RAILWAY SAFETY REGULATOR
RAIL SAFETY ON THE RIGHT TRACK

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IRSC 2025

Advancing Railway Safety through Innovations and Collaborations

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Harnessing Innovation and Collaboration to Advance Railway Safety in South Africa

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Outline

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Sub-theme: Innovation and technologies

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Introduction

The railways in South Africa are facing persistent safety challenges:

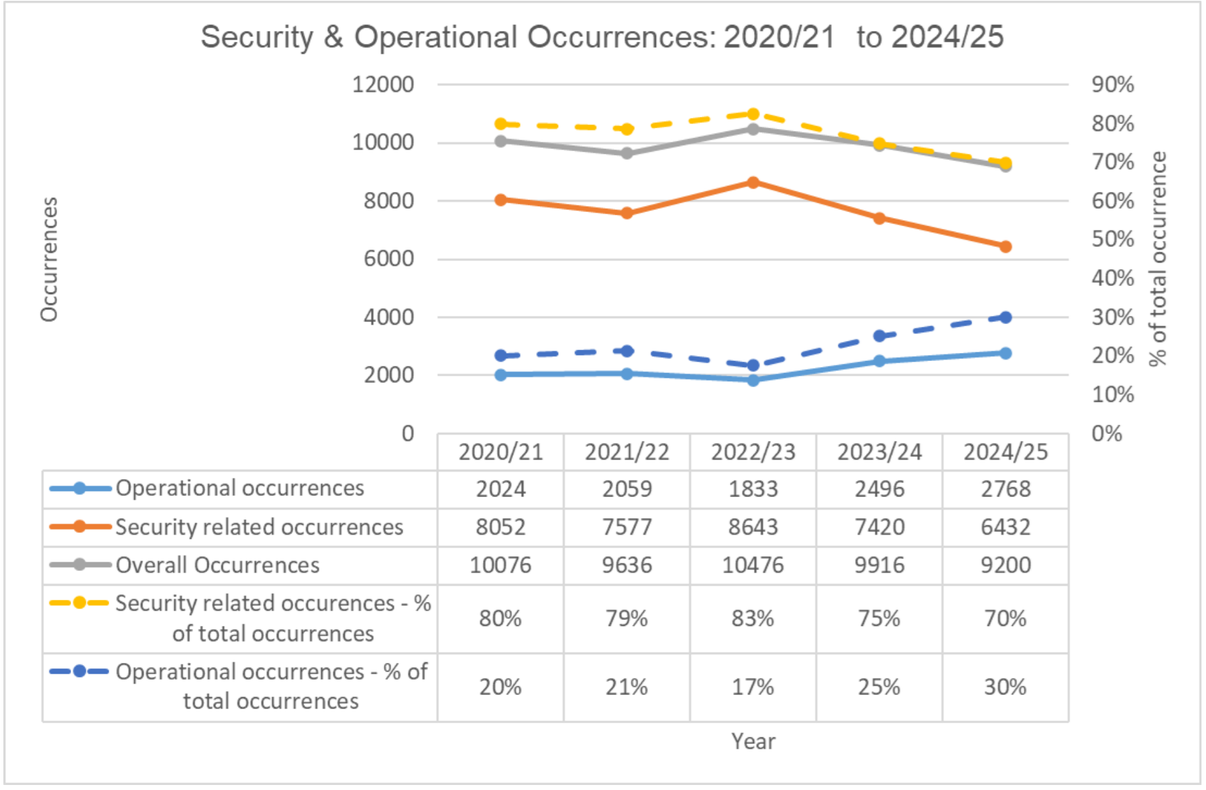
- Underinvestment
- Vandalism
- Aging infrastructure

RSR 2024/25 Annual State of Safety Report:

- 9,200 total safety occurrences
- 2768 → operational occurrences
- 6432 → security related
- 759 collisions and 337 derailments

All of the above undermine public confidence and reliability of the rail network

Proportion of operational and security related occurrences



	2020/21	2021/22	2022/23	2023/24	2024/25
Operational occurrences	2024	2059	1833	2496	2768
Security related occurrences	8052	7577	8643	7420	6432
Overall Occurrences	10076	9636	10476	9916	9200
Security related occurences - % of total occurrences	80%	79%	83%	75%	70%
Operational occurrences - % of total occurrences	20%	21%	17%	25%	30%

Source: RSR Occurrence Analysis (2024/25)

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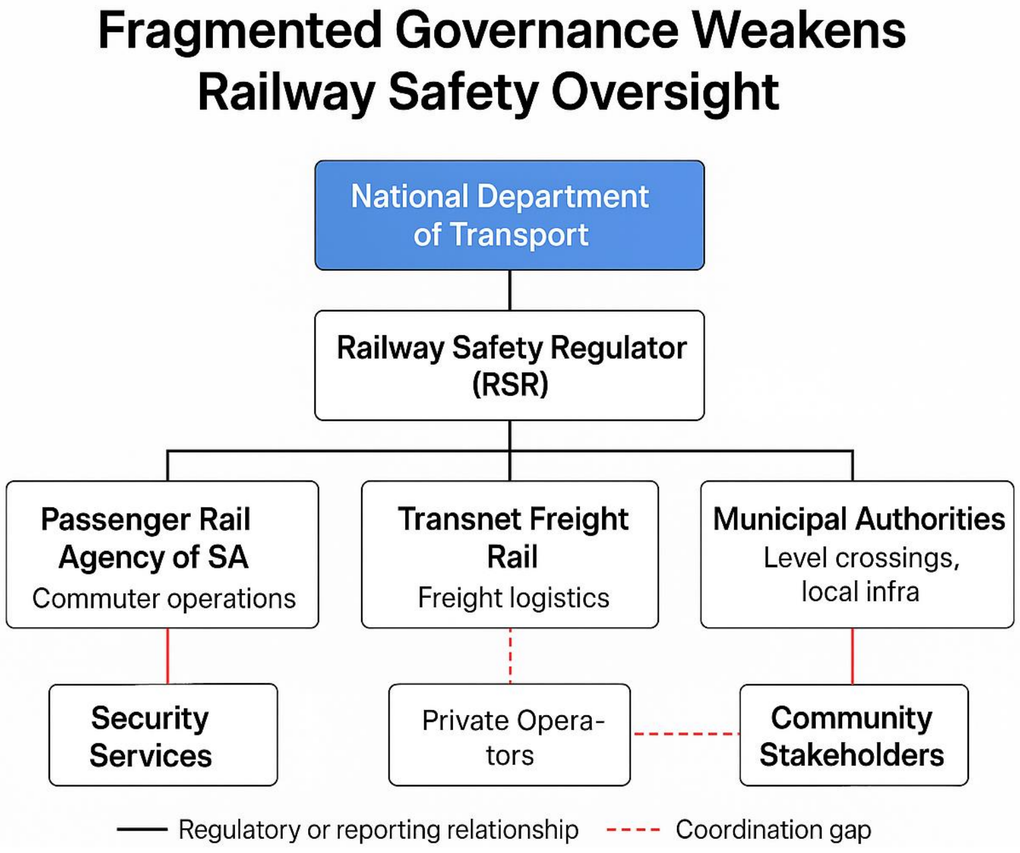
Governance & Systematic Gaps: Core Problem



- Multiple entities share responsibility for rail safety, but coordination is weak.
- Railway Safety Regulator (RSR) sets national safety standards, but implementation is fragmented.
- Overlapping roles and unclear accountability cause delays in incident response.
- Non-integrated safety strategy leads to inconsistent performance, duplicated efforts, as well as compliance and reactive management.

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Digital transformation in rail safety

Industry 4.0 in Rail Transport

- Railways worldwide now integrate digital technologies to improve safety, reliability, and efficiency
- This transformation is underpinned by AI, Internet of Things (IoT), Big Data, and Automation
- The goal: Predict, prevent – protect

Implications for South Africa

- Leapfrog legacy issues by adopting digital rail strategies aligned with global best practice

From analog oversight to **DATA-DRIVEN safety**.

Global rail systems are proving that innovation saves lives

Key Technological advancements	
Technology	**Function**
AI Surveillance	Detects trespassing, vandalism, unsafe behaviour
IoT Predictive Sensors	Monitors asset health in real time
Digital Twin Systems	Simulates rail networks & scenarios
Automated Train Control (ATC)	Controls speed & braking automatically
Big Data & Cloud Platforms	Integrates multi-operator data

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Lessons from Global Leaders

Japan :

- Automated resilience systems (Shinkansen) enabled the achievement of zero passenger fatalities since 1964.

China:

- AI-driven high-speed rail operations integrate **IoT and predictive maintenance**, sharply reducing accidents.

Germany :

- Digital Rail for Germany program uses AI scheduling to improve safety and network efficiency.

United Kingdom:

- Network Rail's Intelligent Infrastructure leverages big data for early fault detection and proactive maintenance.

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South Africa's Current Innovations

South Africa's rail sector has embraced digital and operational innovations; this is proof that the foundation for transformation already exists. Yet, these efforts operate in silos, limiting the envisaged collective safety impact.

Initiative	Lead Organisation	Technology Focus	Safety Culture
AI e-Guarding	**PRASA + Huawei**	Intelligent video analytics for stations and depots	Detects trespassing, vandalism, and security threats in real time
Integrated Port Management System (IPMS)	**Transnet**	Real-time data on cargo, train, and port movements	Enhances coordination and reduces operational bottlenecks
Ultrasonic Broken Rail Detection (UBRD)	**Transnet**	Sensor-based rail integrity monitoring	Prevents derailments by early fault detection
Centralized Train Control (CTC)	**Transnet**	Digital command for train movement and signaling	Improves scheduling, reduces collision risk
Condition-Based Maintenance (CBM)	**PRASA**	IoT sensors track , wheel, and brake health	Shifts maintenance from reactive to predictive

"South Africa's rail sector is already innovating — the next step is integrating these systems into a unified digital safety ecosystem."

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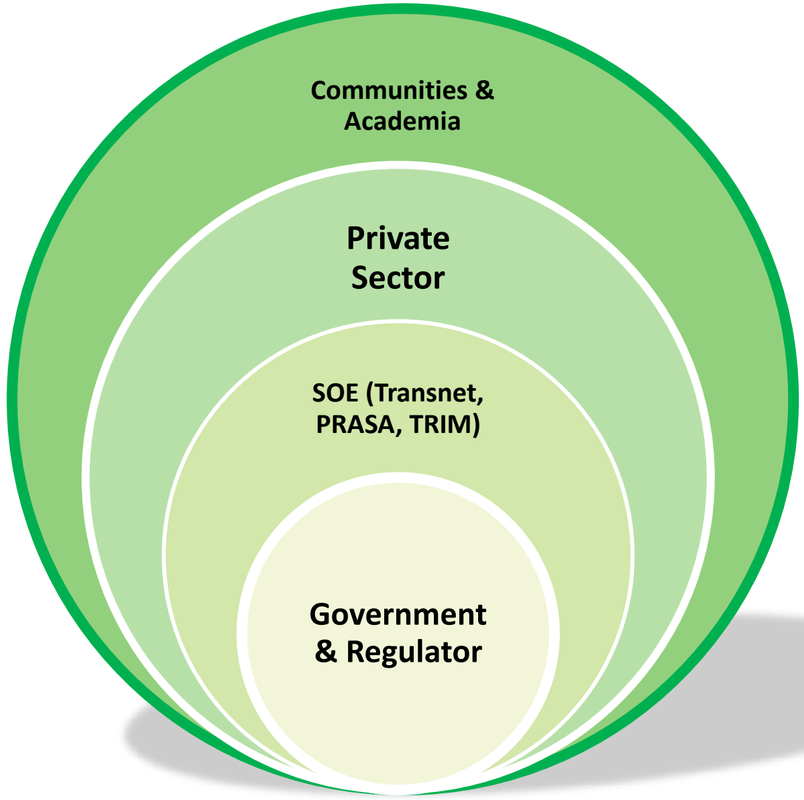
Collaboration for change

Collaboration Type	Description	Expected Impact
Public–Private Partnerships (PPPs)	Joint programs (e.g., PRASA–Huawei AI e-Guarding; Transnet predictive systems) to co-develop and fund smart safety tech.	Accelerates modernization and shared accountability.
Community-Driven Safety Initiatives	Engagement with communities for corridor security, education, and reporting.	Strengthens public trust and local safety ownership.
Academic–Industry Partnerships	Collaborations with universities on IoT, AI, and safety modeling.	Builds local R&D capacity and innovation pipelines.
International Collaboration	Partnerships with **UIC, SADC Transport Secretariat, World Bank, and the International Railway Safety Council (IRSC)** for benchmarking, technical assistance, and funding.	Access to global expertise, training, and data-driven policy frameworks.
Regulatory Coordination	Aligning RSR, PRASA, Transnet, DOT, and municipal oversight.	Ensures cohesive governance and unified national standards.



"Shared Data • Shared Vision • Shared Responsibility"

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Strategic recommendations

- 🔧 **Regulatory Reform:** Harmonize frameworks, empower RSR
- 💰 **Infrastructure Investment:** Modernize assets, attract private funding
- 💡 **Technology Integration:** Expand AI, IoT, digital systems
- 🤝 **Collaboration:** Establish multi-stakeholder governance platforms
- 📊 **Data Governance:** Centralized safety database, predictive analytics
- 🛡️ **Safety Culture:** Embed accountability and trust

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Conclusion

Integrated Governance Structure

- Establish a **centralized safety and innovation authority** that aligns PRASA, Transnet, RSR, and the private sector under one coordinated vision.
- Promote **transparent accountability**, data sharing, and consistent safety standards across all operators.

Seamless Integration of Digital Technologies

- Create an interoperable digital ecosystem linking AI surveillance, IoT-based maintenance, and automated control systems.
- Ensure that technology adoption is guided by national policy frameworks, enabling scalability and sustainability.

Continuous Learning and Improvement Culture

- Embed data-driven decision-making and performance monitoring in all operations.
- Build human capacity through upskilling in digital competencies and safety analytics.
- Use lessons from global best practice to foster a culture of innovation and adaptability.

Inclusive Stakeholder Ecosystem

- Strengthen collaboration among government, SOEs, academia, private industry, and communities.
- Engage international partners (UIC, African Union, regional safety bodies) to share expertise and align with global rail safety standards.
- Encourage co-creation of solutions that balance safety, sustainability, and social impact.

"South Africa's railway future depends not just on technology, but on the collaboration, governance, and shared commitment to safety that turn innovation into lasting transformation."

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