platform train interface
I	People-related occurrences: station infrastructure
J	Electric shock
K	Spillage/leakage, explosion or loss of dangerous goods
L	Fire as result of electric or other operational reason
1	y-related incidents are criminal in nature and primarily fall within the mandate of RRP. The ays a supportive and advocacy role
1	Theft of assets (impacting on operational safety)
2	Malicious damage (vandalism) to property including arson
3	Threats to operational safety
4	Hijacking of trains
5	Crowd-related incidences
6	Industrial action
7	Personal safety on train
8	Personal safety on stations
9	Personal safety outside station platform area (including yards, sidings and depots)

Table 2: SANS Categories for operational occurrences and safety-related incidents

# Railway industry compliance to occurrence and incidents reporting

Section 37 of the RSR Act requires operators to report to the CEO the RSR the category and type of all the railway occurrences in the form and manner prescribed by the Minister. This requirement is described in Sections 7 and 10 of SANS 3000-1 2009. The data integrity of the RSR is influenced by various factors, such as under reporting, late reporting or incomplete information. Since 2008/09, the RSR has followed a rigorous process of data verification aimed at ensuring data integrity. The process also aims to improve the quality of the occurrence and incident data used for the compilation of the current report series. To eradicate under reporting, late reporting and incomplete information, the RSR also issued SMS guidelines to all operators to ensure timely and accurate data recording and reporting. A comprehensive explanation was also provided during the RSR awareness workshops for operators.

The submission of daily and quarterly reports to the RSR by the railway operators issued with safety permits forms part of the general conditions of the operator's railway safety permit. Operators that failed to comply with the conditions of the permit are liable for any corrective action the RSR deems appropriate to ensure compliance. The RSR is thus mandated to issue non-compliance directives or issue penalties in accordance with the RSR Penalty Fee Regulations 2011, as amended and provided for in the Act to achieve 100% submission rate.

During 2016/17, 98% of operators complied with the reporting requirements as per the RSR Act. This is a steady compliance increase from the 2010/11 reporting period. The annual average submission percentage data may be presented as follows:

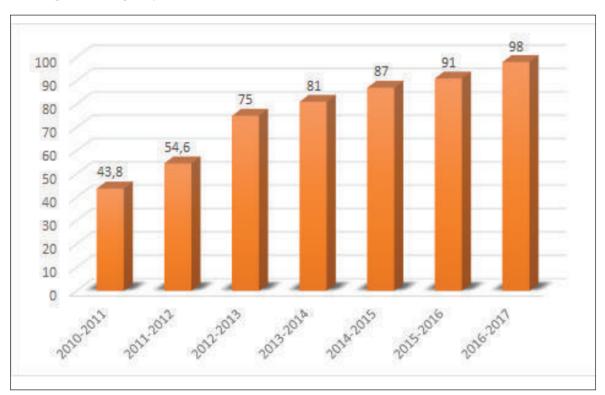


Figure 5: 2010/11 - 2016/17 Occurrence reports submission percentage trend

#### Railway safety performance comparison

This section contains a high-level analysis of the operational occurrences and safety related incidents of all operators during the 2016/17 reporting period. It includes geographic distribution as well as information pertaining to fatalities and injuries. The focus will be on the five main strategic occurrence categories as identified and on important security incidents such as vandalism (including train fires) and theft.

An analysis of the data reported and verified with relevant operators indicates a continued decrease in operational occurrences during the 2016/17 reporting period. A total number of 4 066 operational occurrences in comparison with 4 250 operational occurrences in the previous reporting period indicates a 5% decrease. This figure is the lowest total number of operational occurrences for the period since 2010/11. In stark comparison, 6 379 security-related incidents were recorded representing an increase of 13% compared to 2015/16. The graph illustrates the overall safety performance within the South African Railway industry since 2010/11:

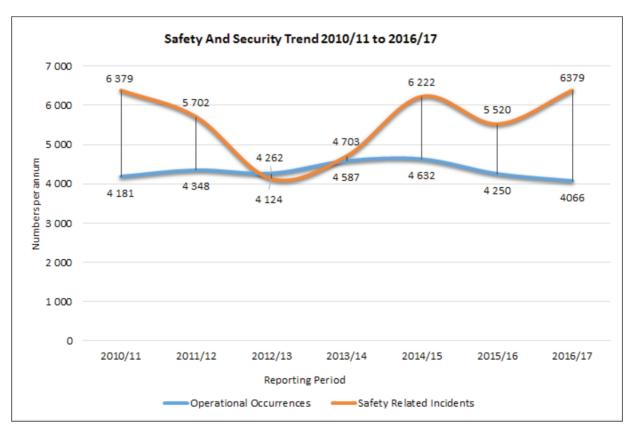
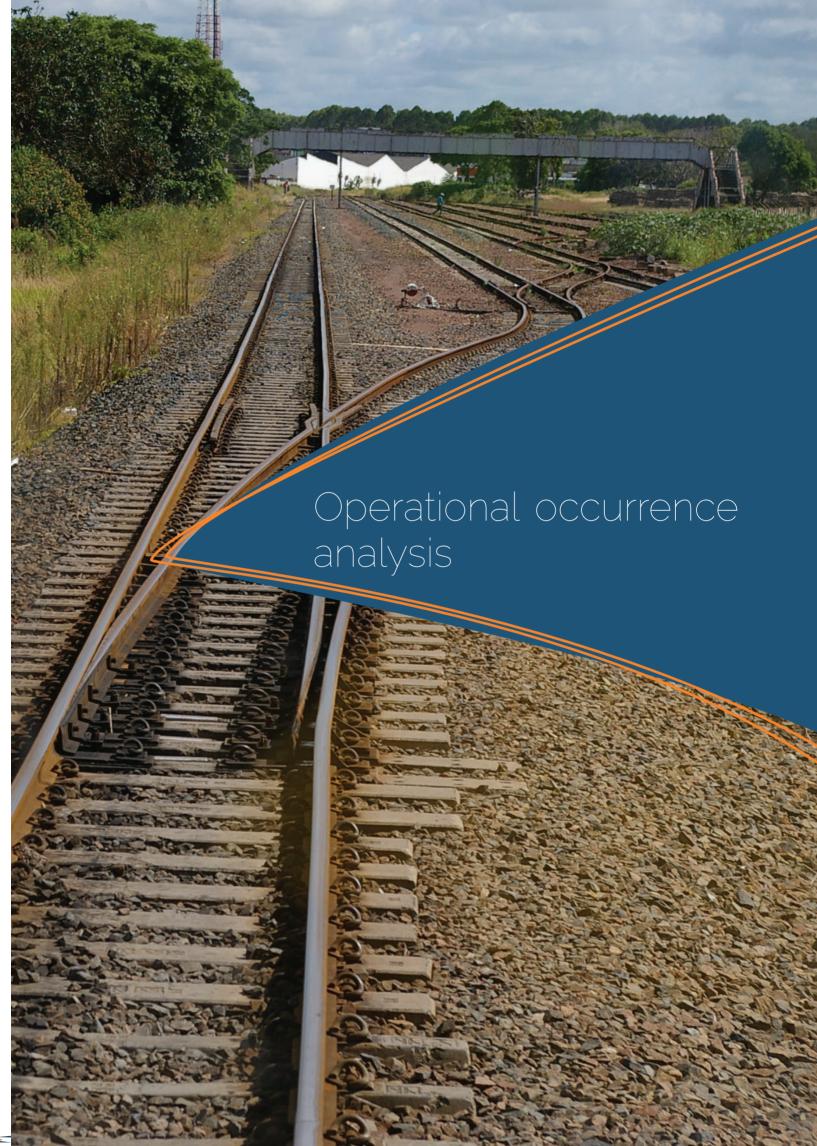


Figure 6: 2010/11 - 2016/17 Overall railway safety performance trends



## Operational occurrence analysis

According to the 2016/17 verified data, railway safety continued to improve across South Africa, with 4 066 operational occurrences. Tragically, the occurrences resulted in 495 fatalities and 2 079 people injured. This represents a 5% drop in the number of operational occurrences, with an 8% increase in fatalities, and 10% decrease in the number of injuries. Despite the general improvement, there has been no progress in reducing the number of some types of occurrences. The number of level-crossing occurrences, people struck by train, occurrences in which people travel outside the train (so-called "train surfing") and electric shock occurrences increased in the same period.

The table provides a yearly total occurrence category comparison from 2013/14 to 2016/17, the trend column provides a comparison with the previous 2015/16 reporting period.

Reporting year	2013/14	2014/15	2015/16	2016/17				
South African National Standards (SANS) category	All	All	All	TFR	PRASA	Other	All	Trend
A: Collisions during movement of rolling stock	980	1 059	1 099	944	45	17	1 006	-9%
B: Derailments during movement of rolling stock	718	592	421	268	28	90	386	-9%
C: Unauthorised movements including rolling stock movements exceeding limit of authority	121	93	94	41	33	10	84	-12%
D: Level crossing occurrences	119	109	87	93	19	7	119	27%
E: People struck by trains during movement of rolling stock	588	643	541	189	460	2	651	17%
F: People-related occurrences: trains outside station platform areas or in section	209	338	337	2	323	0	325	-4%
G: Passenger-related occurrences: travelling outside designated area of train	94	163	131	0	140	0	140	6%
H: People-related occurrences: platform train interface	715	612	658	1	572	0	573	-15%
I: People-related occurrences: station infrastructure	190	166	130	0	111	0	111	-17%
J: Electric shock	35	34	27	13	17	0	30	10%
K: Spillage/leakage, explosion or loss of dangerous goods	250	265	223	208	0	1	209	-7%
L: Operational train fires	568	558	502	357	75	0	432	-16%
TOTAL	4587	4 632	4 250	2 116	1 823	127	4 066	-5%

Table 3: 2013/14 - 2016/17 Operational occurrences per annum

As per the table above, the top five contributing categories in terms of number of occurrences are:

- Category A Collisions during movement of rolling stock (33%);
- Category B Derailments during movement of rolling stock (13%);
- Category E People struck by trains during movement of rolling stock (21%);
- Category H People related occurrences: platform train interface (19%); and
- Category L Fires, including operational electrical faults, "veld fires" and pantograph hook-ups (14%).

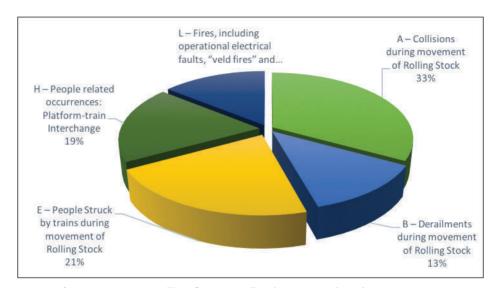


Figure 7: 2016/17 Top five contributing operational occurrences

Given the geographic nature of the two main train operators, most operational occurrences were recorded in the provinces where both operators' main activities are in terms of train volumes. The provincial distribution of operational occurrences is, therefore, as per the previous years, mostly in Gauteng (29%), KwaZulu-Natal (27%) and Western Cape (19%). The graph indicates the provincial distribution of operational occurrences during 2016/17:

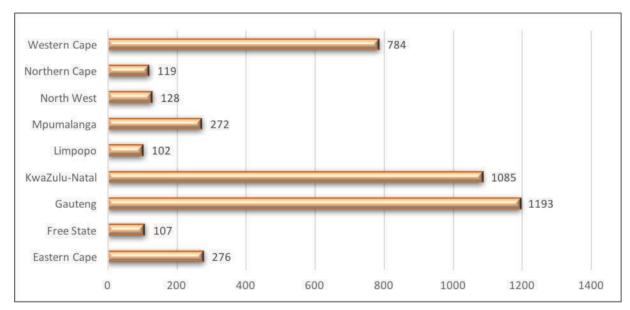


Figure 8: 2016/17 Operational occurrences provincial distribution

The map indicates the geographic distribution of operational occurrences during the period 2016/17:

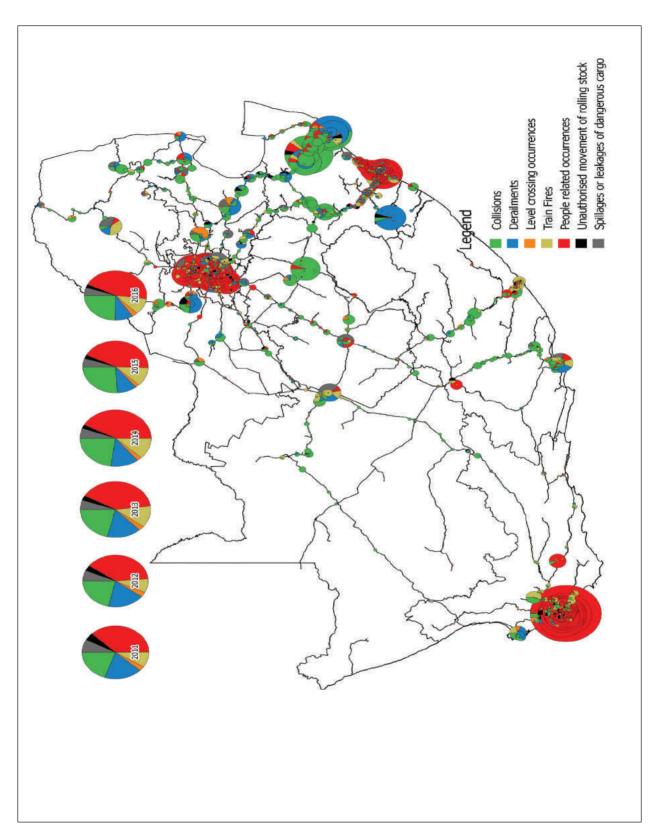


Figure 9: 2016/17 Geographic display of all operational occurrences (all operators)

The top five places per province where the most operational occurrences were recorded are as follows:

Province	Place	No of operational occurrences				
	Germiston	38				
Cautana	Elandsfontein	25				
Gauteng	Pretoria	23				
	Kempton Park	21				
	Doornfontein	21				
	Zwelethu	22				
Kwa Zulu Natal	RBCT	18				
KwaZulu Natal	Reunion	17				
	Berea Road	15				
	Duffs Road	15				
	Philippi	34				
\V/a at a wa Cara a	Nyanga	28				
Western Cape	Bellville	26				
	Cape Town	25				
	Bonteheuwel	24				





Each of the following maps indicates the geographic distribution per specific type of occurrence during the 2016/17 period (all operators). In addition, pie-charts at the top of each map indicate the numbers of the type off occurrence over the period 2010/11 to 2016/17:

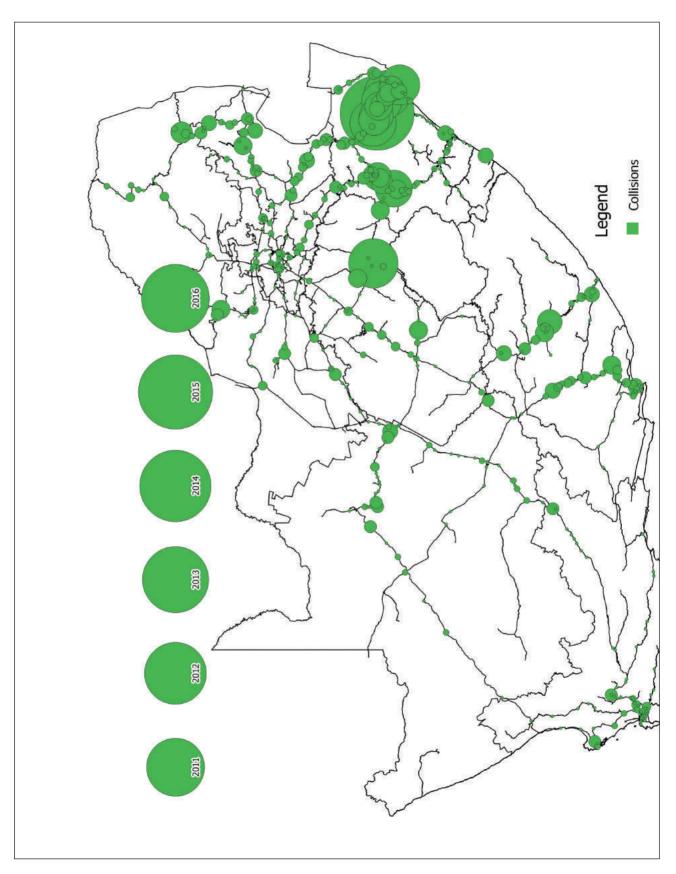


Figure 10: 2016/17 Geographic display: Collisions

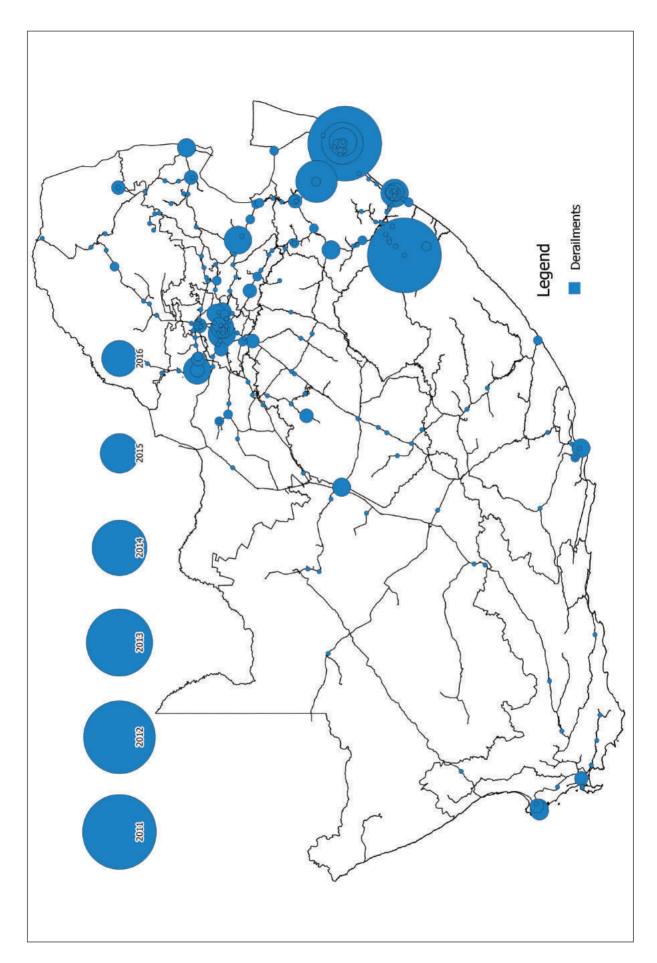


Figure 11: 2016/17 Geographic display: Derailments

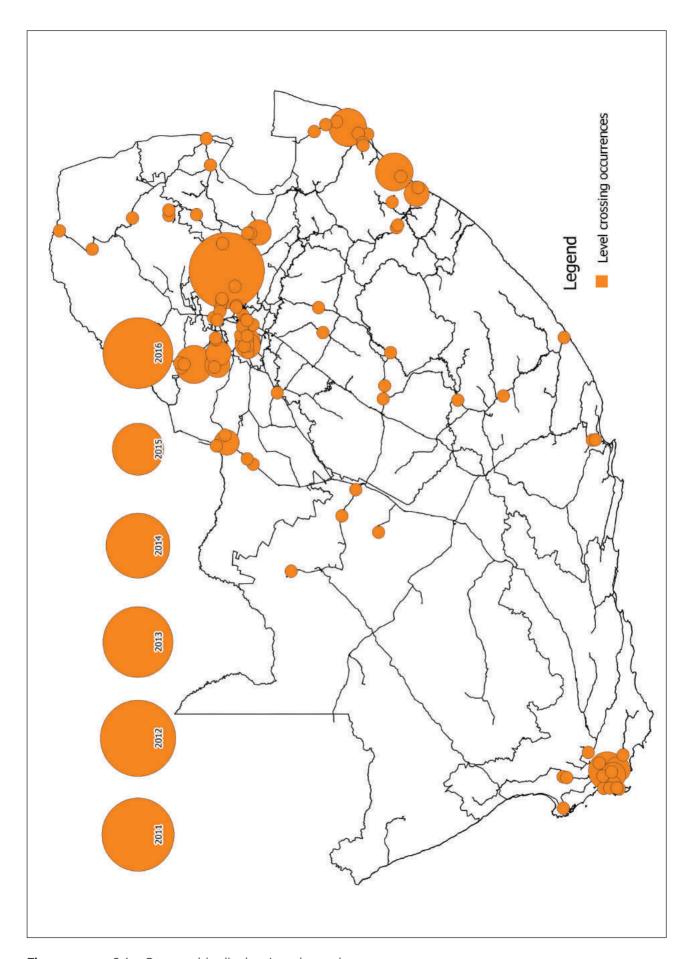


Figure 12: 2016/17 Geographic display: Level crossing occurrences

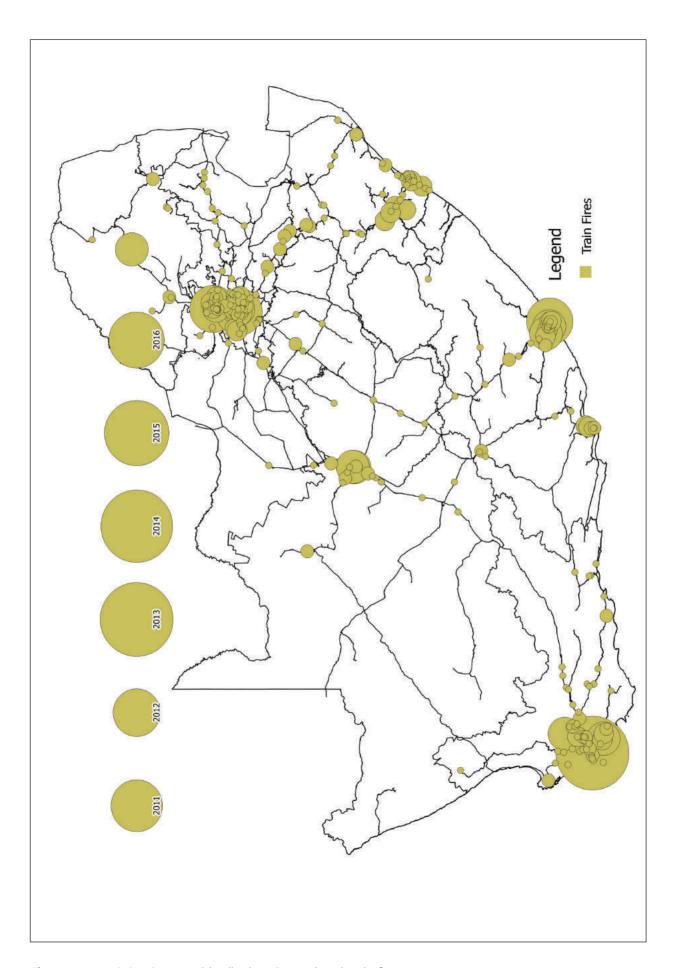


Figure 13: 2016/17 Geographic display: Operational train fires

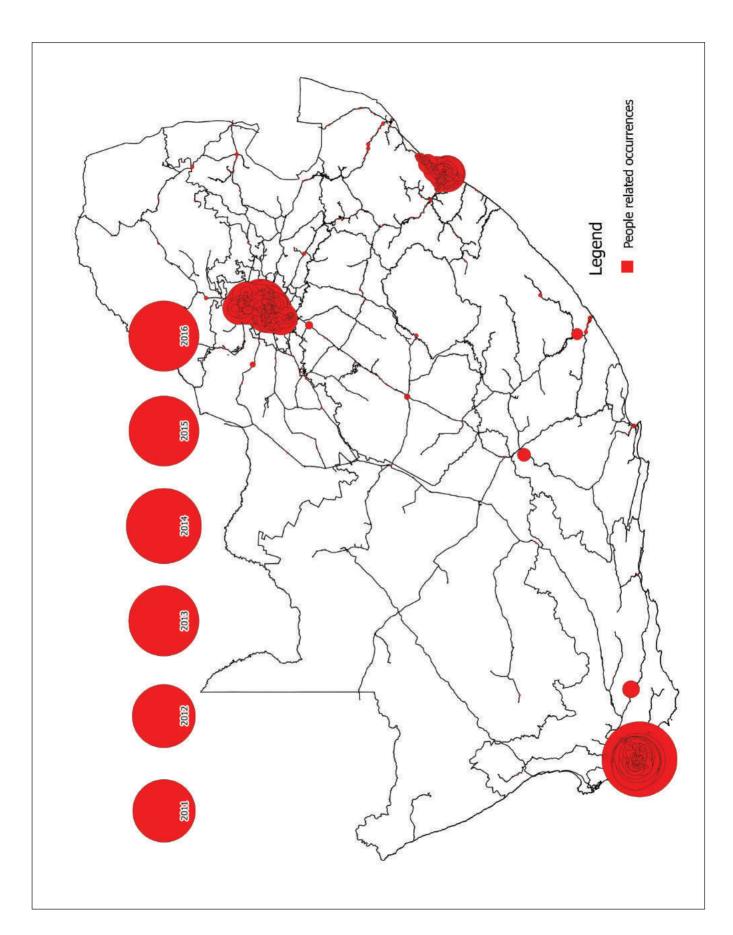


Figure 14: 2016/17 Geographic Display: People related occurrences (people struck by trains, platform train interface

#### Operational occurrence trends per operator

Given the nature of the South African rail industry, the two main operators, namely Transnet (TFR in particular) and PRASA Rail once again accounted for 97% of all operational occurrences reported to the RSR. The contributions of these two operators remained the same as the previous reporting period; Transnet contributed 52% and Prasa Rail to 45% of all operational occurrences. The remaining 3% was reported by various other operators such as Bombela, Richards Bay Coal Terminals, Impala Platinum and Umfolozi Sugar Planters Limited. The data also indicates that there are some operators who recorded zero occurrences during the same period which is laudable. The graph illustrates the distribution of operational occurrences per operator over the period from 2010/11 to 2016/17:

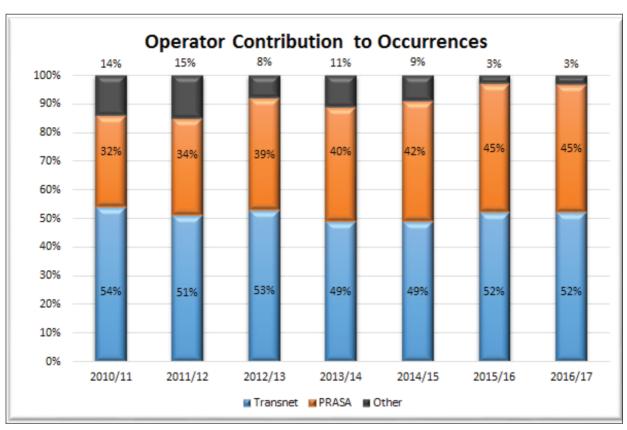


Figure 15: 2016/17 Distribution of occurrences per operator

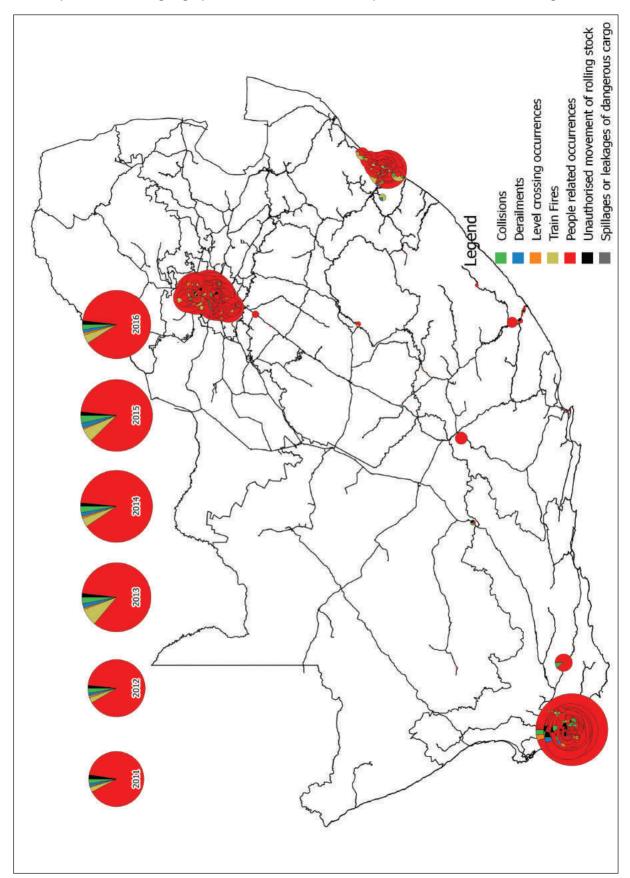


Figure 16: 2016/17 Geographic display of all operational occurrences - PRASA

The map clearly illustrates that most occurrences as reported by PRASA, are people-related occurrences, comprising of either people struck by trains or platform train interface occurrences. It is also clear that the highest numbers are concentrated in the provinces of Gauteng, Western Cape (Cape Town) and KwaZulu Natal (EThekwini) and involve daily commuter-trains (Metrotrain). As per the map, a few occurrences involving the long-distance Shosoloza train, were also reported in the Eastern Cape.

The geographic distribution for all Transnet subsidiaries during 2016/17 are as per the map below:

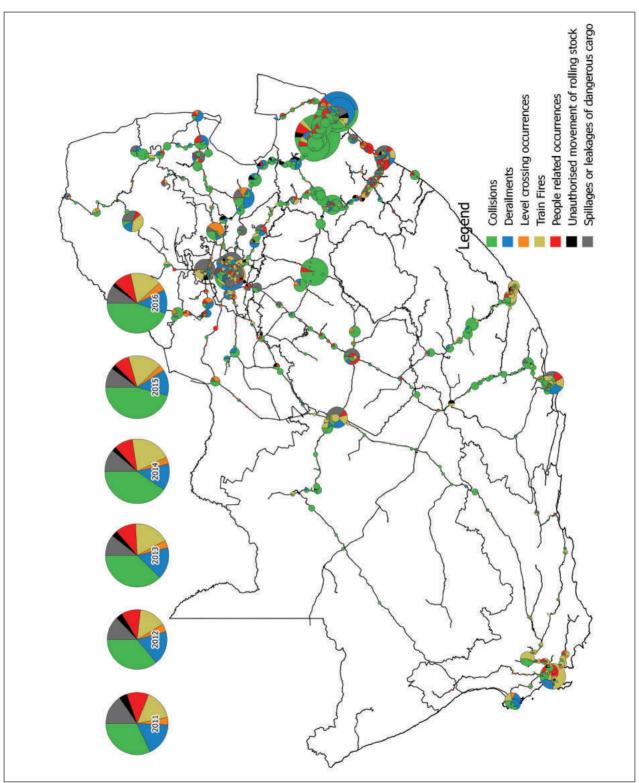


Figure 17: 2016/17 Geographic display of all operational occurrences - Transnet

The geographic distribution of all operational occurrences during 2016/17 as reported by Transnet, bears a strong similarity to the map illustrating all operational occurrences. This is mainly because Transnet (TFR in particular) operates as the largest freight operator, and also owns the majority of the infrastructure within the South African rail Industry. It remains concerning to note that occurrences involving derailments, collisions, operational train fires and spillages of dangerous goods continue to dominate the Transnet operational occurrences. These types of occurrences could lead to a delay in trains, thereby negatively affecting reliability and availability of freight services by rail. It is also clear that the Coal-line from Gauteng to Richards Bay as well as the Natcor Line between Gauteng and EThekwini (KZN) account for the majority of occurrences, while the freight lines in the Eastern Cape and towards Mozambique in Mpumalanga were also affected. Of further concern, is the high concentration of occurrences in at major depot areas in Gauteng and others such as Kimberley, Bloemfontein, Bethlehem, Ermelo and Nelspruit.

#### Fatalities and injuries resulting from operational occurrences

On a regular basis, South African newspapers publish articles such as "A man is fighting for his life after he was struck by a train near the Berea Road railway station this morning. Reports indicate that the man was trying to cross the lines when he fell in front of the train (Accident.co.za, 2011)." During the 2016/17 reporting period, 495 people lost their lives in the South African railway environment while 2 079 people were injured. This shows an increase of 5% in fatalities from the previous period, and amounts to almost two deaths per day, while the 10% decrease in injuries still mean that almost 6 people are injured daily.

The graph below illustrates the trend of fatalities and injuries during operational occurrences from 20101/11 to 2016/17:

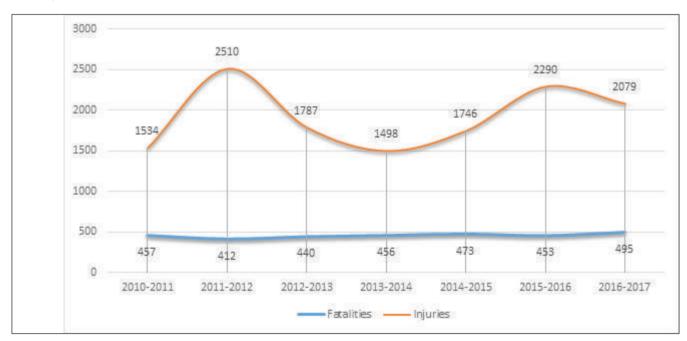


Figure 18: 2010/11 - 2016/17 Fatalities and injuries

Category E (people struck by trains) remains the highest contributing occurrence, but of concern is the number of people injured from falling off a moving train (17 fatalities) or travelling on the outside of a train (20 fatalities).

In the two pie-charts, the occurrence types contributing to fatalities and injuries are illustrated:

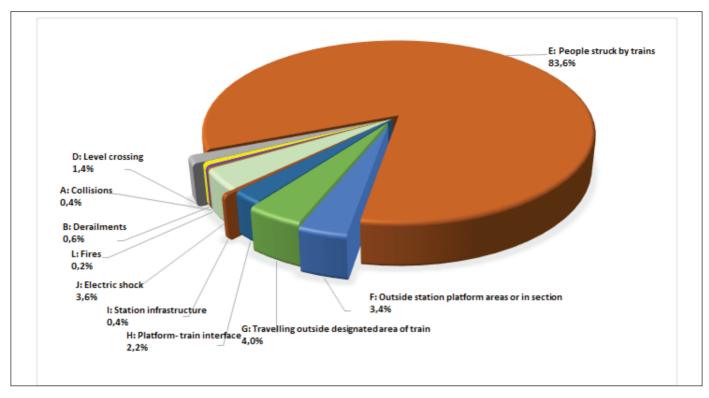


Figure 19: 2016/17 Fatalities per operational occurrence category

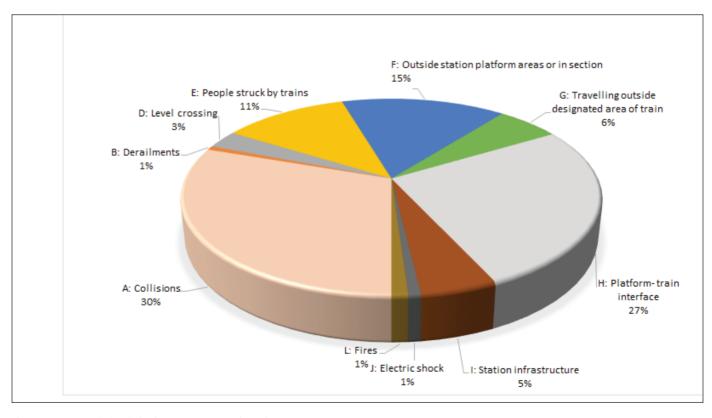


Figure 20: 2016/17 Injuries per operational occurrence category

In line with the geographic distribution of operational occurrences, the majority of fatalities (44%) were recorded in Gauteng, while 28% of fatalities were reported in the Western Cape and 19% in KwaZulu-Natal. In terms of injuries, Gauteng reported 41%, Western Cape 14% and KwaZulu-Natal 18%.

Province	Fatalities	Injuries
Eastern Cape	19	19
Free State	4	12
Gauteng	219	1 124
KwaZulu-Natal	92	481
Limpopo	4	24
Mpumalanga	9	17
North West	9	12
Northern Cape	2	2
Western Cape	137	388
Grand total	495	2 079

**Table 5:** 2016/17 Provincial distribution of occurrence fatalities and injuries



The map depicts the geographic distribution of fatalities and injuries due to operational occurrences during 2016/17:

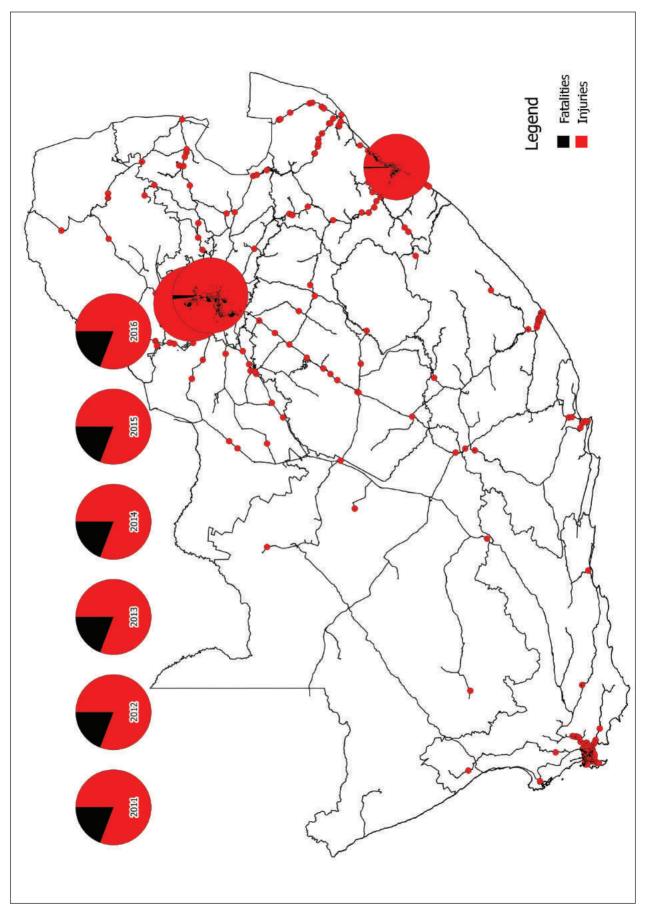


Figure 21: 2016/17 Geographic distribution of operational occurrence fatalities and injuries

#### **Security-related incidents**

The RSR supports the work of the South African Rapid Rail Police (RRP) in terms of addressing security-related incidents in the South African railway environment. The rail industry is plagued by theft and acts of vandalism of infrastructure such as cables, signalling equipment, transformers and rail track components such as rail fasteners and rail tracks. In terms of rolling stock, locomotive batteries, train doors, and other components are the prime theft commodities. Given that such actions have a negative impact on train operations, the RSR tracks such occurrences and advises the RRP and operators accordingly.

The continued and increasing theft of overhead electric cables or signalling/infrastructure equipment results in abnormal train operations, with increased risk exposures and which may result in operational occurrences such as train collisions or derailments. This in turn results in unexpected passenger train delays, which result in dissatisfied commuters venting their anger on trains by setting the rolling stock alight.

Operators informed the RSR of security-related incidences in compliance to SANS 3000-1 (2009), however, some incidents are only reported to the RSR or the RRP depending on the nature of the crime as well as the reporting entity involved. To ensure alignment between the data of the RSR and RRP, annual comparative data verification is performed. As previously stated, a total number of 6 379 security-related incidents were recorded during the 2016/17 reporting period, which is a 13% increase from 5 520 incidents recorded during the 2015/16 reporting period. It is the highest number of security-related incidents recorded since 2010/11. The table below indicates the security-related incident trend since 2013/14:

Reporting year	2013/14	2014/15	2015/16	2016/17				
South African National Standards (SANS) category	All	All	All	TFR	PRASA	Other	All	Trend
1: Theft of assets	3 068	4 213	3 600	2310	2061	8	4 379	18%
2: Malicious damage (vandalism)	1 019	1 094	1 158	374	757	31	1 162	0,3%
3: Threats of operational safety	6	0	2	0	0	0	0	-200%
4: Train kidnapping or hijacking	o	0	0	0	0	0	o	0%
5: Crowd-related occurrences	7	2	0	0	0	0	o	0%
6: Industrial action	4	4	1	0	8	0	8	88%
7: Personal safety on trains	283	516	368	0	408	0	408	10%
8: Personal safety on stations	247	278	305	0	312	0	312	2%
9: Personal safety outside station platform area	69	115	86	35	74	0	109	21%
TOTAL	4 703	6 222	5 520	2 719	3 620	39	6 378	13%

Table 6: 2013/14 - 2016/17 Security-related incidents

The main contributing categories are crimes associated with theft of assets, malicious damage and acts of vandalism such as arson and acts of crimes on commuters on trains, at stations and outside the station. The graph below indicates the distribution safety-related incident categories:

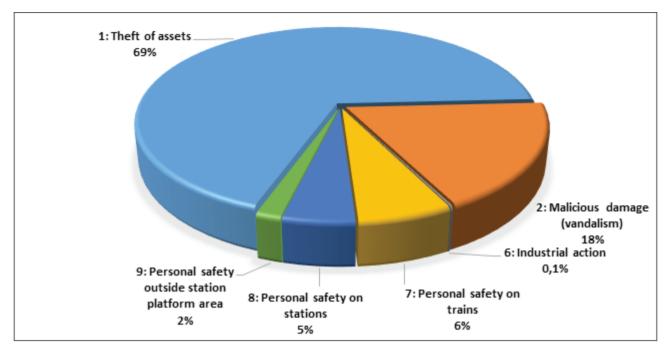


Figure 22: 2016/17 Security-related incident distribution

TFR account for 43% and Prasa Rail 57% of all safety-related occurrences. The theft of assets constitutes 69% of all security-related incidents, and more than 52% of such incidents happen within the Transnet environment. PRASA bears the brunt of acts of vandalism, especially malicious acts of arson. The table illustrates the distribution of security-related incidents per operator during the 2016/17 reporting period:

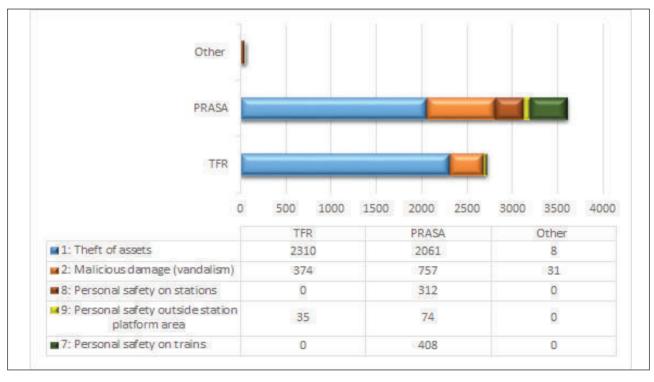


Figure 23: 2016/17 Security-related incidents per operator

Security-related incidents continue to have a disruptive effect on safe and reliable rail transport, and as such the RSR will continue to monitor areas where continued activities threaten the railway industry. These criminal activities often lead to train delays due to faulty signalling equipment, lack of communication and abnormal train operations. Several train collisions have been recorded, resulting directly from abnormal train operations following acts of vandalism. The table show the top 10 places affected by security-related incidents per operator during 2016/17 reporting period:

Transnet	PRASA Rail
Komatipoort	Cape Town
Emakwezini	Paarden Eiland Yard
Richards Bay North	Braamfontein yard
Empangeni	Bonteheuwel - Netreg
Vandyksdrift	Germiston
Blinkpan	Bonteheuwel - Lavistown
Rooikop	Kliptown
Kaapmuiden	Houtheuwel
Witbank	India

**Table 7**: 2016/17 Top 10 places per operator affected by safety-related incidents

In terms of geographic distribution, the map illustrates the distribution of security-related incidents during 2016/17:

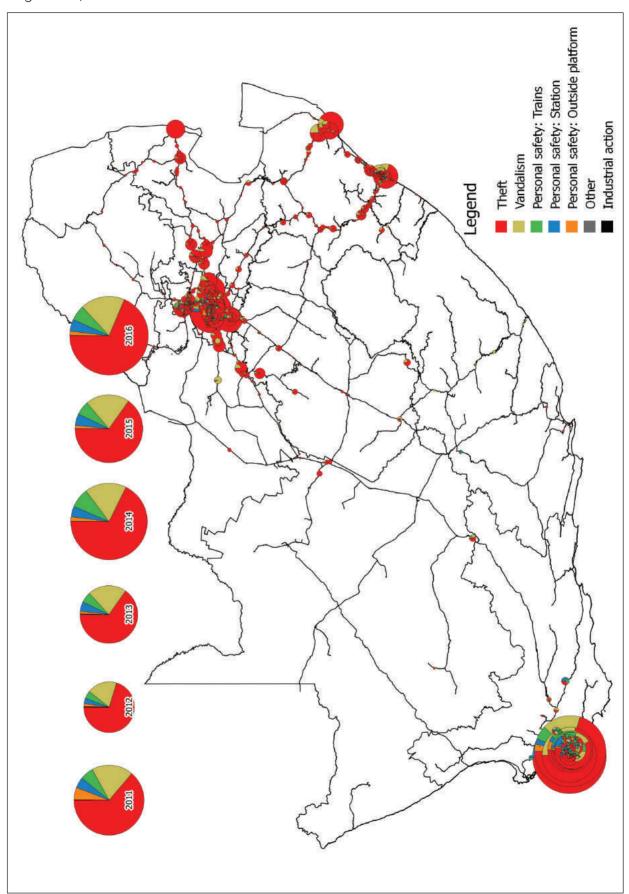


Figure 24: 2016/17 Geographic distribution of security-related incidents

## Rapid Rail Police successes

The RRP have increased their visibility during the reporting period and have also increased their focus on arresting those who are contravening the law within the rail environment. In addition, 169 firearms, with a value of R749 580 and 7 592 kg of cables with a value of R1 051 205 were recovered during RRP operations.

The table below illustrates the number of arrest per category as part of the RRP successes:

TYPE OF CRIME	TOTAL
Illegal Railway Crossing	15 887
Travel without valid Train Ticket	2 559
Keeping Train Doors Open	68
Blocking Train Doors	16
Standing Between Coaches	54
Traveling Between Coaches	97
Staff Riding	5
Fair Evasion	182
Illegal Smoking on the Train	127
Embark or disembark from a moving train	9
Drinking inside the train	10
Train surfing	1
Travel where not allowed	3
TOTAL	19 018

**Table 8:** 2016/17 RRP security-related successes

#### Fatalities and injuries as result of security-related incidents

In line with the increase in security-related incidents, the number of people who have lost their lives or sustained injuries due to criminal acts in the rail environment also increased from the previous reporting period. A total number of 16 fatalities (increase of 14%) and 525 injuries (increase of 13%) was reported, in comparison to 14 fatalities and 466 injuries in the previous 2015/16 period. The graph below illustrates the year-on-year increase in both fatalities and injuries.

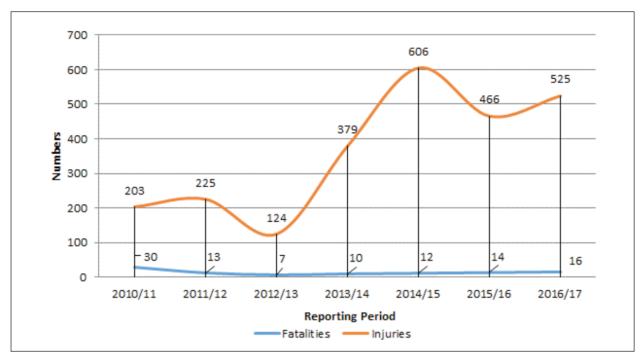


Figure 25: 2016/17 Fatalities and injuries due to security-related incidents

Gauteng and Western Cape recorded most fatalities and injuries due to security-related incidents, as shown in the table:

Gauteng	Western Cape
City Deep	Bellville
Doornfontein	Cape Town
Fountains	Eikenfontein
Germiston	Elsiesriver
Inhlazane	Heideveld
Jeppe - George Goch	Kraaifontein
Johannesburg	Kuilsriver - Bellville
Kwaggastroom	Mitchells Plain
Leralla	Netreg
Midway	Nyanga
Phefeni	Parow
Pretoria	Stikland

Table 9: 2016/17 Places which recorded most security-related fatalities and injuries

As per the previous reporting periods, many fatalities and injuries are recorded in the categories relating to assault of commuters and members of the public outside stations, at stations or when travelling on trains. The graphs indicate the various contributing security-related incidents resulting in fatalities and/or injuries

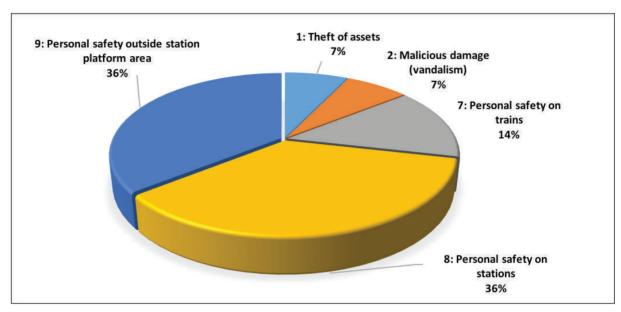


Figure 26: 2016/17 Fatalities per security-related category

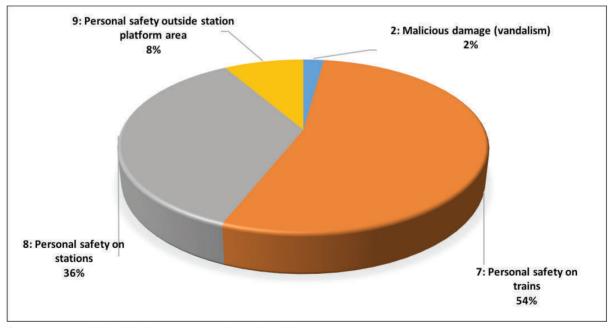
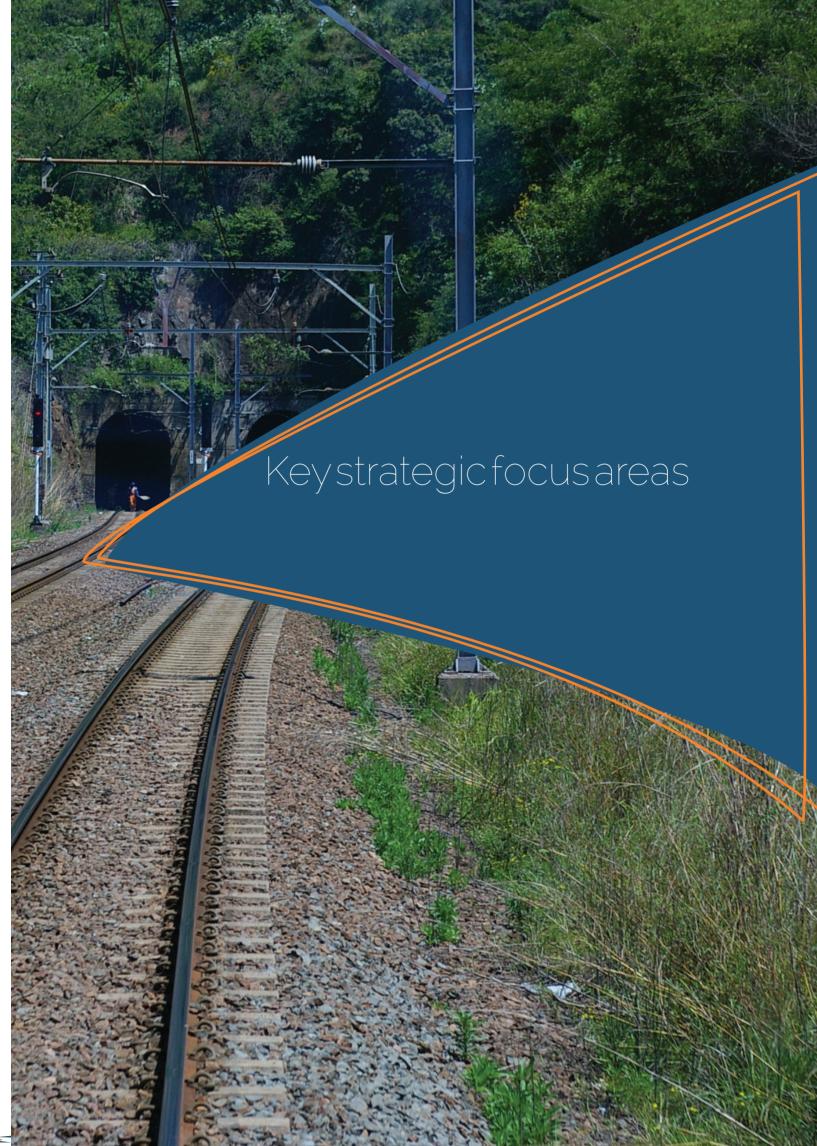


Figure 27: 2016/17 Injuries per security-related category



# Key strategic focus areas

In aspiring towards the vision of zero occurrences, the RSR has been focusing on the identified 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 compliance and enforcement. The selected areas are operational-occurrence based, and are in line with international best practice of assessing the risk profile of operators within the railway industry. The focus areas are the following operational occurrence categories, as defined in SANS 3000: 1 2009: General:

- Category A-a: Mainline collisions between rolling stock
- Category B-a: Mainline derailments of rolling stock
- Category D-a: Level Crossing occurrences at authorised level crossings
- Category E-a: People struck by trains in a main line
- Category H-a and H-b: Platform train interface occurrences

The five categories of operational occurrences, when they happen, have either a large scale financial impact in terms of direct costs incurred for damage to rolling stock due to derailments and collisions; indirect costs due to closure of lines for recovery purposes; or possible large-scale human impact in terms of fatalities and injuries during passenger train collisions, level crossings and people-related occurrences such as people struck by trains and platform train interface occurrences. The graphs illustrate a comparison of the operational occurrences in the period 2013/14 to 2016/17:

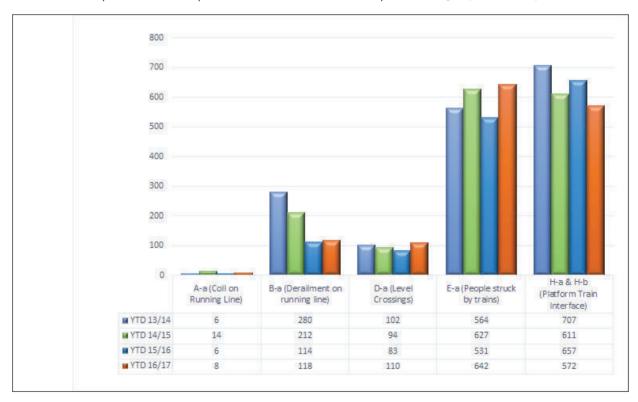


Figure 28: Strategic focus annual occurrence totals comparison 2013/14 - 2016/17

## Running line collisions between rolling stock

During the 2016/17 reporting period, eight train-on-train collisions on a running line were reported. This is an increase of two occurrences from the six reported in the previous reporting period. Though an increase in the number of occurrences is noted, the main concern remains the involvement of passenger trains in such collisions. Not only did the three passenger train collision occurrences result in R277 million in direct costs because of damage to rolling stock and infrastructure, but resulted in two fatalities and 623 injuries. The outcome of investigations to determine the root causes of these occurrences are discussed in the RSR Intervention section of this Report, however, it is vital to note that contributing factors such as theft of signalling and communication equipment and poor communication remain a concern. The table below provides the locations of the collisions.

Province	Place	Fatalities	Injuries	Costs (R Million)
Eastern Cape	Flonker	1	3	R39
Eastern Cape total		1	3	R39
Gauteng	Kaalfontein - Tembisa	1	242	R23
	Lynross	0	212	R14
Gauteng total		1	454	R37
KwaZulu-Natal	Merebank	0	165	R12
KwaZulu-Natal total		0	165	R12
Limpopo	Thabazimbi	0	0	
	Thabazimbi - Lephalale	0	0	
Limpopo total		0	0	Ro
Mpumalanga	Spruytsrus	0	1	R101
Mpumalanga Total		0	1	R101
North West	Rustenburg	0	0	0
North West total		0	0	
Grand total		2	623	R277

**Table 10**: 2016/17 Running line collisions per province

## Running line derailments

The total number of derailments on a running line increased by 3% from 114 during 2015/16 to 118 in the 2016/17 reporting period. KwaZulu-Natal remains the main affected area with Umfolozi recording eight such derailment during 2016/17. Other areas of concern are Sybrandt and Welgedagt in Gauteng and Rustenburg in North West. An analysis of mainline derailments per operator shows that TFR contributed 71.2% of all mainline derailments. The direct costs to PRASA and Transnet as reported to the RSR are more than R130 million with three fatalities and 12 injuries as a result of the 118 occurrences.

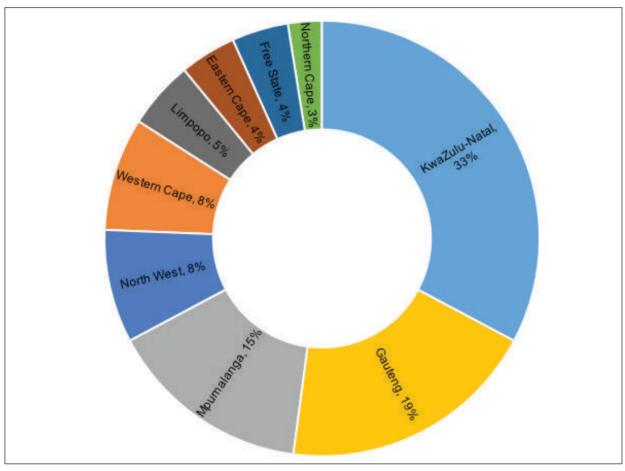


Figure 29: Running line derailments per province

#### Level crossing occurrences

Statistics reflect a 25% increase in level-crossing related occurrences for the reporting period. It is also not surprising that the number of fatalities and injuries has increased during this reporting period. Investigations indicate that the main reason for these occurrences can be attributed to poor road vehicle driver behaviour and inadequate level-crossing signage. The graph illustrates the drastic increase in the number of occurrences, fatalities and injuries during the current reporting period.

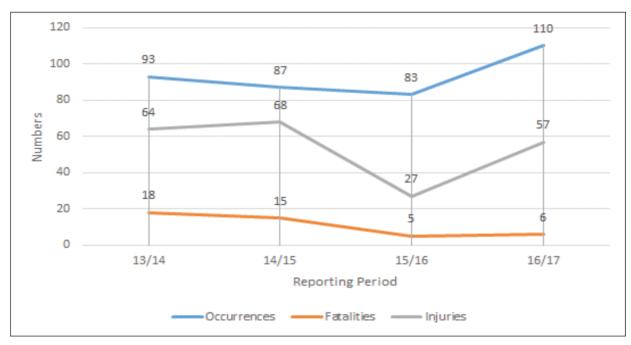


Figure 30: 2013/14 - 2016/17 Mainline level crossing occurrence trend

The RSR has intensified its commitment to decrease level crossing occurrences, and as such has established the Level Crossing Technical Committees at provincial level to involve road and rail stakeholders. A targeted approach aims to identify the most problematic level crossings per province and focus on addressing the specific remedy required. This, however, is a costly and intensive process and results will only be forthcoming once the identified interventions have been completed. The focus has been in provinces where the largest number of occurrences have been recorded. Support is provided to the other provinces to identify problematic level crossing and identify mitigation actions. The graph shows that most level crossing collisions between rolling stock and road vehicles occur in Gauteng, KwaZulu-Natal, Mpumalanga and Western Cape.

Of concern is the increased involvement of PRASA Rail passenger trains in such occurrences in areas such as Gauteng (Zuurbekom, Westonaria) and KwaZulu-Natal (Charlottedale) which could potentially have resulted in numerous fatalities and injuries.

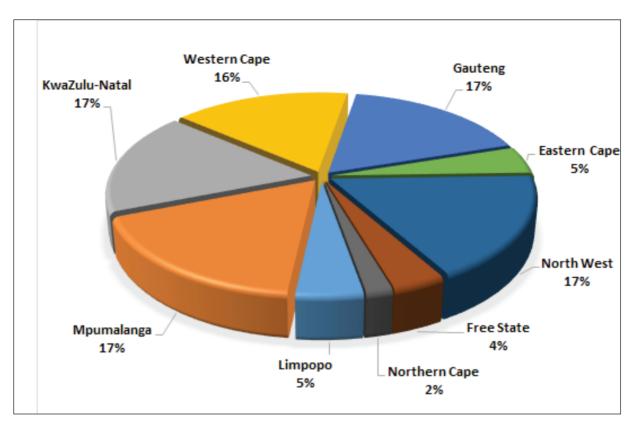


Figure 31: 2016/17 Mainline level crossing provincial distribution

#### People struck by trains

One of the biggest challenges facing the South African railway industry is the relative open rail system which resulted from vandalism, theft of railway fences and the uncontrolled occupation of the railway reserve. This situation has brought about new challenges for railway operators on how to protect their assets and manage access into the railway reserve. The lives of the public, train drivers and track maintenance crews are placed in danger by unauthorised people entering the railway infrastructure. For some trespassers, access to the railway reserve provides the shortest distance to their workplaces, clinics or schools, while others roaming around to commit criminal activities. Despite these dangers, train-pedestrian collisions remain on the increase when the year-on-year statistics of these types of occurrences are analysed.

During the 2016/17 reporting period, an increase of 10% (642) in people struck by trains on a running line was recorded. This led to a 10% increase in the number of fatalities (412) and 22% increase in the number of injuries (234). An analysis of the data from 2010/11 to 2016/17 indicates the places where the most people are struck by trains.

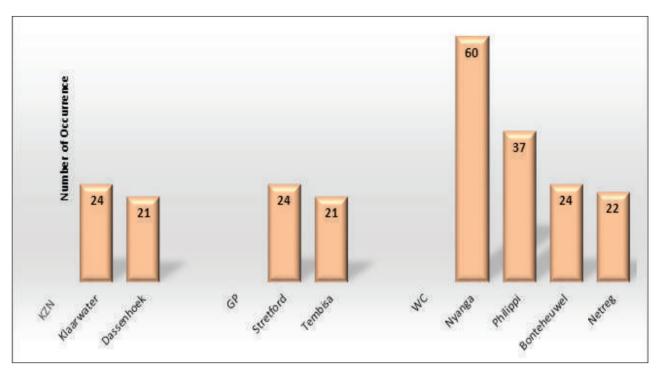


Figure 32: 2010/11 - 2016/17 Main places of people struck by trains

The table below illustrates that these occurrences happen during peak times, again as a result of the reasons stated above.

	Number of occurrences						
Time	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Saturday
Unknown	8	5	9	8	8	7	7
00:00-02:00	6	8	5	16	7	16	14
02:01-04:00	12	8	7	4	16	13	11
04:01-06:00	64	50	46	40	61	45	42
06:01-08:00	96	72	83	84	77	62	36
08:01-10:00	42	38	34	32	22	42	33
10:01-12:00	33	23	27	35	17	36	22
12:01-14:00	37	43	32	27	32	43	30
14:01-16:00	53	34	35	47	50	59	48
16:01-18:00	83	71	70	70	79	67	51
18:01-20:00	89	66	86	93	112	66	60
20:01-22:00	26	26	29	30	37	29	23
22:01-23:59	7	7	6	14	9	25	12
Total	556	451	469	500	527	510	389

**Table 11:** 2010/11 - 2016/17 People struck by trains timeframes

#### Platform train interface

It is refreshing to observe a decrease of 15% in platform train interface occurrences; 572 in 2016/17 versus 657 in 2015/16. The decrease in platform train interface occurrences speaks to the reduction of harm to commuters; the number of injuries decreased by 15% from 655 in 2015/16 to 555 in 2016/17, while the number of fatalities remained the same (9). In continuing to monitor the performance of the major contributing operator, that is PRASA Rail, towards significantly addressing the risk of injuries to commuters when embarking and disembarking trains, the analysis below indicates that some of the stations that form part of the PRASA Modernisation Project, remain high on the list where such occurrences have been recorded.

Place	Occurrence	Fatalities	Injuries
Pretoria	14	0	12
Cape Town	10	2	8
Johannesburg	10	0	10
Umlazi	9	0	9
Duffs Road	8	0	8
Bellville	7	0	7
Merebank	7	0	7
Leralla	6	0	6

Table 12: 2016/17 PTI areas of concern

During the 2016/17 FY, RSR investigations were conducted at identified stations across the country to determine the root causes of the apparent overcrowding at stations. Findings of the investigations are summarised as follows:

**Reliability:** Trains are running at 80% reliability, and delays are largely due to theft of cables, signalling equipment and critical infrastructure. This results in abnormal driving circumstances with restricted speeds, which only increase the delays even further.

**Availability:** Due to acts of arson and vandalism to train sets, the availability of the train sets dwindled dramatically resulting in the numbers of commuters exceeding the available riding space and hanging on to the outsides of the carriages resulting in people standing between trains

**Communication**: Only stations that have recently been upgraded have clear passenger addressing systems. The remaining stations have no means of communication at all and this give rise to commuter anxiety, who then attempt to board the next train in fear of further delays.

**Train surfing:** Passenger fare evasion still appears to be a major concern; the number of people accessing the station platform via the railway line adds to the platform congestion.

**Platform train interface:** Those stations that have not been upgraded in recent years have both vertical and horizontal gaps which pose challenges to passengers when climbing in and out of trains. This problem is further compounded by other commuters pushing from behind. In addition, uneven and poorly marked platforms also add to the already unsafe situation.

**Security:** All the reports indicate that there are not enough security personnel to manage overcrowding of trains and to secure platform safety. At most stations, the RRP officers are deployed outside the station, and only a few PRASA Officers are on the platforms. This makes it very difficult to prevent people from entering the station illegally, as well as to ensure safe boarding and alighting when trains arrive. There is also inadequate protection for train drivers who are threatened and intimidated by commuters.

#### Trend per train kilometre

According to international best practise, risk in railway safety, when expressed in the number of outcomes per exposure, is possibly the best measure of the safety level. International safety risk models measure the trend of fatalities per million, train km, as well as the specific rate of identified high impact occurrences per million train km. This year marks the first round of inclusion of this type of analysis, and will be expanded even more in future reporting periods, as the RSR has embarked on establishing safety risk model and risk profiles for operators during the 2017/18 financial year.

Accident risk, expressed in the number of outcomes per exposure, is one of the best measures of the safety level. Even though due cognisance is taken of the major levels differences in the safety risks levels between the European Union (EU) and South African Railway industry, it is interesting to note that the EU fatality risk per million train-kilometres (train-km) (system risk) as reported in 2015, was 0.3 killed per million train-km in the EU. Similarly, one can estimate the fatality risk of railway passengers (passenger risk). This was 0.15 passengers killed per billion train-km in the reporting period. The graph below indicates that the South African rate per million train-km is increasing and is measured at 7.53 for 2016/17. In addition, the fatalities per billion freight ton-km also increased from 3.27 to 3.45 in the current period. The SA rate for fatalities per million passenger km has remained relatively stable between 0.03 and 0.05 fatalities per million passenger km.

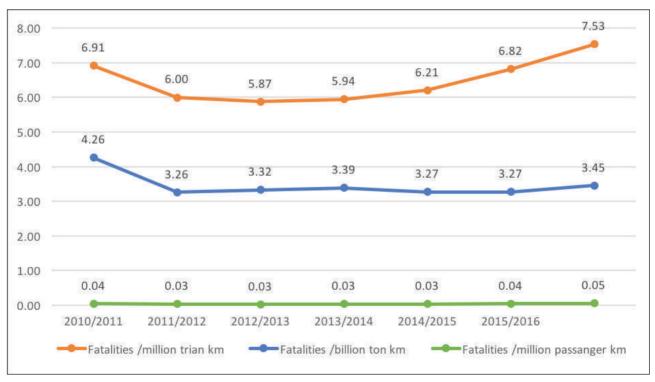


Figure 33: 2010/11 - 2016/17 Fatalities per million train km

International safety risk models measure the trend of the specific rate of identified high impact occurrences per million train km. These include derailments, collisions and level crossing occurrences. The graphs below indicate the trends for both TFR and PRASA in terms of the three main occurrence categories per million train km, over the period 2010/11 to 2016/17, using the 2010/11 reporting period as baseline.

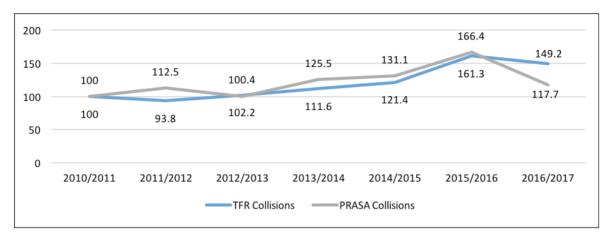


Figure 34: 2010/11 - 2016/17 Collisions per million train km

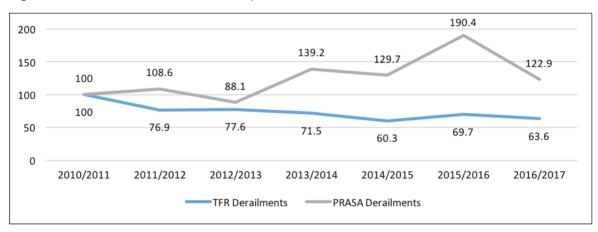


Figure 35: 2010/11 - 2016/17 Derailments per million train km

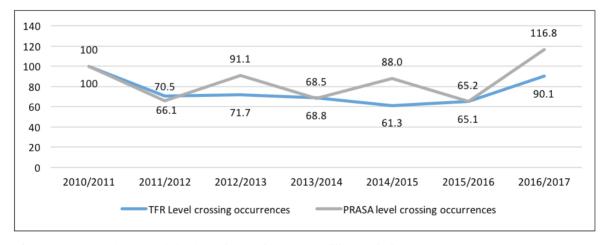
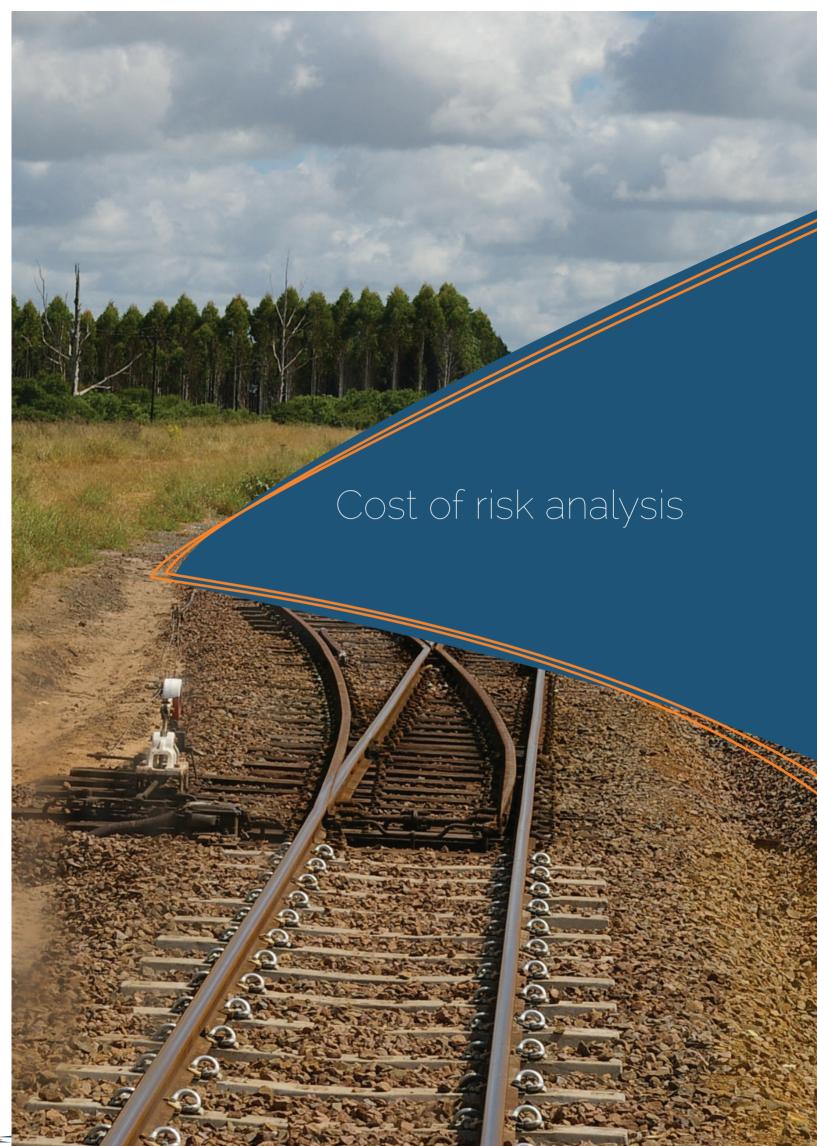


Figure 36: 2010/11 - 2016/17 Level crossings per million train km



# Cost of risk analysis

In this section, the 2015 Cost of risk model will be expanded to include 2016/17 data and will therefore provide a six-year analysis of occurrences per costs, per operator. It aims to illustrate the main cost drivers in the industry in terms of safety, in addition to the areas where most costs are incurred. This section, therefore, aims to assist operators in identifying their high-risk focus areas for among others, maintenance planning, SMS prioritising and allocation of costs in terms of risk mitigation.

The declared direct costs of occurrences and incidents increased from R889 million to R961 million during this reporting period, with the main costs drivers, as per the graph below, derailments, collisions and train fires. This remains a serious concern, as derailments and collisions are not normally as a result of external factors and could therefore have been averted by preventive actions such as maintenance, abiding by standard operating procedures etc.

Given the large-scale investment in increasing the operational readiness of the railway industry in South Africa, these costs remain highly problematic as such could have firstly been averted and secondly could have been directed to further investment, safety enhancement, training, awareness and many more useful actions

The graph below illustrates the costs distribution over the period 2010/11 to 2016/17, per main contributing category.

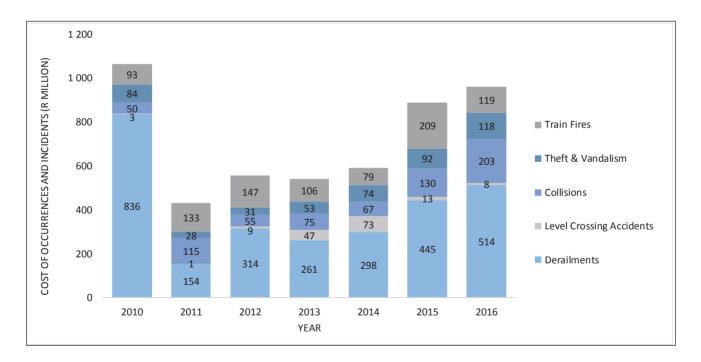


Figure 37: 2010/11 - 2016/17 Main cost drivers

The scaled data on the map in Figure 9 suggests a persistent threshold of system risk in South African rail operations since 2010. These include both annual counts of extrinsic incidents (and intrinsic occurrences, reported directly by the Operator to the RSR, for the South African rail system.

Railway occurrence cost is, however, only meaningful when related to the associated corridor-specific economic activity. The associated economic activity for freight rail is the value of the commodities transported, effectively the transported gross domestic product. Thus, for a freight corridor, we define cost of risk as the ratio of the railway occurrence cost to the nominal value of the commodity transported, both normalized for volume to rand per metric tonne expressed as a percentage. Similarly, the associated economic activity for urban commuter rail is the gross value add per capita (GVA) that each commuter contributes to the metro economy where he or she works. Thus, for a rapid rail commuter corridor, we define cost of risk as the ratio of the railway occurrence cost to the gross value add per capita, both normalized for volume to rand per passenger expressed as a percentage.

Since the operating cost of a railway system is primarily characterised in terms of traffic density (seminal research by Harris 1977 for freight, and Graham et al 2003 for urban passenger), we define systemic cost of risk as the cost of risk for a given level of traffic density (Figure 37).

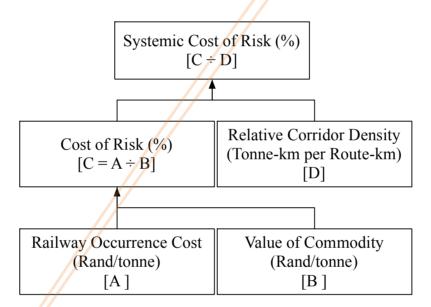
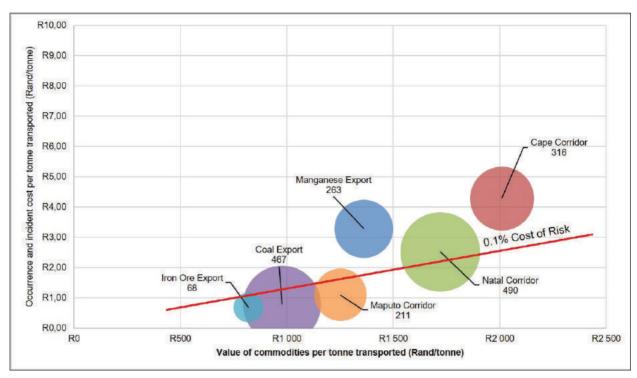


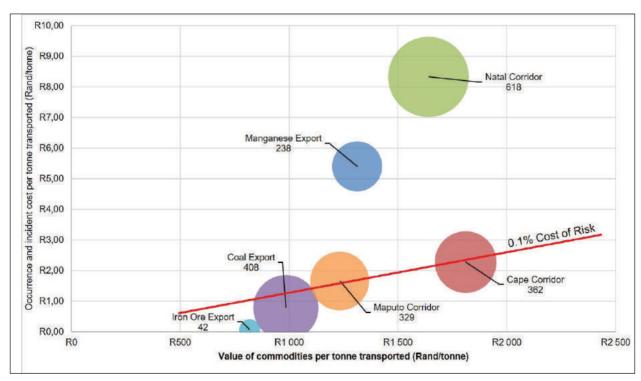
Figure 38: Systemic cost of risk (freight rail example, but equally valid for passenger rail)

The Cost of Risk metric becomes an actionable management tool when we use it to express the 'riskiness' of a corridor. We do this with the introduction of a discriminatory 'red line' threshold, thus separating acceptable corridors from those 'risky' corridors that might require risk-mitigating interventions. In the absence of a pre-existing benchmark, we choose an arbitrary low value of 0.1% Cost of Risk for the 'red line' shown on the diagrams in Figure 38 and Figure 39.

Whereas corridors with Cost of Risk "bubbles" located above the red line threshold are considered 'risky', those in line with or below the red line are considered acceptable risks.



**Figure 39:** Railway occurrence counts and cost for the value of freight transported per major corridor showing an arbitrary 0.1% cost of risk threshold (red line) for 2015/16.



**Figure 40:** Railway occurrence counts and cost for the value of freight transported per major corridor showing an arbitrary 0.1% cost of risk threshold (red line) for 2016/17.

Operational resilience is the ability of the railway organisation to continue value addition to scale within its operational limit after disruption. This means sustaining the requisite traffic density (tonne-km or passenger-km per Route-km). Since the RSR measures and records both extrinsic incidents and intrinsic occurrences as disruptions, we can use these criteria in the definition of systemic cost of risk. Therefore, one way to conveniently describe operational resilience is a simple analysis of the time variance of systemic cost of risk (Figure 40).

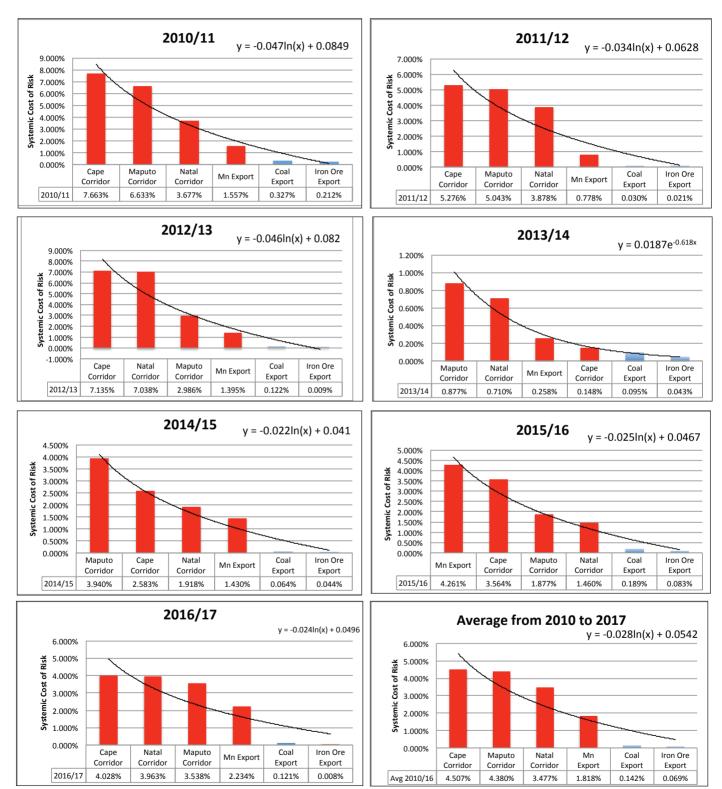
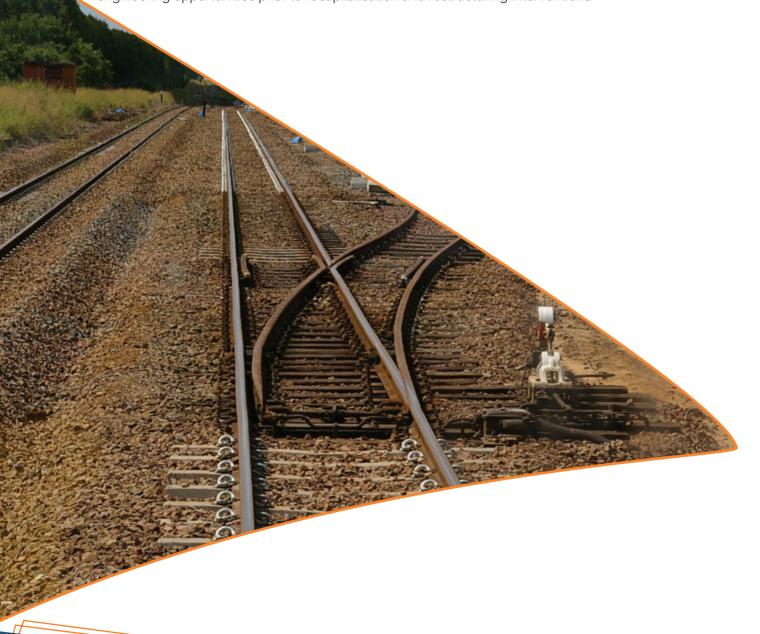


Figure 41: Systemic cost of risk for the major corridors in South Africa in asymptotic sequence

When we arrange the annual systemic cost of risk per corridor in descending order, we note asymptotic behaviour of systemic cost of risk with freight density. Although the corridor order of red-marked general freight corridors vary from year to year, the heavy haul lines consistently occupy the lowest and second lowest systemic cost of risk. Furthermore the coal export corridor, which also carries a very substantial amount of general freight, remains in second best position after the 'pure play' iron ore export corridor – the systemic cost of risk leader for freight in South Africa.

Since 2010, on average, the South African railway system experiences one (extrinsic) railway incident and one (intrinsic) operator occurrence every sixteen minutes. The vexing question is why this frequency of railway occurrences remains so consistently high despite all the grand efforts of the RSR and the licensed operators to reduce them. It is conceivable that an element of systematic cost of risk lies embedded in the data and the RSR will continues to pursue the root causes.

We define systematic cost of risk as an artificial risk threshold programmed into the railway over many years using slow changing convention; policies, procedures, standards and guidelines (PPSGs). If so, systemic cost of risk can be reduced through technical audits that review these engineering operational and technical conventions, update PPSGs, and identification of value-engineering opportunities prior to recapitalisation and restructuring interventions.





# South African rail corridor analysis

# Cost of Risk on some of the main Transnet Freight Rail main corridors

It is useful to consider how each corridor performs over time against the same Cost of Risk 'red line' threshold described earlier.

The following diagrams expand the national Cost of Risk perspective (Figure 37) into a time series per major freight corridor.

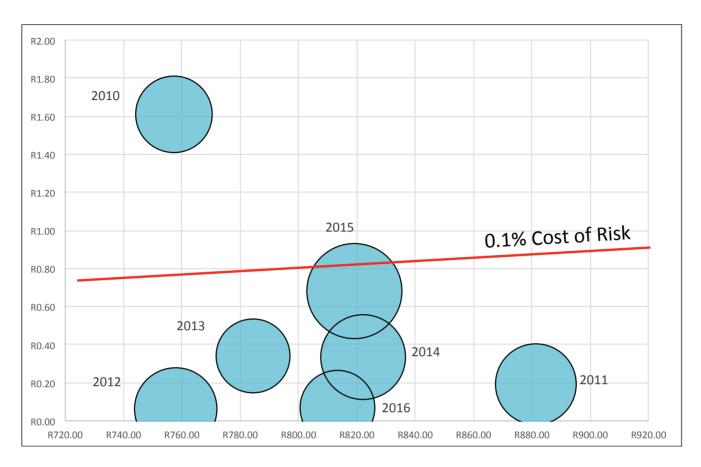
For the volume up to and including 2015/16 the export coal and iron ore and general freight business (GFB) volumes were taken directly from Transnet Freight Rail data on a corridor-by-corridor basis. For the 2016/17 year, the RSR received no rail data for general freight volumes and we therefore had to estimate the traffic.

The method we used assumed rail maintained its market share per commodity (as it's not possible to do per commodity without actual data for 2016/17), and we then inflated or deflated each commodity, based on growth we saw for the whole economy. We then adjusted the total GFB tonnes, and scaled it to the reported GFB total volumes in Transnet's annual results for 2016/17. For value, we took the tons of each commodity, multiplied by estimated value per ton. For previous years, we had prices per commodity per year, but not for the 2016/17, so we had to use the same value per tonne as the previous year (2015/16). The reader must therefore treat the X-axis in the 'bubble' diagrams as an informed estimate. The RSR will engage with the operator to improve on this data set, which can be restated in the 2017/18 report.

The corridor-specific Cost of Risk bubble diagrams (Figure 41 to Figure 45) are sequenced in terms of the number of long term average railway occurrences. Note that there is no correlation of bubble sizes between corridor diagrams. Each individual corridor diagram reflects the time series of bubbles relatively sized to itself. The long term average railway occurrence bubble-size count for each corridor is listed in Table 12 below.

Corridor	Long term average railway occurrence count
Iron ore exports	51
Manganese exports	247
Gauteng – Western Cape	291
Coal export	445
Gauteng – KwaZulu-Natal	452

Table 13: Long term average railway occurrence bubble-size count for each corridor



**Figure 42:** Time series of railway occurrence cost vs. the value of freight transported for the iron ore export corridor showing an arbitrary 0.1% cost of risk threshold (red line).

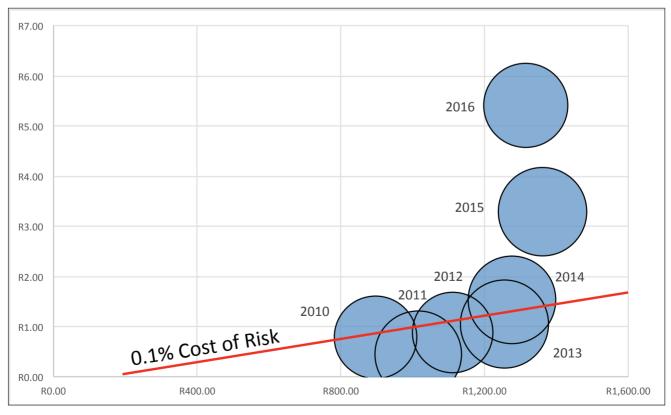
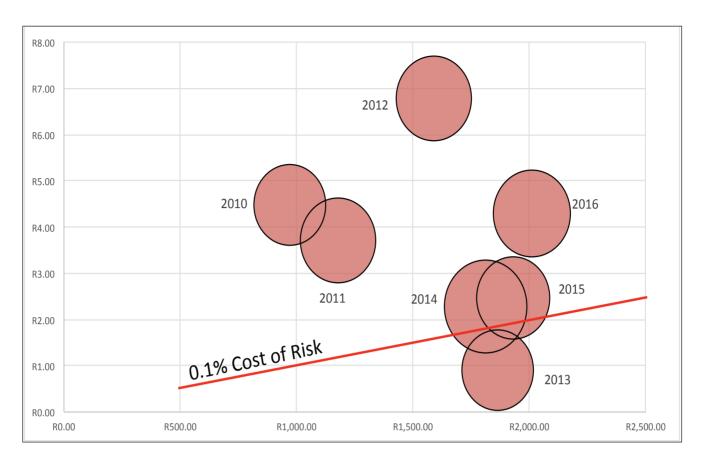
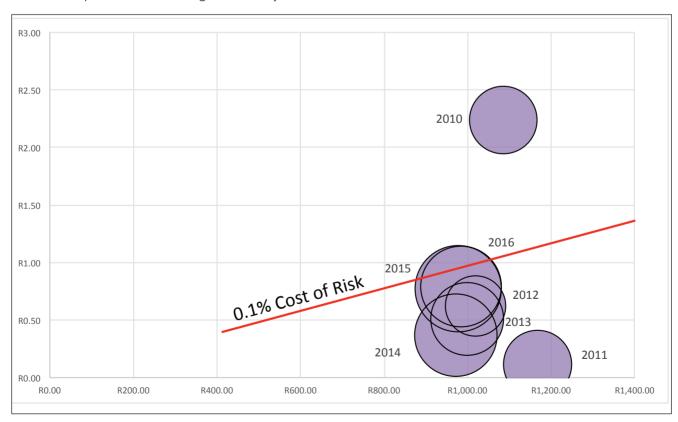


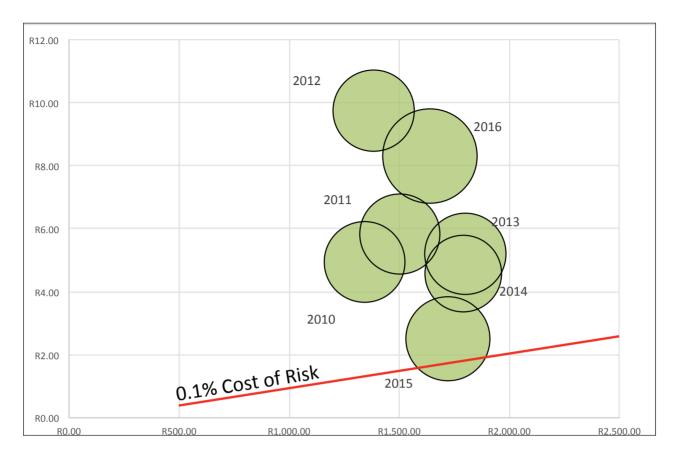
Figure 43: Time series of railway occurrence cost vs. the value of freight transported for the manganese export corridor showing an arbitrary 0.1% cost of risk threshold (red line).



**Figure 44:** Time series of railway occurrence cost vs. the value of freight transported for the Gauteng – Western Cape corridor showing an arbitrary 0.1% cost of risk threshold (red line).



**Figure 45:** Time series of railway occurrence cost vs. the value of freight transported for the coal export corridor showing an arbitrary 0.1% cost of risk threshold (red line).



**Figure 46:** Time series of railway occurrence cost vs. the value of freight transported for the Gauteng – KwaZulu-Natal corridor showing an arbitrary 0.1% cost of risk threshold (red line).

It is apparent from outlying Cost of Risk bubbles on the iron and coal export corridors in 2010, the Gauteng – Western Cape and Gauteng – KwaZulu-Natal corridors in 2012 and the manganese export corridor in 2015, that Cost of Risk is sensitive to both:

- 1. Large costly occurrences such as derailments that skew the otherwise acceptable performance for any one year; as well as
- 2. Volatility of the value of the commodity mix on the corridor.

Understanding and mitigating the root causes of these large impact railway occurrences is a key driver for cost reduction over time.

#### Cost of Risk in PRASA metros

PRASA is organised in metros, each with a number of commuting corridors. There is a paucity of GVA data applicable to Cost of Risk assessment for passenger rail in South Africa. The gross value add per capita (GVA) is infrequently measured by others and only at the metro level, hence we can only present data at the metro level. Substantial research by others is required to assess the GVA per corridor per metro on an annual basis and in greater detail. This task lies outside the scope and mandate of the RSR reports on the State of Safety.

For the passenger cost-benefit analysis the total occurrence and incident costs per 1 000 passenger trips as declared by PRASA serves as the Passenger Rail Cost Numerator. The Gross Value Add (GVA) of PRASA passengers¹ per 1000 passenger trips is used as the Passenger Rail Benefit Denominator. Eleven metropolitan and district municipalities were analysed and divided into two groups of municipalities with more than 70 000 passenger trips per annum or less than 20 000 trips per annum.

Note that there is no updated gross value add per capita data, which reflects the year on year X-axis location of the GVA bubbles as stationary. Essentially for people movement, we can only comment on the variance in Cost.

As is the case for freight rail, the reader must therefore treat the X-axis in the 'bubble' diagrams as an informed estimate. The RSR will engage with the operator to improve on this data set, which can be restated in the 2017/18 report.

The Figure below presents the cost-benefit analysis for all the PRASA metros nationally. The Johannesburg metro presents the most 'bang for buck' mass transit system, that we can use as a domestic benchmark. Not only is the Cost of Risk 'low' but the gross value add per commuter is also high. Save for the Cape Winelands, the Cost of Risk profile for the smaller metros of Sedibeng, Umgungundlovu, Buffalo City, Nelson Mandela Bay and West Rand are functional when benchmarked to major metros. The Cost of Risk profile clearly shows up the challenges in the Western Cape metro, where PRASA has suffered substantial loss due to rolling stock and damaged infrastructure.

<sup>&</sup>lt;sup>1</sup> GVA per district municipality for 2011 obtained from Harrison P. 2013. South Africa's "cities of hope": Assessing the role of cities in creating opportunity for young people. Centre for Development and Enterprise. Johannesburg. South Africa and adjusted for 2015 by using the published consumer price index (CPI) as per Statistics South Africa (StatsSA) publication P0141.

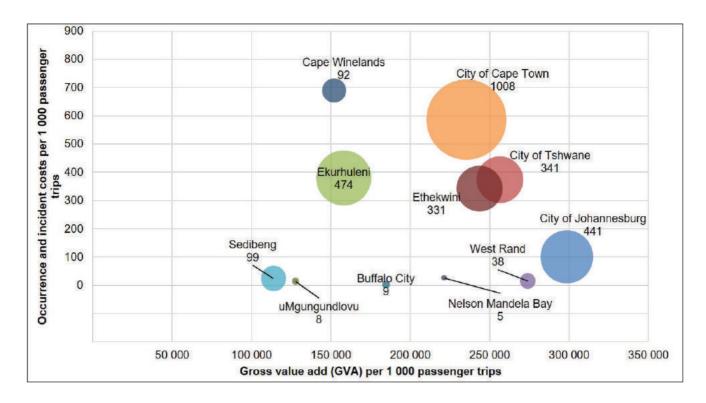


Figure 47: PRASA cost-benefit analysis for all PRASA metropolitan municipalities in 2016/17

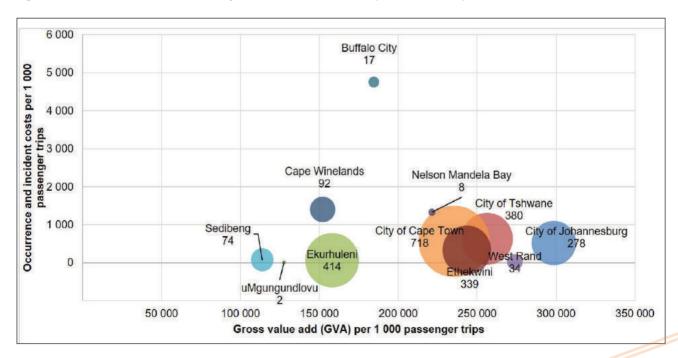


Figure 48: PRASA cost-benefit analysis for all PRASA metropolitan municipalities in 2015/16

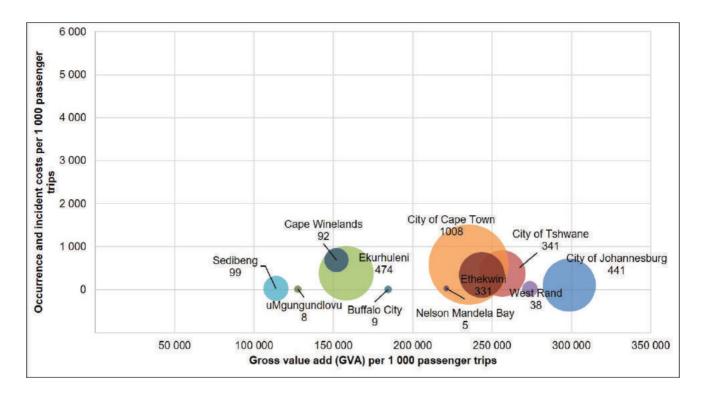


Figure 49: PRASA cost-benefit analysis for all PRASA metropolitan municipalities in 2016 scaled to 2015

The above national diagrams are depicted on the same scale to show how a costly railway occurrence in a small metro (Buffalo City) can impact (2016) the landscape.

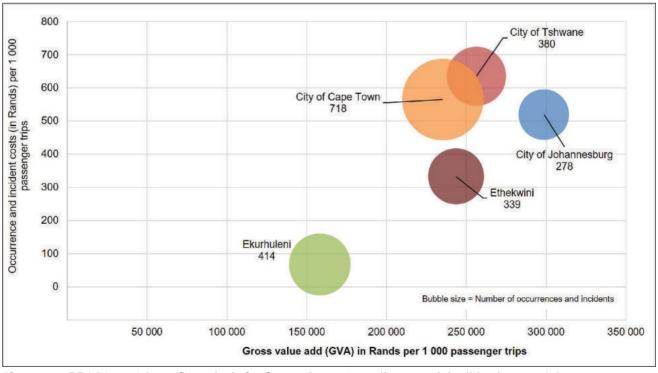


Figure 50: PRASA cost-benefit analysis for five major metropolitan municipalities in 2015/16

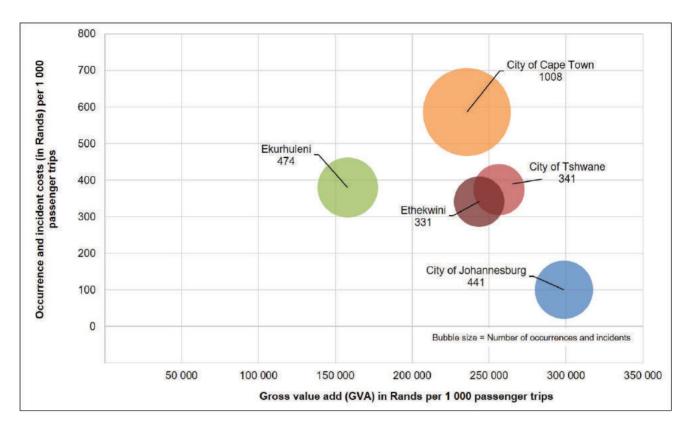


Figure 51: PRASA cost-benefit analysis for five major metropolitan municipalities in 2016/17

A comparison shows a substantial reduction in the Cost of Risk in 2016/17 for the Tshwane and Johannesburg metros. However, Ekurhuleni became 'riskier' and the Cost of Risk in the Cape Town metro remain tenaciously high.

The following two graphs presented to the same scale clearly shows that in 2015/16 the Cost of Risk for the Buffalo City district municipality was a 'high risk outlier' for low-density metros. In 2016/17 this Cost of Risk has normalized to its peer group. Cape Winelands also shows a reduction in Cost of Risk.

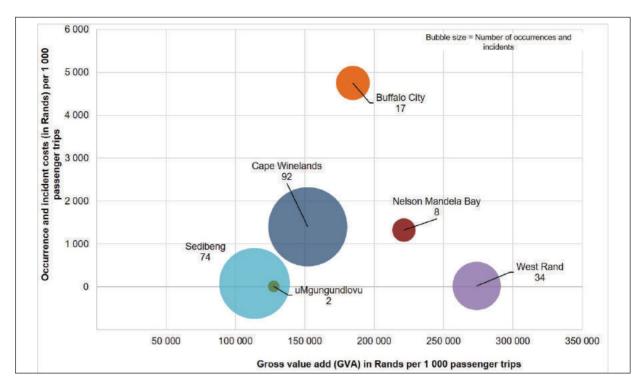


Figure 52: PRASA cost-benefit analysis for six district and metropolitan municipalities in 2015/16

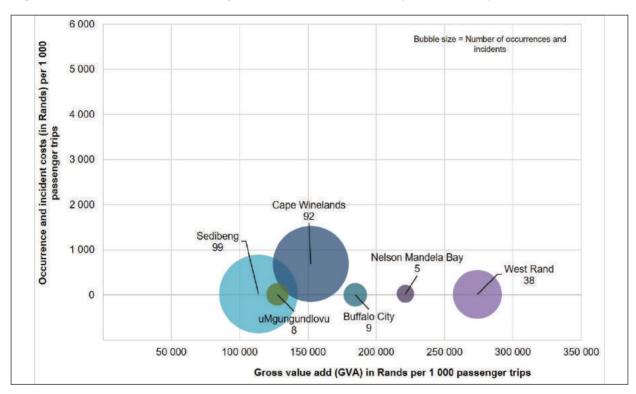
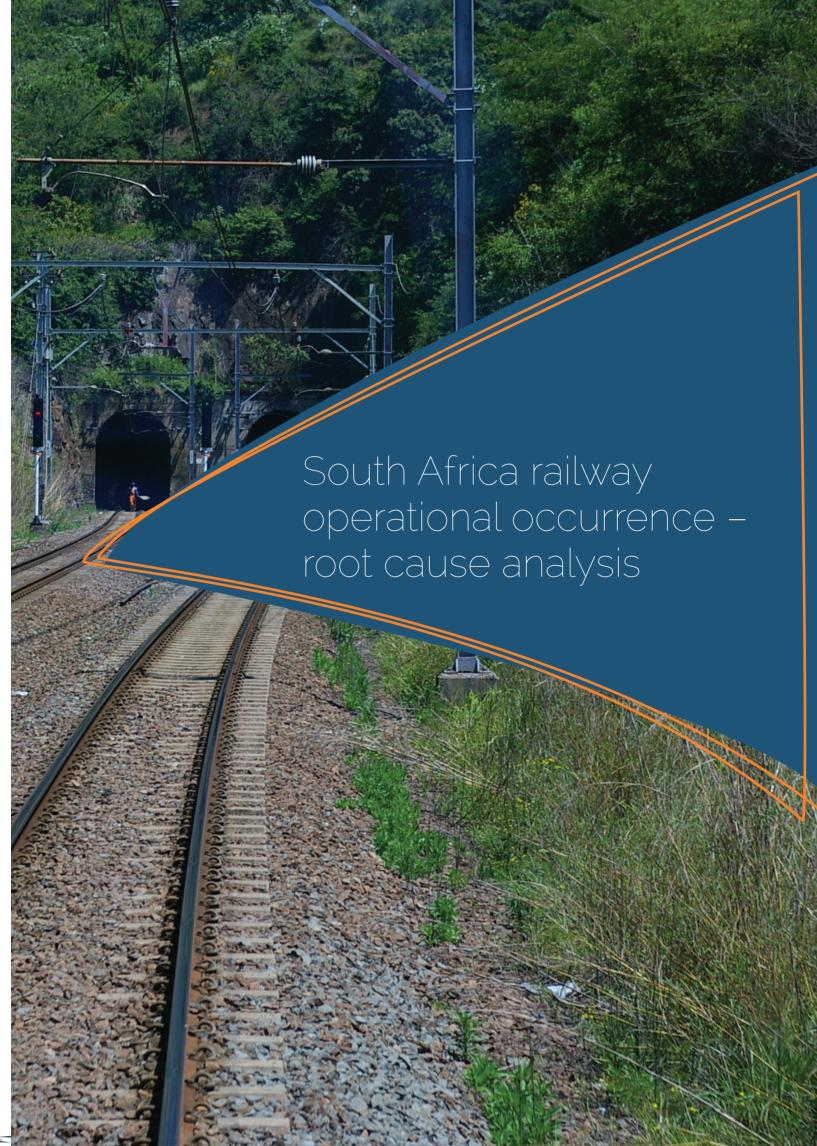


Figure 53: PRASA cost-benefit analysis for six district and metropolitan municipalities in 2016/17

Whereas population statistics are generally reported on a "number per hundred thousand" scale, it is not clear what the "acceptable" monetary norm for railway occurrences in passenger rail is, or should be. Hence we avoided the introduction of any arbitrary cost of risk threshold for passenger rail as it raises the debate of what acceptable cost is, especially given the high number of people related railway occurrences in South Africa.

Apart from the new rolling stock program, it is conceivable that more current and in-depth 'know your commuter' research data, when translated into focused operational and technical improvements on the existing PRASA rail system, will lead to a future reduction in cost of risk.



# South Africa railway operational occurrence – root cause analysis

## Inspections, audits and investigations

The Act has several provisions empowering the appointment of inspectors and the inspection of activities authorised under a railway safety permit. If an inspector believes that a condition or activity is a threat or might be a threat to safe railway operations, the railway safety inspector may issue a directive to any person responsible for that condition or activity to the effect that;

(a) the activity be restricted or suspended and the inspector may place conditions on that activity; or (b) action be taken within a specified time by the person concerned to remove the threat.

The Regulator may also, on its own accord, or upon receipt of a directive from the Minister be obliged to investigate any railway occurrence for the purposes of preventing similar occurrences in the future. In performing the investigation, the Regulator has wide powers of inspection, calling witnesses and producing reports and recommendations. The graph illustrates the increased focus on assurance efforts though audits and investigations to determine areas of concern and root causes, which through effective Safety Management Systems, can be mitigated and thereby reducing occurrences.

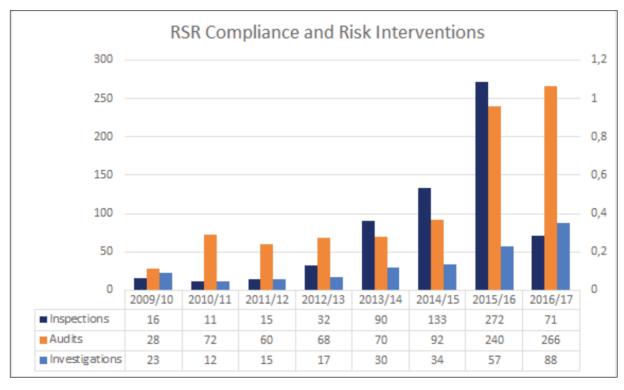


Figure 54: RSR intervention graph trend

## Root cause analysis

The RSR conducts investigations in line with the its mandate in instances of serious collisions, derailments and level crossing occurrences and where a trend has been identified in high risk corridors of people struck by trains, or at stations with a high trend of platform train interface occurrences. The aim is determining the root cause of such occurrences. As was the case in the previous reporting period, close to 60% of all occurrences investigated were because of a human factor-related root cause. Perway defects contributed to 23% and rolling stock-related causes added another 10% to the findings. The graph indicates the various root causes as per the RSR's 2016/17 investigations.

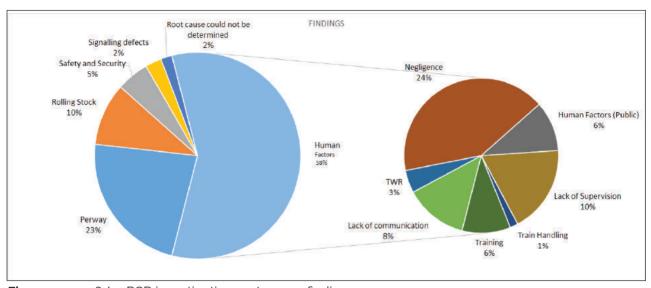


Figure 55: 2016/17 RSR investigation root-cause findings

When analysing the root-cause per occurrence type, it is concerning to note that supervision and negligence play a major role in collisions, while negligence and perway challenges caused the most derailments. In terms of level crossings, it is noticeable that more than 50% of such occurrences were because of negligence on the side of vehicle drivers, but also that the perway at the level crossing also contributed to such. The investigations also confirmed that most people are struck by trains because of the overall lack of security around the rail reserve, either physically because of lack of fencing or security to prevent access, or because of illegal trespassing by members of the community. Lastly, the RSR investigators confirmed that almost a third of platform train interface occurrences are as a result of a perway issue, given that the platforms at most stations in the corridors were vertically and horizontally misaligned.

Categories	Collisions	Derailments	Level crossing	Person struck	Platform train interface
Communication	6%	7%	0%	10%	16%
Could not be determined	ο%	0%	10%	0%	0%
Fatigue	3%	1%	0%	0%	0%
Faulty manual authorisation	8%	4%	0%	0%	0%
Lack of supervision	28%	13%	4%	14%	5%
Law enforcement	0%	0%	9%	2%	0%
Negligence	14%	24%	52%	<b>7</b> %	3%
Not adhering to TWR	3%	3%	1%	0%	0%
Perway	1%	29%	21%	14%	32%
Poor maintenance	0%	1%	1%	0%	0%
Rolling stock	6%	6%	1%	9%	17%
Safety and security	0%	1%	0%	11%	14%
Security	2%	0%	0%	33%	11%
Signalling	8%	2%	0%	1%	0%
Staff shortage	8%	1%	0%	0%	2%
Train handling	1%	2%	0%	0%	0%
Training	6%	5%	1%	1%	2%
TWR	4%	1%	0%	0%	0%

**Table 14:** RSR Investigation root cause findings

Operators are required by the Act to investigate every operational occurrence. The table indicates the root causes as identified by operators and reported to the RSR as part of their respective quarterly reports. The items highlighted are the main root causes for collisions, derailments and level crossing occurrences, as per each of the main categories:

Track and civil infrastructure	Collisions	Derailments	Level crossings
Rail breaks	2.8%	2.6%	0.2%
Kick outs	0.1%	1%	0%
Track geometry including slacks, twist and cant	0.9%	2.8%	1.3%
Gauge widening	1.6%	4.3%	0.9%
Wash away	0.1%	0.4%	0%
Defective points and crossings	0.9%	4.1%	2.4%
Structural failure (bridges, culverts, tunnels, OHTE)	0.6%	0.2%	0%
Signal failures	Collisions	Derailments	Level crossings
Wrong side signal failure	0.3%	0%	0.4%
Signal equipment defects	0.4%	0.1%	0.4%
Electro-magnetic interface	0.1%	0%	0%
Rolling stock	Collisions	Derailments	Level crossings
Broken axel	0.7%	2.8%	0.4%
Braking system failure	1%	1.2%	0.4%
Coupler failure	0%	1,8%	0.2%
Wheel profile including a sharp flange	2%	3.6%	0.2%
Operational irregularities	Collisions	Derailments	Level crossings
Loading irregularity	0.6%	0,8%	0,6%
Movements exceeding limits of authority	2.1%	2,2%	0,4%
Speeding	1.3%	0,8%	0,4%
Shunting irregularities	7.2%	3,6%	2,0%
Operational irregularity (error caused by driver, TCO, shunter, maintenance)	37.9%	34.4%	2,2%

Operators root causes						
Human factors	Collisions	Derailments	Level crossings			
Failure of the Human Resources procurement and placement process	0.1%	0.1%	0.4%			
Substance abuse	0%	0%	0.4%			
Shift work and fatigue	0.1%	0.1%	0%			
Training	2%	0.7%	0.4%			
Unfit for duty due to physical and/or psychological condition	0.3%	0.2%	0.4%			
Gross negligence	36.8%	31.8%	86.4%			

Table 15: Root causes as identified by operator investigations



## Preventative actions

## The RSR regulatory framework instruments at work

In terms of Section 5 of the Act, the objects of the RSR are to give effect to its oversight function; promote improved railway safety performance; monitor and ensure compliance; and develop regulations. A review of the RSR's oversight role established that the term oversight functionally implies that of directing and guiding. The RSR is, therefore, legally responsible for the guidance and direction of safety operations within railways, thereby making train operators directly accountable to the RSR with regards to their safety performance and management rules, policies, procedures and systems.

In order execute its legislative mandate, The Regulator develops, implement and enforce various legislative tools which are inclusive of, railway safety standards, railway safety regulations, compulsory notices, guidance notices, to mention a few. In compliance with the objects referred above, there are two sets of regulatory tools, namely standards and regulations, which compiled and subjected to public comments prior to publication, in line with the standards and the regulations development and implementation processes.

During the review period, two regulations have been compiled for publication in the government gazette by the DoT for public comments. The published regulations are; the Draft Security Matters Regulations, 2017 and The Draft Regulations Regarding Infrastructure or Activity Affecting Safe Railway Operations, 2017. These regulations together with the various tools used by the Regulator are intended to support the railway industry to ensure improved Railway Safety performance. The purpose of the Draft Regulations Regarding Infrastructure or Activity Affecting Safe Railway Operations, 2017 are to provide requirements for the management of railway reserves to ensure safe railway operations and safety and security to people, property and the environment. The purpose of the Draft Security Matters Regulations, 2017 is to prescribe the minimum-security requirements that must be met by operators.

In addition, the RSR stepped onto unchartered grounds when it launched the first set of the Regulator Standards in December 2016. In the past, the RSR developed South African National Standards (SANS) through the SABS which were then adopted by the Railway Safety Regulator Board in accordance with the Act, and were then used as regulatory and compliance tools for the Railway Industry in South Africa. The Regulator Standards amplifies the current published SANS 3000 series of standards and should always be read in conjunction with the applicable SANS 3000 standards and any other normative standards. The introduction of the Regulator Standards will further assist the Railway Industry to effectively comply with Railway Safety Management requirements and to improve operators' railway safety performance which is one of the key focus areas of the Regulator. There are four Regulator Standards that were launched i.e. Fatigue Management (FM); Wheels, Axles and Bearings; Railway Stations and Occurrence Management. These standards serve as an amplification of the existing SANS 3000 series of standards.

### **Education and awareness**

The RSR engages various stakeholders that are either directly or indirectly affected by railway operations to encourage safe railway behaviour. These include operators, commuters, communities and media. Important safety information is shared through safety awareness campaigns, conferences, imbizo, roadshows and focus groups. Through these interactions, the RSR shares much-needed information with the stakeholders.

During the year under review, the RSR has expanded its focus on media, even covering the Southern African Development Community and beyond. Particular attention was paid to regional media, with a focus on the areas where the RSR has regional presence.

The coverage included print, broadcast and online media. The RSR was prominently featured in several different regional media in Gauteng, KwaZulu-Natal, Western Cape, North West and the Eastern Cape. In addition, the RSR made extensive use of the its social media platforms.

The table below contains the major awareness campaigns per area during the review period, and the focus areas of each of the campaigns:

Name of awareness campaign	Area	Focus area
Sara Rail Conference	Gauteng	Regional integration and interoperability
National Youth Summit	Gauteng (including other provinces)	Safe railway behaviour
Media engagement session	Western Cape and KwaZulu-Natal	Safe railway behaviour
Africa Rail Conference	Gauteng including Africa	Showcasing and profiling the RSR
Media engagement (various radio stations)	Gauteng, Eastern Cape, North West	Safe railway behaviour
Reeston and Roundhill level crossing campaign	East London	Level crossings
Platform train interface campaign	East London	PTI
Media engagement	Gauteng	Technology review process
Media engagement	Pretoria (in the Blue Train)	Showcasing and profiling the RSR
State of Safety Breakfast	Western Cape	State of railway safety in South Africa
Deputy Minister Imbizo	Gugulethu, Western Cape	Safe railway behaviour

Table 16: 2016/17 RSR education and awareness campaigns

## **RSR technical training**

The RSR has identified the need for a formal approach to the training and continued education of railway engineering practitioners and railway safety inspectors in the railway engineering industry, with specific reference to railway safety. The University of Pretoria has the established knowledge and expertise in its Faculty of Engineering, the Built Environment and Information Technology to meet this need by means of offering certain programmes to railway engineering practitioners and railway safety inspectors. As a result of the Memorandum of Agreement signed between the RSR and University of Pretoria on 14 November 2016, an RSR Chair in Railway Safety was established in the Faculty of Engineering, Built Environment and Information Technology at the University of Pretoria. Among other benefits and areas of cooperation (see cooperation rationale here below), the RSR Chair in Railway Safety allows candidates to participate in railway safety related research and training. To date, 12 RSR candidates have attended each of the following well-structured courses:

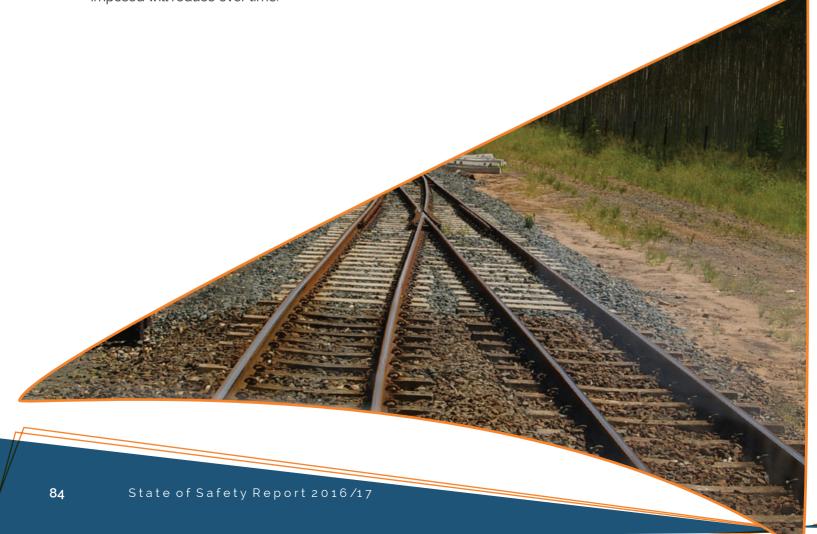
IMDCRE Introduction to Multidisciplinary Concepts in Railway Engineering

RSAIR Railway Safety Audits, Investigation and Reporting

TMCS Train Movement and Control Systems

## Offences and penalties

Any person who contravenes or fails to comply with the Act, in particular Section 22 (operating without a permit), Section 24 (contravening a permit condition) or Section 36 (does not heed a directive from an inspector) or hinders a railway safety inspector may be found guilty of an offence. Maximum imprisonment is 15 years. The Minister may also make regulations providing that persons who fail to comply with any provision of this Act, applicable regulations and standards or imposed under it, or any condition imposed in terms of a safety permit, must pay one or more penalties to the Regulator. The Regulator may publish details of such non-compliance in the manner prescribed. However, the making of such regulations and the imposition of such penalties are on the understanding that the Regulator will strive to improve compliance with this Act so that incidences where penalties are imposed will reduce over time.



## Conclusion

It is with some relief that the continued decrease in the total number of operational occurrences is reported. However this is in stark comparison to the continued rise in security-related incidents, which increasingly continue to hamper railway operations in the South African railway environment.

In aspiring towards the vision of zero occurrences, the RSR has been focusing on the identified five strategic focus areas 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 compliance and enforcement. The selected areas are operational-occurrence based, and are in line with international best practice of assessing the risk profile of operators within the railway industry.

The five categories of operational occurrences, when they happen, have either a large scale financial impact in terms of direct costs incurred for damage to rolling stock due to derailments and collisions; indirect costs due to closure of lines for recovery purposes; or possible large-scale human impact in terms of fatalities and injuries during passenger train collisions, level crossings and people-related occurrences such as people struck by trains and platform train interface occurrences.

Analysis of safety performance over the period 2013/15 to 2016/17 indicates that collisions, derailments, level crossing and people struck by train occurrences in terms of occurrences on a running line have increased on a year-on year basis, whilst the platform train interface occurrences have declined. The steady decline in platform train interface can be attributed to an increased focus on the identified high risk stations per province, including the stations that are part of the PRASA modernisation project, in terms of audits and inspections, but also an increased human factor focus from the investigations and HFM units.

Although an increase is noted in the two categories of people struck by train and level crossing occurrences, it is vital to keep in mind that such occurrences are mainly because of the openness of the rail network and the apparent lack of action by other role-players such as municipalities and road law enforcement agencies. In addition, the outstanding publication of the Regulation on Rail Reserve, which aims to address these issues to a large degree, currently hampers the RSR's ability to enforce operators and relevant parties to address these issues. However, the RSR has established provincial level crossing technical committees in 2015/16, which are managed by the respective regional offices, with assistance from the Level Crossing specialist at Head Office. These committees have identified 2 high risk level crossing per province and projects are underway to address each of these as per the specific resolution required. It is envisaged that the amended Level Crossing Standard which was published in 2016/17 will also increase the regulatory reach of the RSR. In terms of people struck by train, discussions with identified metropolitan municipalities on spatial planning has commenced in the major areas however as stated, the absence of the Regulation on Rail Reserves still hampers such actions to a large degree.

The inclusion and expansion of the Cost of Risk model, has enabled the SR to refine its focus on these areas where the risks are the most costly, and the new inclusion of the analysis of occurrences per million train-km, as per international benchmark practises, also allows for further detailed risk identification. In the coming year, the RSR will expand on this with by concluding an industry-wide safety risk model analysis, which will be included in the 217/18 State of safety report.

The RSR remains committed to its mandate to promote rail as a safe and affordable mode of transport. As such we will continue to expand our regulatory framework and education and awareness initiatives to not only increase the level of safety management by operators but also the level of safety culture and awareness among commuters and members of the public.

## References

PREUSS, H. (2017, April 11). SA's bulk exports increase by 27.4%. From IOL Business: http://www.iol.co.za/business-report/economy/sas-bulk-exports-increase-by-274-8615324

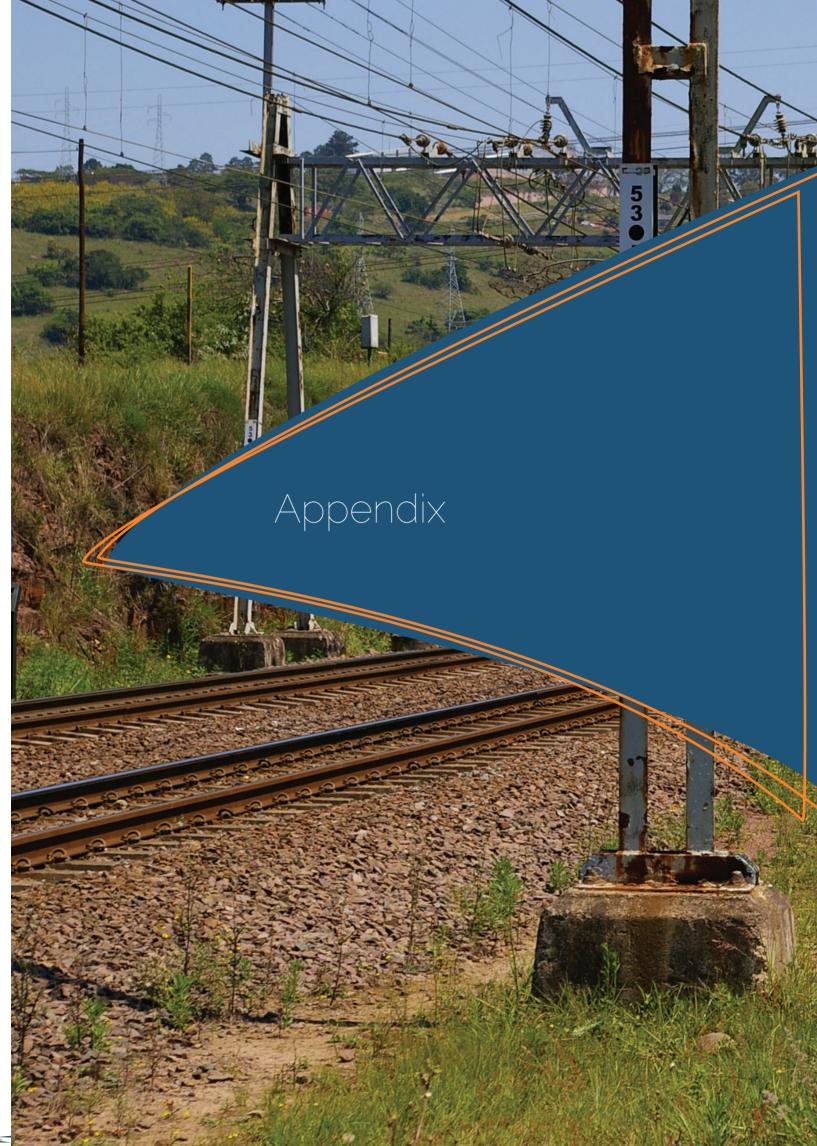
Railway Safety Regulator. (2015). RSR Strategic & Annual Performance Planning - 2015/20. Centurion, South Africa: Railway Safety Regulator.

Railway Safety Regulator. (2015). State of Safety 2014/15. Pretoria: GCIS.

Railway Safety Regulator. (May 2015). State of Safety Report 2014/15. Centurion: Railway Safety Regulator.

Railway Safety Regulator. (2009). The Legislative Oversight Role of the Railway Safety Regulator.

Republic of South Africa. (2002). National Railway Safety Regulator Act no 16. Pretoria: Government Press.



# Appendix A:

## SANS 3000: 1 (2009) Operational Occurrence and Safety-Related Incidents Detailed Categories

## **Operational occurrence categories**

Category	Description
А	Collisions During movement of rolling stock
А-а	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
А-е	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)
В	Derailments during movement of rolling stock
В-а	Derailment of rolling stock on a running line
B-b	Derailment of rolling stock on a line other than a running line
В-с	Derailment during tippler activities
С	Unauthorised 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
С-е	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
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 recognised 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 recognised level crossing

Category	Description
D-c	A person(s) struck by rolling stock at a recognised pedestrian level crossing
D-d	A person(s) struck by rolling stock at a recognised road level crossing
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
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
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
Н	People related occurrences: platform train interface
H-a	Occurrence where a passenger fell between the train and the platform whilst entraining/detraining a stationary or moving train
H-b	Occurrence where a passenger fell on the platform whilst entraining/detraining a stationary or moving train
H-c	Occurrence where an employee fell between the train and the platform whilst entraining/detraining a stationary or moving train
H-d	Occurrence where an employee fell on the platform whilst entraining/detraining a stationary or moving train
Н-е	Occurrence where a contractor or contractor's employee fell between the train and the platform whilst detraining a stationary or moving train
H-f	Occurrence where a contractor or contractor's employee fell on the platform whilst entraining/detraining a stationary or moving train
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 passenger area of the station

Category	Description
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
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 whilst on or in rolling stock
J-e	Electrical shock to an employee whilst positioned on or part of rolling stock
J-f	Electrical shock to a contractor or contractor's employee whilst 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-l	Electrical shock of a contractor or contractor's employee in the passenger area of a station
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 whilst staged
K-d	Missing consignment of dangerous goods
K-e	Theft of dangerous goods
K-f	Explosion of dangerous goods
L	Fire occurrences
L-a	Fires on a fixed operational asset
L-b	Fire of freight
L-c	Fire of rolling stock
L-d	Veld fires that threaten operational safety

# Security related incident categories

Category	Description
1	Theft of assets impacting on operational safety
1-a	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 (signalling) in section
1-h	Theft of train control equipment (signalling) in yards and sidings
1-i	Theft of ancillary equipment including public address systems, information boards, CCTV
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 (signalling) in section
2-h	Malicious damage (vandalism) of train control equipment (signalling) in yards and sidings
2-i	Malicious damage (vandalism) of ancillary equipment including public address systems, information boards, CCTV
3	Threats of operational safety
3-a	A bomb threat to network
3-b	A bomb threat to station
3-c	A bomb threat to rolling stock
3-d	Threats due to electrical power outages
3-e	Threats other than bomb and power outage threats
4	Train kidnapping or hijacking
4-a	Kidnapping or hijacking of passenger trains
4-b	Kidnapping or hijacking of freight trains

Category	Description
4-C	Kidnapping or hijacking of other rolling stock
5	Crowd-related occurrences
5-a	Crowd related occurrence and includes stampede action
6	Industrial action
6-a	Industrial action that causes a threat to security or safe railway operations or to security
7	Personal safety on trains
7-a	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
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-e	Indecent assault
9-f	Aggravated robbery
9-g	Common robbery
9-h	Theft
9-i	Bomb explosion

# Appendix B:

# 2016/17 Operational occurrences per category and sub-category

2016/17 Operational occurrences					
Category	Q1	Q2	Q3	Q4	2016/17 Total
A-a	2	1	3	2	8
A-b	284	252	203	185	924
A-c	2	0	2	0	4
A-d	4	4	9	9	26
A-e	7	7	9	9	32
A-f	3	1	5	3	12
Total	302	265	231	208	1 006
В-а	29	16	39	35	119
B-b	34	59	60	56	209
В-с	12	23	9	14	58
Total	75	98	108	105	386
C-a	23	14	19	22	78
C-b	2	2	1	1	6
C-c	0	0	0	0	0
C-d	0	0	0	0	0
C-e	0	0	0	0	0
C-f	0	0	0	0	0
C-g	0	0	0	0	0
C-h	0	0	0	0	0
Total	25	16	20	23	84
D-a	28	35	23	24	110
D-b	1	2	0	1	4
D-c	0	0	0	0	0
D-d	2	1	1	1	5
Total	31	38	24	26	119
E-a	160	182	142	158	642
E-b	0	2	3	0	5

Category	Q1	Q2	Q3	Q4	2016/17 Total
E-c	2	0	0	0	2
E-d	0	0	0	0	0
E-e	0	1	0	1	2
E-f	0	0	0	0	0
Total	162	185	145	159	651
F-a	68	106	65	85	324
F-b	0	0	0	1	1
F-c	0	0	0	0	0
Total	68	106	65	86	325
G-a	33	18	49	40	140
Total	33	18	49	40	140
H-a	22	18	14	20	74
H-b	112	125	110	151	498
H-c	1	0	0	0	1
H-d	0	0	0	0	0
Н-е	0	0	0	0	0
H-f	0	0	0	0	0
Total	135	143	124	171	573
l-a	0	0	0	0	0
I-b	24	29	33	25	111
I-c	0	0	0	0	0
I-d	0	0	0	0	0
I-e	0	0	0	0	0
I-f	0	0	0	0	0
Total	24	29	33	25	111
J-a			6		16
J-a J-b	2	4		4	
	1	0	1	2	4
J-c	0	0	0	0	0
J-d	1	6	1	1	9
J-e	0	0	0	1	1
J-f	0	0	0	0	0
J-g	0	0	0	0	0
J-h	0	0	0	0	0

J-i	0	0	0	0	0
J-j	0	0	0	0	0
J-k	0	0	0	0	0
J-l	0	0	0	0	0
Total	4	10	8	8	30
K-a	2	0	1	3	6
K-b	0	0	0	0	0
K-c	55	42	47	59	203
K-d	0	0	0	0	0
К-е	0	0	0	0	0
K-f	0	0	0	0	0
Total	57	42	48	62	209
L-a	8	8	5	7	28
L-b	0	0	0	1	1
L-c	32	20	22	29	103
L-d	32	156	67	45	300
Total	72	184	94	82	432
2016/17	988	1 134	949	995	4 066

Notes	

Notes



#### **HEAD OFFICE (CENTURION):**

Tel: +27 12 848 3000, Lake Buena Vista Building, No.1 Gordon Hood Avenue, Centurion, 0157, South Africa

#### **JOHANNESBURG:**

+27 11 848 4000, Harrow Court, Isle of Houghton, 36 Boundary Road, Houghton Estate, 2198, South Africa

#### **CAPE TOWN:**

Tel: +27 87 806 5180, 20th Floor, 9 Riebeeck Street (Lower Burg Street) Atterbury House, Cape Town, 8000, South Africa

#### **DURBAN:**

+27 87 806 5219, 1st Floor, No. 101 Ridgeview Office Park, 26 Noondo Place, Umhlanga Rocks, Durban, South Africa

RP245/2017 ISBN: 978-0-621-45711-7