

# CONDITION OF SOUTH AFRICA'S TRANSPORT FIXED INFRASTRUCTURE: THE FOURTH JOURNEY ALONG THIS ROAD

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## ABSTRACT

Service delivery problems, particularly those attributable to the adequacy or inadequacy of operation and maintenance of infrastructure, have received heightened attention across the country.

In 2006 the South African Institution of Civil Engineering (SAICE) released the first ever “report card” of the condition of engineering infrastructure in South Africa. The purpose of the report card was to draw the attention of government, and of the public at large, to the importance of maintenance, and to factors underlying the state of repair of infrastructure. The success of this report card was such that SAICE, greatly assisted by its then partner the Council for Scientific and Industrial Research (CSIR), brought out further report cards in 2011 and 2017. Another, this time primarily the work of volunteers from the technical divisions of SAICE, was released during the fourth quarter 2022.

Of the dozen public sector infrastructure sectors assessed in 2022, no less than five concern transport, viz:

- Roads.
- Airports.
- Commercial harbours.
- Fishing harbours.
- Rail.

This paper:

- Reviews the drivers of infrastructure, and particularly of the condition of infrastructure.
- Reports the transport-related findings of the 2022 national infrastructure report card – in the context of all infrastructure sectors.
- Identifies trends in and the key drivers determining this condition.

## 1. BACKGROUND

A paper presented at the 2018 Annual Southern African Transport Conference (SATC) described the nature and purpose of report cards on the condition of infrastructure. It also described the historical background of the South African Institution of Civil Engineering (SAICE) report cards, the research methodology of all three report cards (SAICE 2006;

SAICE 2011; SAICE 2017), and the key cross-sector findings of all three (Wall and Rust, 2018). It also briefly described some effects of transport infrastructure condition – e.g. the effect of “road roughness” on vehicle operating costs.

At the risk of repeating some of the contents of the 2018 paper, the background, research methodology and findings are summarised as follows:

In 2006, SAICE, in partnership with the Council for Scientific and Industrial Research (CSIR), released the first report on the condition of a broad spectrum of engineering infrastructure in South Africa (SAICE 2006). The purpose was to draw the attention of government, and the public at large, to factors underlying the condition of infrastructure, and to the importance of maintenance. Its success was such that SAICE and the CSIR produced the next report card in 2011 (SAICE 2011), with the third being released late in 2017 (SAICE 2017).

SAICE and the CSIR concluded that since 1994 significant strides have been made to correct infrastructural imbalances. Drinking water, sanitation, education, energy and health infrastructure have received focused attention, and government is continuing to invest at a rapid pace in infrastructure for disadvantaged communities. However, the combination of limited resources, public sector restructuring, inefficiency, shortages of key skills and less than optimum governance has resulted in extreme pressure on the condition of the public infrastructure asset base.

The infrastructure report cards (IRCs) grade public sector infrastructure (water, sanitation, solid waste, roads, airports, harbours, rail, electricity and hospitals and clinics) on the following scale:

- A: World class.
- B: Fit for the future.
- C: Satisfactory for now.
- D: At risk of failure.
- E: Unfit for purpose.

## **2. METHODOLOGY**

The methodology to compile the first three SAICE infrastructure report cards included:

- Compilation of basic research reports based on desk top work by the CSIR.
- Arranging for the drafting of additional reports for selected sectors where the CSIR did not have sufficient expertise itself.
- Moderation of the sector reports by SAICE experts with additional inputs where necessary and early results from an opinion survey.
- Determination of the final gradings by SAICE.
- Writing and publication of the report card and its associated commentary by SAICE experts.

In 2006, the overall condition, i.e. averaging across all infrastructure sectors, was assessed to be at the D+ grade.

The second report card released in April 2011 (SAICE 2011) concluded that, again ‘on average’, there had been improvement, and awarded the overall grade of C-. Nonetheless, it highlighted that this “marginal improvement in the average condition of South Africa’s

infrastructure over the previous five years” had been influenced by the major investment in “national assets” (stadiums, harbours, rail, national roads and airports) in preparation for the 2010 FIFA Soccer World Cup. The downside of the focus on these national assets was that it had diverted the attention of the authorities from maintenance and upgrading of their core infrastructure – with predictable consequences. The authors concluded that ‘the quality and reliability of basic infrastructure serving the majority of our citizens is poor and, in many places, getting worse.’ (SAICE 2011, page 5).

The 2017 report card lowered the overall average back to D+ and noted that the ‘apparent improvement’ between 2006 and 2011 ‘was not a cause for complacency’, and it is evident that the poor attitude to maintenance continues and is reflected in the downturn on the current overall grade.’ (SAICE 2017, page 5).

When the time came to prepare the fourth IRC, the CSIR was once more approached, asking it to again provide the excellent research support it had provided in all three previous years. However, this time the approach was unsuccessful. SAICE, therefore, turned to its own membership, asking its technical divisions to research and write the reports on each of the infrastructure sectors that the CSIR had previously undertaken to do. This approach generally worked out well – indeed, the outputs produced by some of the technical divisions proved to be of the highest quality, which speaks volumes for the commitment of the volunteers who undertook the task. Outstanding performers included the Water and Transport divisions, and also the contributions by the South African Institute of Electrical Engineers and the Energy Expert Group of the South African Academy of Engineers. Unfortunately, SAICE does not have technical divisions corresponding to just a few of the infrastructure sectors (e.g. basic education infrastructure), and therefore in respect of these, it proved more difficult to cobble together the range and quality of the information required.

The current paper:

- Reviews the gradings given in the 2022 report card.
- Outlines the transport fixed infrastructure condition trends: 2006-2011-2017-2022.
- Outlines and reviews the drivers of infrastructure, and particularly of the condition of transport fixed infrastructure.
- Identifies the key factors influencing the condition.
- Draws conclusions.

### **3. KEY FINDINGS**

Of the dozen infrastructure sectors assessed in the 2022 report card, five concern public sector transport fixed infrastructure, viz:

- Roads.
- Airports.
- Commercial harbours.
- Fishing harbours.
- Rail.

### 3.1 Trends

The trends, from 2006 through 2011 and 2017 and now to 2022, can be summarised as follows:

- Roads:
  - National roads have improved, and are now graded B+;
  - the grading given to paved roads in metropolitan areas, for several years static at C-, has now slid to D, the same grade as paved provincial roads;
  - “other paved municipal roads” are rated D-, same as in 2017; and
  - unpaved provincial and municipal roads hold onto an E grading, as in previous years, despite a discernible deterioration.
- Airports (the nine major airports owned by Airports Company of South Africa): graded B in 2006, but in 2011 and 2017 improved to B+, are now at B-;
- Commercial harbours (the nine commercial harbours owned by Transnet): were graded C+ in 2006, but in 2011 and 2017 improved to B-, a grading which they held in 2022;
- In 2011, fishing harbours had benefited from a major refurbishment programme completed just a few years before, but the improved condition had not been maintained, and therefore it had fallen to C. In 2022, however, the next major refurbishment effort was nearing completion, which reflected in the improved grading of B;
- Rail (some re-categorisation in this sector has made comparisons difficult but, broadly):
  - the heavy-haul freight lines, graded B in 2006 and B+ in 2011 and 2017, were assessed at B- in 2022;
  - the general freight lines were graded C in 2006, but rose to C+ in 2011 and then declined to C, dropping further to C- in 2022;
  - the branch lines grading moved from D- in 2006 to D in 2011, to D- in 2017 and E in 2022;
  - the passenger lines (principally the commuter rail lines, but also the intercity passenger trains) grading moved from D+ in 2006 to C- in 2011 and to D+ in 2017, thereafter falling precipitously to E in 2022; and
  - Gautrain, A in 2017 (the first year it was graded), fell to A- as assessed in 2022.

In brief, within the transport sector, comparing 2022 with the preceding report cards:

- The facilities on which much of the formal economy primarily depends, viz national roads, airports, harbours and the heavy-haul freight lines – together with Gautrain – are graded highest, viz A- through B-; whereas
- PRASA passenger lines fell the most of all across all transport sectors, but every one of the rail sector gradings fell;
- Gravel roads remain at E, and are now joined by rail branch lines; and
- All other subsectors remain within C and D gradings.

In 2022, compared to 2017, four transport subsector gradings remained the same, while eight deteriorated. The only subsector to improve, albeit comparing 2022 with 2011 (it was not graded in 2017), was that of the fishing harbours – thanks largely to fortuitous timing of the report card vis-a-vis the big-budget infrastructure refurbishment programme from which the fishing harbours seem to benefit at irregular intervals.

All of this is seen in the context that, the overall grading, across all report card sectors, has varied from D+ in 2006, to C- in 2011, back to D+ in 2017 and in 2022 dropped to a straightforward D, the lowest overall grading yet.

### 3.2 Data

Data which is systematically captured and analysed enables planning, prioritisation of targets and adequate budgeting for maintenance, but it must be data that is credible and sufficiently comprehensive and up-to-date.

Public sector transport fixed infrastructure condition monitoring was in 2022 much the same as in previous years, that is, how much monitoring is undertaken varies widely, depending mostly on the zeal and resources of the authority that owns the infrastructure. For example, whereas the general state or condition of a road is customarily described in terms of a visual condition index (VCI) using a five-point scale, i.e. very good, good, fair, poor and very poor, in practice, few South African road authorities undertake regular condition assessments. Acceptable information was received only from the South African National Roads Agency Ltd (SANRAL), two of the nine provincial roads authorities, and half of the metropolitan municipalities. Information from other roads authorities, in particular municipalities, was comparatively scarce and too incomplete to enable firm general conclusions to be reached, other than to infer that authorities which are not sufficiently informed of the condition of the roads would very likely also not be able to manage these assets in a satisfactory manner.

For those sectors, for example, the municipal and provincial roads noted above, improvement in infrastructure condition monitoring is required to enable the all-important shift from reactive “repair” to planned “maintenance”.

## **4. FINDINGS: SECTOR BY SECTOR**

### 4.1 Roads

The primary contributing factors leading to pavement deterioration in South Africa are institutional capacity constraints, weak asset management, lack of maintenance, high traffic volumes, overloading and poor stormwater management.

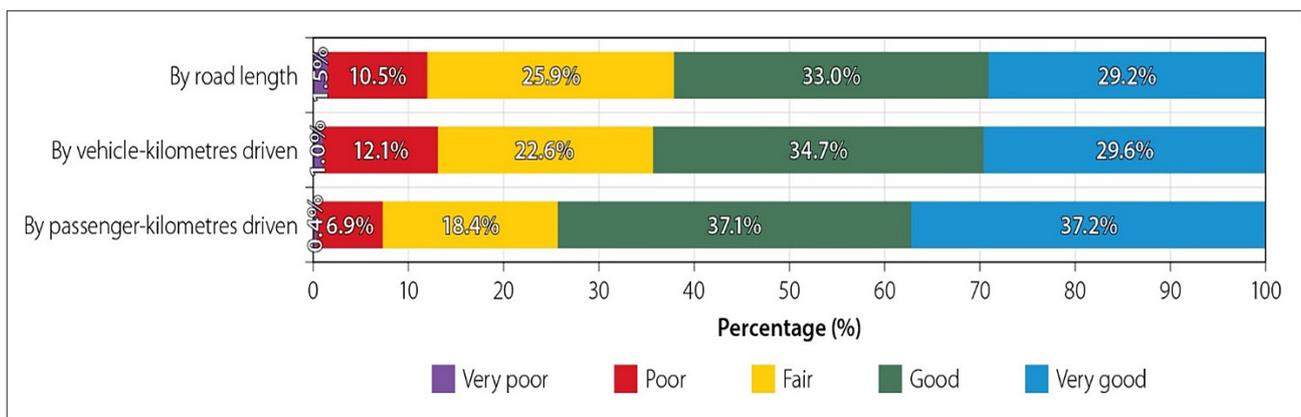
The South African circa 750 000 km road network is managed at three levels:

- (a) Primary intercity, with roads of national economic importance managed by SANRAL on behalf of the Department of Transport (DoT);
- (b) The secondary and tertiary intercity network, primary access and mobility roads largely managed by the nine provincial departments; and
- (c) The mostly urban and rural roads managed by municipalities.

The condition of this road network varies greatly with category, type of road, sphere of government and geographical location. At one end of the spectrum, the condition of the 21 000 km managed by SANRAL is “very good”, no doubt largely because it has managed to retain its high level of professional engineering expertise. On the other hand, most of the provinces have over two decades steadily lost experienced road professional expertise. Of the municipalities, while the larger metropolises have, to a great extent, retained their levels of professional expertise, and consequently the condition of their road networks, very few other municipalities have been as fortunate (or prudent).

Referring for the moment only to municipalities, a factor in the condition of all of their fixed infrastructure (not only roads) is undoubtedly their expenditure on maintenance and repairs – the larger, more urban municipalities generally spend more, whereas many of the more rural municipalities are constrained financially, which reflects also in their maintenance and expenditure budgets.

Not only is knowledge of the condition of the road system essential for prioritisation of expenditure, but so, too, is knowledge of the usage of the system. For example, it would seem to be common practice to ensure that roads which are perceived to be more important to the economy receive preferential attention – a perception which is generally manifested in roads carrying higher volumes of traffic being kept in better condition. Using the Western Cape as an example, as Figure 1 illustrates, the expenditure per kilometre on the more densely trafficked provincial roads is higher.



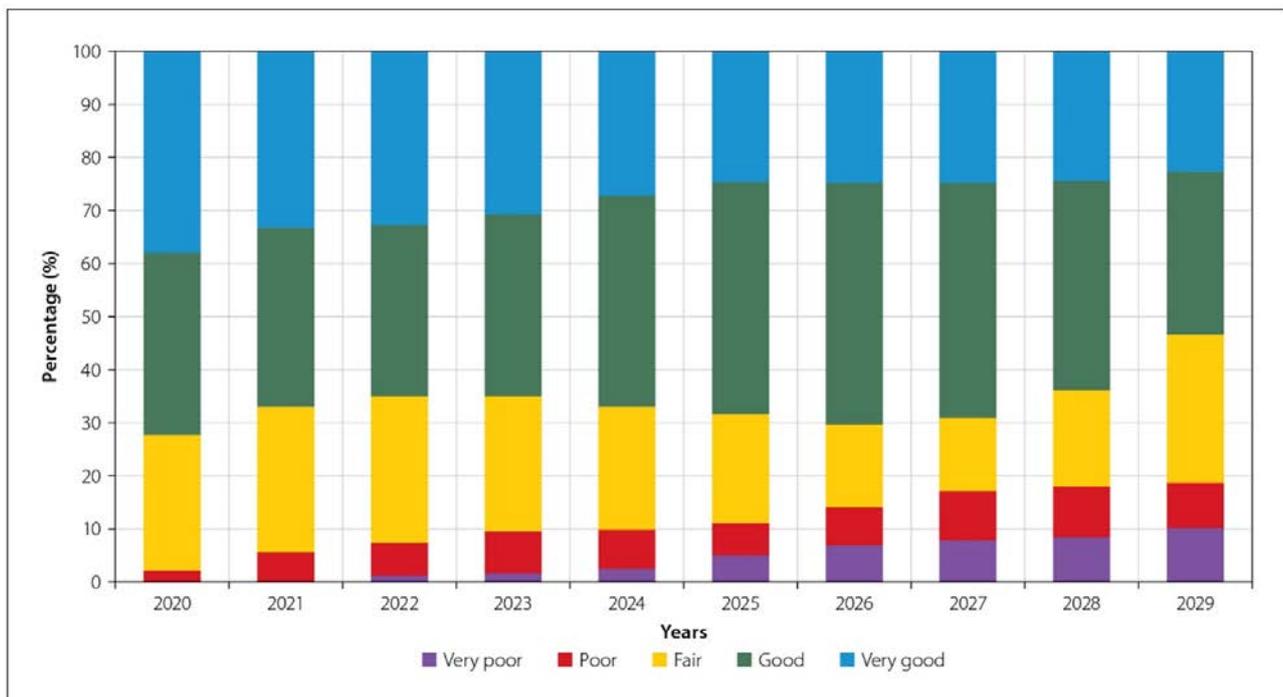
Source: Data from Western Cape Government, 2021

**Figure 1: Western Cape paved road condition by road length, vehicle-kilometre and passenger-kilometre (2019)**

However higher traffic is not – or should not be – the only determinant of road maintenance prioritisation. A particular road might carry a very low volume of traffic, but it is the only link for some otherwise isolated communities – on these grounds, the road might deserve greater attention than its count of vehicle-kilometres driven would suggest.

The consequences of the widespread underfunding of road condition maintenance and improvement, year after year, are seldom assessed by road authorities. Of the provinces, only Mpumalanga and Western Cape were able to report on this. Figure 2 illustrates a prediction of far less “very good” and far more “very poor” lengths if there is no escalation of the budget allocation.

A positive move has been that in 2018 the national Department of Transport initiated a programme to force provincial road authorities to develop, maintain and operate proper pavement management systems. However, the process was interrupted by Covid-19, and progress is therefore not where it was planned to have been.



Source: Data from City of Cape Town, 2021

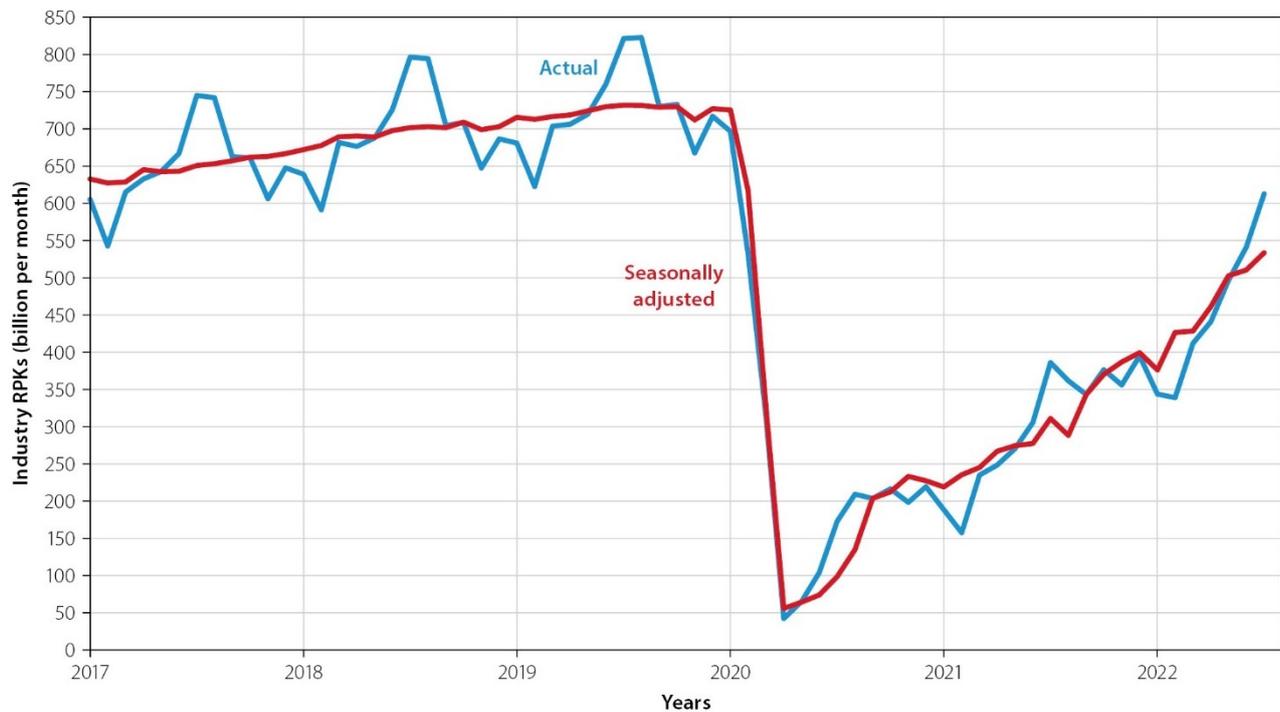
**Figure 2: City of Cape Town predicted condition deterioration if no change in maintenance budget allocation**

## 4.2 Airports

The state-owned Airports Company of South Africa (ACSA) owns and operates (i) the three major international airports, namely, Oliver Tambo International, Cape Town International and King Shaka International and (ii) six other commercial airports (Kimberley, George, Upington, East London, Port Elizabeth and Bloemfontein). The international airports account for nearly 90% of the 30 million annual passenger movements – that is, in normal times, but, thanks to COVID-19, at its worst moments (during 2020), passenger traffic globally fell by a staggering 94% year-on-year (Figure 3 illustrates). This brought with it corresponding devastating loss for both aeronautical and non-aeronautical revenue. Although air cargo movement increased dramatically during the pandemic, 2021 revenue was still less than half of peak pre-pandemic levels, and recovery since then has been slow. Given that ACSA's success in operating and maintaining its airports has in the past been attributed to its strong financial position, competent technical and managerial staff, and mandatory regulatory compliance, the extent to which the pandemic may have, directly or indirectly, affected its infrastructure in the long-term is only now beginning to emerge.

ACSA is responsible for the property as a whole at its airports and in particular, the runways, terminals and some of the hangars and technical areas. ACSA is not responsible for the navigational aids and air traffic control which are the responsibility of Air Traffic and Navigation Services (ATNS).

ACSA's success in operating and maintaining its airports is strongly incentivised by the mandatory requirements for safety and reliability of, principally, the Civil Aviation Authority of South Africa (CAASA) and the International Civil Aviation Organisation (ICAO). Therefore, ACSA is careful to keep its infrastructure up to standard and consequently the score card gradings have through the years ranged between B+ and B-.



Source: Data from IATA Economics, July 2022

**Figure 3: Global air passenger volumes (in revenue passenger kilometres (RPKs)) to July 2022**

### 4.3 Commercial Harbours

The commercial harbours are the responsibility of the state-owned company Transnet through its business units the National Ports Authority (TNPA) and Transnet Port Terminals (TPT). The TNPA is responsible for the harbours and their infrastructure, including berths, port buildings, tug and pilot services, navigable areas (therefore including services such as dredging) and aids to navigation. It is also the “landlord” of the terminal operators, which include not just TPT but also major oil companies and others. Each of these is responsible for its own shoreside equipment such as straddle carriers, cranes and conveyor belts, and terminals (such as grain elevators) and their equipment.

There are nine harbours in the TNPA stable: seven major commercial harbours: Saldanha Bay, Cape Town (Table Bay), Port Elizabeth, Ngqura (Coega), East London, Durban, Richards Bay, and two minor harbours: Port Nolloth and Mossel Bay. Since Transnet’s return to profitability a dozen years ago, there has been significantly greater emphasis in TNPA (and indeed in all other Transnet business units) on infrastructure, both on capital investment to grow the business, and on repair and replacement of existing infrastructure.

TNPA conducts regular inspections of all of its infrastructure, including breakwaters, quays and other berthing structures, roads and paving, railway infrastructure within harbour limits, dry docks and slipways, electrical and mechanical aspects of the preceding (including lighting and pumping), and navigational aids – the latter not only within harbour limits, but along the coast e.g. beacons, lighthouses and telecommunications. This condition monitoring informs the work of the maintenance staff: monitoring information is used to identify faults which need to be repaired, and to schedule planned maintenance interventions.

Currently, the commercial harbours infrastructure (defined, for report card purposes, to comprise breakwaters, quay walls, terminal areas, lighting, and navigation systems) can be said to be in an acceptable condition for port operations. Both the fixed and movable infrastructure still perform well in meeting the safety and operational standards.

#### 4.4 Fishing Harbours

The national Department of Public Works and Infrastructure (DPWI) Small Harbours and State Coastal Properties Development Unit, established in 2015, is responsible for the 12 proclaimed fishing harbours, all of which are in the Western Cape. The Unit was by the end of calendar 2022 close to completing a multi-year comprehensive refurbishment of all these harbours, including removal of sunken vessels, dredging, repairs to slipways, shore crane replacement, and civil and electrical engineering repairs.

A similar major refurbishment of all harbours ended in 2007, but thereafter far too little was done in terms of maintenance and repair. The result was that by the time the 2011 infrastructure report card (IRC) appeared, deterioration was so apparent that SAICE could grade the harbours no higher than “C”, despite them having been restored to an excellent condition just a few years before. It is now hoped a maintenance programme is planned and will be instituted to ensure that the (2022) improved condition of the infrastructure is kept up.

#### 4.5 Rail

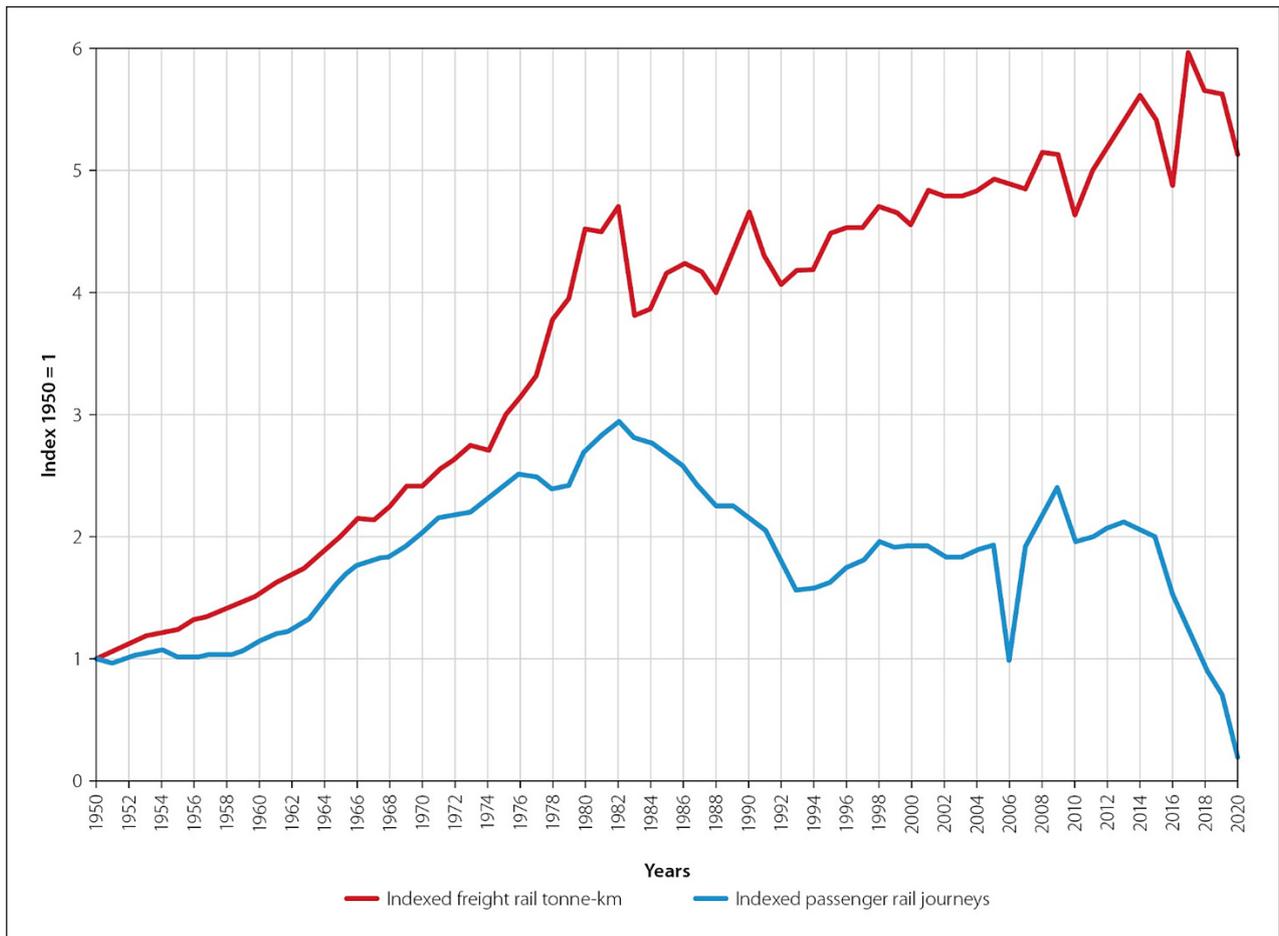
Four entities, namely the state-owned companies Transnet Freight Rail (TFR) and the Passenger Rail Agency of South Africa (PRASA), Gautrain Rapid Rail Link (Gautrain – a public-private partnership, owning only 0.3% of the total track) and the Railway Safety Regulator (RSR), are responsible for the rail sector.

Rail passenger and rail freight patronage have followed very different trajectories over the last seven decades. Freight rail traffic grew by a factor of five, largely driven by the export of coal and iron ore. Inter-city rail passenger traffic started declining from its peak about 40 years ago, and has since to all intents and purposes disappeared. Intra-city commuter transport infrastructure has deteriorated markedly, falling catastrophically since the last IRC, as Figure 4 illustrates.

Rising sabotage, theft and vandalism have resulted in high costs of corrective maintenance as opposed to preventative or asset life-cycle maintenance. As shown in Figure 5, the safety performance of all operators has been affected. Per million train kilometres, the security-related incidents (the red line) now far exceed those caused by operational issues (the blue line). This long-term destruction places the rail sector at significant risk and must be arrested if South Africa is to utilise the rail mode to anything near its full potential, and thereby relieve pressure on the road system to which so much rail traffic has diverted.

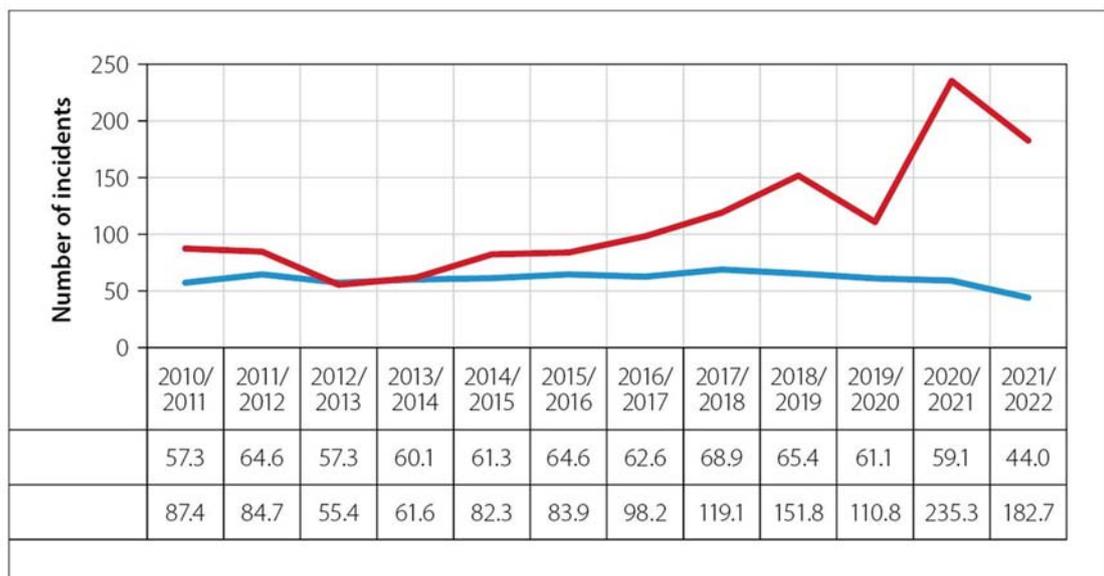
All systems (with the exception of Gautrain) have built up severe maintenance backlogs in both rail infrastructure and rolling stock. This has occurred over at least the past decade, thanks to many factors, including mismanagement, loss of market share, failure to reduce costs by increasing density, poor service levels, and the tragedy of state capture. TFR indicated capacity constraints for the primary export commodities (coal and iron ore), driven by locomotive unavailability, vandalism of rail infrastructure and continued cable

theft. An important indicator of these constraints is the massive drop in throughput (one-third less than the maximum tonnage previously achieved).



Source: Data from Transnet Freight Rail and PRASA

**Figure 4: 1950-2020 trends in passenger rail journeys and freight rail tonne-kilometre**



Source: Data from RSR 2022

**Figure 5: Operational- and security-related incidents per million train kilometres: trend 2010-2022**

The main general freight corridors are critical for rail growth and to relieve the country's overburdened road infrastructure. This network is generally in fair condition, although there has been significant deterioration since the last IRC.

Of the branch lines, only a low percentage is operational.

The general condition of the PRASA commuter rail network is very poor. Operational issues such as outdated equipment (including rolling stock), theft, arson and vandalism – and passenger protection against criminality – also need to be addressed to improve weak operational performance and the unreliability of the service.

## 5. KEY DRIVERS

The report cards have provided ample evidence of factors which generally determine if, or the extent to which, the infrastructure in the care of a particular organisation – almost irrespective of the infrastructure sector the organisation is in – is likely to be adequately maintained and operated.

They have also, over the years, increasingly recognised the importance of a number of generic factors which, taken together, often lead directly to infrastructure being in the condition that it is. In brief, the principal of these have been:

- **Skills:** The lack of skills in many organisations responsible for infrastructure – and the impact of this on planning, procurement, design, construction and care of infrastructure. Many municipalities, for example, are desperately understaffed in crucial infrastructure-related positions, or are staffed by people who do not have the required training or experience;
- **Funding:** That few infrastructure-owning organisations allocate remotely sufficient funding to maintenance of their existing asset base;
- **Systems and procedures:** Particularly for infrastructure asset management; revenue enhancement; cost reduction; data collection and interpretation<sup>1</sup>; sharing of information and coordination of activities (e.g. between departments); life-cycle costing; and delivery-directed (rather than blindly rule-bound) procurement, and
- **Institutions:** Institutional weakness, inhibitive of infrastructure asset management, can take many forms, such as: lack of trust between colleagues; little spirit of cooperation; rapid turnover of personnel; and lack of accountability. Another, often associated, form of institutional weakness is the top level of management making decisions that have turned out to be disastrous for the service – an example from during the covid-19 lockdown is the bulk of PRASA private security contracts being cancelled, reportedly because of procurement irregularities, without thought to the consequences.

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<sup>1</sup> To elaborate: The 2017 and 2022 report cards have both highlighted that while the appropriate data might be collected, it is not often made effective use of. Especially (in the context of the report card) data on infrastructure condition – better data allows early identification of need for repair or remediation of some kind, or replacement.

The last few years have seen, or provided evidence of, increasing illegal activity, or even criminality.

- Especially thanks to the Commission on State Capture (the Zondo Commission), the extent of corruption – including in the procurement of infrastructure and infrastructural services (locomotives being a case in point) – is being revealed. Much of this has already had great impact on the condition of infrastructure and/or service delivery;
- While demands for better service delivery are understandable, they should not be expressed, as they too often are, by destruction of existing infrastructure, and
- Not so much illegal as a question of shirking responsibility is the escalation of non-payment: for example, billions are owed Eskom and water boards by municipalities, while municipalities themselves are owed billions by their customers.

A final example is the increasing extortion exercised by so-called “construction mafia”, or even by the adjacent communities, disrupting construction projects (including maintenance and repair) by demanding inclusion despite little or no evidence of their ability to add economic value.

All of these actions greatly increase the cost of providing infrastructure and delivering services.

The IRC 2022 identified a number of entities performing well above the norm. It found that these entities generally have the following in common:

- Stable leadership. (E.g. SANRAL<sup>2</sup> and Gautrain have had only two CEOs each for the past two decades);
- Strategic importance. (E.g. pressure is placed on TFR by major business groupings to operate the heavy haul lines more efficiently);
- Imposed minimum standards. (E.g. ACSA must conform to international standards or its operating licence will be withdrawn);
- Financial solvency and effective management systems; and
- Appropriate infrastructure asset management policies and their implementation.

## 6. CONCLUSIONS

The process by which the fourth South African national infrastructure report card was compiled has been well tested. Each of the SAICE technical divisions has, as long as the infrastructure sector allocated to it has been within its area of competence (e.g. all the harbours to Marine Division, the roads to Transport Division and the railways to Railways and Harbours Division), demonstrated a depth of understanding of the infrastructure sector and the circumstances in which infrastructure is well looked after, and delivers reliable services – or is not well looked after, as the case may be, and what in particular can lead to a deterioration of the condition of the infrastructure, and consequent falling reliability of the services.

Six of the nine ‘A’ or ‘B’ gradings of IRC 2022 as a whole (32 subsectors in total), namely SANRAL, ACSA, commercial harbours, fishing harbours, TFR’s heavy-haul freight lines, and Gautrain, are of transport infrastructure. While this is gratifying for the institutions concerned, the fact that more non-transport infrastructure subsectors cannot move above ‘C’, which, after all, is no better than ‘Satisfactory for now’, should be of national concern.

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<sup>2</sup> Its third CEO was appointed after IRC 2022 was released.

In the years until the next IRC, SAICE has stated that it is committed to expanding the scope and detail with which it examines the condition of public sector infrastructure in South Africa, and the reasons for its changing condition. SAICE also committed to making itself available to government and the public to discuss the findings of IRC 2022, and to engage on discovering the best solutions.

## **7. ACKNOWLEDGEMENTS**

As noted earlier, the IRC 2022 is almost entirely the work of volunteers, most of them from the technical divisions of SAICE, with further contributions by the South African Institute of Electrical Engineers and the South African Academy of Engineers. For the data which they were able to make use of, they, in turn, were dependent on a multitude of willing officials in both the public and private sectors.

Special thanks for this paper on South Africa's transport fixed infrastructure go to the sterling contributors from the following SAICE technical divisions: Transportation, Marine, and Railway and Harbour Engineering.

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