

# A PROCESS TO ASSESS THE CONDITION OF SOUTH AFRICA'S TRANSPORT FIXED INFRASTRUCTURE

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## ABSTRACT

In 2006 the South African Institution of Civil Engineering (SAICE), in partnership with the Council for Scientific and Industrial Research (CSIR), released the first ever “report card” assessment rating 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 condition of infrastructure. Its success was such that the CSIR and SAICE brought the second report card out in 2011, and are now working together to prepare a third.

Of the 10 infrastructure sectors assessed in the previous report cards (and which will be assessed again in the third), no less than four concern transport, viz roads, airports, ports and rail.

Whereas completion of the third report card will not take place until early 2017, the objective of this paper is to describe (i) the background to and purpose of infrastructure report cards and the process by which the South African report cards are compiled and (ii) key findings of the previous report cards, with a particular focus on the transport sector.

## BACKGROUND

Many factors enable a city to be a liveable and viable entity, a desirable place for working, investing and living. The condition of the built environment infrastructure, i.e. that part of the public sector capital stock producing services utilised by households, such as hospital services, drinking water, sanitation, electricity, or which facilitates economic activity, such as electricity, roads and ports, is a very important such factor. Well-maintained infrastructure underpins quality of life and economic development. Dysfunctional services, such as potholed roads, delayed train services, or unreliable water supply or electricity, constitute not only threats to health and economic activity, but can – and do – also trigger service delivery protests. South Africans are not unfamiliar with these types of protests.

The importance of well-maintained infrastructure to the economic health of nations is clear. Indeed the positive relationship between gross fixed capital formation and economic growth, is well documented (Kumo 2012), and is the basis for sustained economic and social development. If maintenance is inadequate, social and economic growth will be impeded – something that cannot be afforded.

In 2006 the South African Institution of Civil Engineering (SAICE), in partnership with the Council for Scientific and Industrial Research (CSIR), released the first ever “report card” assessment rating of the condition of engineering infrastructure in South Africa (SAICE 2006). 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 condition (state of repair) of infrastructure. Its success was such that the CSIR and SAICE brought the second report card out in 2011 (SAICE 2011), and are again working together to prepare a third, scheduled to appear late early in 2017.

It is anticipated that the findings of this next report card will be widely debated because, in the last few years, service delivery problems, particularly those attributable to operation and maintenance of infrastructure, have received heightened attention across the country – notably, in 2015, in respect of electricity.

Whereas publication of the new report card will only take place some months after the conference, in this paper may be found:

- the background to and purpose of infrastructure report cards and the process by which the South African report cards are compiled and
- key findings of the previous report cards, with a particular focus on the transport sector.

## **INFRASTRUCTURE REPORT CARDS**

Infrastructure report cards are a reflection at a point in time on the condition of built environment infrastructure, i.e. that part of the nation’s public sector capital stock that produces services that are consumed by households, such as hospital services, drinking water, sanitation, electricity, or facilitates economic activity, such as electricity, public transport, roads and ports. This infrastructure is a public asset. All in a nation have a stake in its upkeep and operation, and all, directly or indirectly, share in the consequences of its neglect.

One of the earliest “report cards” on infrastructure was produced in the USA in 1988 by its National Council on Public Works Improvement. Ten years later the American Society of Civil Engineers (ASCE) produced the first “Report Card on America’s Infrastructure”. Since 2001, they have released updates every second or third year. The reports have gradually become more detailed and broader in scope so that now reports are produced by State and, in some instances, by County.

The ASCE initiative is well funded and is an integral part of the lobbying process that is so much a part of American public participation culture – for example the most recent national report card (ASCE 2013) advises its readers that:

"Infrastructure is America's backbone: your local water pipes and the Hoover Dam, the power lines connected to your house and the electrical grid spanning the US, your street and the national highway system – they need your help".

It then exhorts readers to "Take action today: take a deeper look at the nation's infrastructure conditions in the 2013 Report Card – from the state infrastructure facts, to the interactive charts ..... Choose a state to see infrastructure facts". An interactive map can thereafter be clicked on, and if what this reveals about infrastructure in the chosen area stirs the reader to act, he or she is encouraged to click on an icon "Tell Your Legislator".

In the United Kingdom, the Institution of Civil Engineers (ICE) has annually since 2000 published a "State of the Nation" Report. ICE has also progressively elaborated its product to regional reports, and has made the grading more sophisticated by incorporating trends and sustainability aspects. For example, the most recent national report (ICE 2014), in addition to reporting on the condition of infrastructure, carried short and punchy articles on "Funding, financing and leadership" and "Capability and capacity". The most recent of the regional reports, that for Scotland (ICE 2015), featured "Skills and capacity".

These and other infrastructure report cards are intended to draw the attention of both government and the public at large to the importance of maintenance, and to factors underlying the condition of infrastructure – factors such as skills and finance, for example. Whereas they have little technical value to infrastructure professionals, the intention is that they be put to good use in macro level planning, lobbying for infrastructure funding, stimulating debate and highlighting the actions that engineers believe are needed to improve the condition of a nation's infrastructure. By publishing them, learned societies and institutions provide more than information – they commit to a role of advocacy.

## **THE SOUTH AFRICAN INFRASTRUCTURE REPORT CARDS**

Massive strides have been made by all spheres of government in the last 22 years to correct infrastructural imbalances. Drinking water, sanitation, energy and transportation access have received focused attention, and, acting on its mandate, the government is continuing to invest at rapid pace in infrastructure for disadvantaged communities. However the combination of limited resources for the demands of existing infrastructure, priority provision for the previously disenfranchised, public sector restructuring, and shortages of key skills has led to extreme pressure on the condition of the public infrastructure asset base.

SAICE decided 10 years ago that the widely-reported condition of engineering infrastructure, and the negative effect which the poor condition of infrastructure was having on quality of life and economic development, was of sufficient concern that it should compile a "report card" of the condition of infrastructure. It approached the CSIR for assistance with the research component – which assistance was readily given – and, in 2006, the first "National Infrastructure Report Card" was published. (SAICE 2006)

This, the first ever report card of the condition of engineering infrastructure in South Africa, highlighted “the observations of the professionals responsible for the planning, construction, operation and maintenance of our nation’s life-support system”. It graded infrastructure (water, sanitation, solid waste, roads, airports, ports, rail, electricity and hospitals and clinics) on a scale from "A+" ("in excellent condition"), through to "E-" ("infrastructure has failed or is on the verge of failure, exposing the public to health and safety hazards"). Overall, it gave the infrastructure a D+ grade.

The second report card, again a CSIR/SAICE partnership, was launched in April 2011. (SAICE 2011) This covered ten sectors<sup>1</sup>, one more than in 2006. These were further divided into 27 sub-sectors, six more than the previous time. It was found that, in comparison to 2006, nine of the sub-sectors showed improvement, twelve remained unchanged and four had deteriorated. The Public Schools sector and the Fishing Harbours sub-sector were new and therefore did not have trend indicators. Overall, a grade of C- was awarded.

This overall improvement from a grade of D+ in 2006 reflected marginal improvement in the average condition of South Africa’s infrastructure over the past five years, influenced by the heavy investment in, especially, national assets such as stadiums, ports, rail, airports and national roads, much of this in preparation for the 2010 FIFA Soccer World Cup. However the downside of the attention given to the Cup has been that this appears to have distracted authorities from the core business of maintenance and upgrading of other infrastructure – with predictable consequences. An example with major impact of the long-term effect of this has proved to be the ongoing power crisis in South Africa, caused by a number of factors, prominent among which, it must be noted, is the neglect of maintenance because of the imperative that "the lights stay on during the World Cup" – as admitted by the CEO of Eskom at his widely-reported and most revealing press conference in January 2015. (Matona 2015)

Thus the authors of the third report card strongly cautioned against a perception that the rise to C- represented a blanket improvement. On the contrary, “the quality and reliability of basic infrastructure serving the majority of our citizens is poor and, in many places, getting worse. Urgent attention is required to stabilise and improve these”. (SAICE 2011)

Note that these report cards do not comment on backlogs as expressed in the absence of infrastructure to serve certain areas and communities. It is the condition of existing infrastructure which is the focus, together with the effect of that condition

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- Water and sanitation services infrastructure.
- Solid waste management.
- Roads.
- Airports Company of South Africa airports.
- Commercial ports.
- Rail permanent way and structures.
- Electricity generation infrastructure.
- Health care infrastructure.
- Public ordinary schools infrastructure.
- The large-scale water resources infrastructure owned by Department of Water and Forestry.

on service delivery (e.g. that a badly operated and maintained water treatment works is sometimes unable to supply the town for days at a time). Also important, but not the main focus, are the factors which lead directly to this infrastructure being in this condition.

## **RESEARCH METHODOLOGY 2006 AND 2011**

The 2006 report card was prepared under intense time pressure and without the comfort of a defined budget. In contrast, the process towards the 2011 report card had the comfort of a more formal agreement between SAICE and the CSIR, a much bigger budget and longer timeframe, and a more formal and more intensive process of peer review.

In summary the following research methodology was followed by the CSIR:

- Drafting sector reports (desk top work) for infrastructure sectors to be identified and for which it has the required in-house expertise;
- Endeavouring to arrange for the drafting of reports for selected sectors where it does not have sufficient expertise itself; and
- Contributing to the process of grading and, particularly, to the drafting of the report card itself.

SAICE then used a number of peer review groups, selected for their knowledge and expertise in each subsector, to review the CSIR output and use a consensus grading of the condition of infrastructure in each of the subsectors as mentioned above.

The same research questions are being posed to the current report card team as were posed to the earlier teams. These questions are simply stated:

- What is the condition of key elements of South Africa's bulk infrastructure?
- How does this compare with the 2006 and 2011 assessments? What is the overall trend, and what are the trends by sectors?
- What contributes to the condition and its trends? What recommendations can be made?

The methodology used in 2006 and 2011 has worked well, and therefore the new report card is being prepared along more or less the same principles.

## **KEY FINDINGS, 2006 AND 2011**

In both 2006 and 2011, two key themes ran as a thread through all the grades. The first was the shortage of skills and the impact of this on planning, procurement, design, construction and care of infrastructure. The second was the lack of adequate funding for the maintenance of the existing asset base and the new assets that come on-stream each day.

South Africa suffers an acute skills shortage in the infrastructure sector. Just two illustrations should highlight how serious this is. Firstly, a survey undertaken by SAICE some years ago showed that more than one-third of all 231 local municipalities did not have a single civil engineer, technologist or technician –

vacancies in local government for engineering practitioners then exceeded 1000. (Lawless 2007) Circumstantial evidence suggests that the situation has not improved since.

The low skills base of so many in the public sector who are responsible for infrastructure manifests in many ways, one of the most important of which is the frequent underspending of the capital budgets of many public sector institutions – particularly municipalities, some of which grossly underspend every year. Another manifestation of the low skills base is the frequently encountered poor quality of workmanship by both public and private sector.

After skills, the second key constraint was the lack of adequate funding for the maintenance of the existing asset base and the new assets that come on-stream each day. An annual maintenance budget allocation of 4% of replacement cost is commonly regarded as the minimum needed in order to keep assets in good condition. (CIDB 2009) However, such allocation is rare. Moreover, it is usually too low, especially when it is expected to cater for a maintenance backlog which requires rehabilitation or refurbishment in addition to routine maintenance.

In 2011, a third key theme, viz the need for systems and a systematic approach, also ran as a thread across all the grades. Such an approach would enhance the integration of services and maximise the use of scarce human and infrastructural resources. It will also reduce the incidence of failure as constant data collection on condition allows early identification of acute and chronic weak points in the delivery chain. Neglect is also costly in financial terms - for example, roads maintenance that is delayed for one year could cost three to six times more when there is eventually no choice but to do it.

An alarming feature, more prevalent in some sectors than in others, has been the shortage of critical data pertaining to infrastructure. On the basis of early enquiries in preparation for the third report card, it would appear that the availability of data and its reliability are not likely to have improved. Reliable, consistent data is a prerequisite for the urgently required shift from reactive "repair" to planned "maintenance". Data which is systematically captured and analysed enables planning, prioritisation of targets and adequate budgeting for maintenance. A small number of municipalities have shown how this should be done – they have utilised their data consistently in order to prioritise spending, even while their budgets are invariably less than they need.






The allocation of maintenance funding is by owners of public sector infrastructure, with very few exceptions, simply not sufficient, especially in circumstances where it is expected to also cater for a maintenance regime that has led to neglect. All too frequently the inadequacy of the allocation is compounded by poor management which results in these meagre funds going unspent, e.g. in the health sector. This is not true of all sectors. ACSA (Airports Company of South Africa) and SANRAL have consistently maintained their infrastructural assets, reducing the need for expensive refurbishment at a later stage.







Adequate, integrated systems would also improve coordination across different departments of government. Often, departments share responsibility for infrastructure, e.g. the Department of Public Works is responsible for construction of hospitals and clinics which are operated and managed by the Department of Health. In other cases, diversified responsibility may result in competing priorities or non-sequential project completion because of a lack of coordination across departments. One example of this is the incongruity of the on-time completion of the Gauteng Freeway Improvement Project and the incomplete public transport initiatives for the province. In this case the competence of one agency (SANRAL) is punished by the tardiness of another.

The importance of life-cycle costing cannot be overemphasised. Although departmental-specific policies or legislation often support this idea, this does not translate to implementation, especially in early stages such as procurement, which so often makes no attempt to optimize life-cycle costing. That is, the bid with the lowest capital price is favoured, although accepting this bid usually means significantly more expensive maintenance and repair costs in the long term.

## THE TRANSPORT SECTOR

The two report cards are available on the SAICE website ([www.civils.org.za](http://www.civils.org.za)), so all that is incorporated in this paper is a brief explanation of only the transport-related grades from 2011, noting in particular the trends from 2006 to 2011.

Sector	2011 Grade	Trend	Brief condition report from 2011 Report
Roads	<b>B</b> For national highways		The national road network is in the good to excellent range with the proportion of roads in poor to very poor condition never exceeding the international benchmark of 10%. SANRAL continues to demonstrate excellence in monitoring and maintenance systems.
	<b>D-</b> For paved provincial roads		The provincial paved road network has deteriorated significantly over time. Shortages of skilled personnel in provincial departments, inadequate funding and outdated systems, and the lack of routine and periodic maintenance, have all contributed to the current condition.
	<b>C-</b> for paved metropolitan roads		Less than 10% of the paved metropolitan roads are in poor to very poor condition. Balancing the need for the upgrading of township roads with the necessity to perform routine and periodic maintenance remains a challenge given the limited resources.
	<b>D</b> For paved district and local municipal roads		In general, municipalities lack capacity, skilled resources and funding to effectively manage their road networks. Condition data is scarce. Few municipalities make use of pavement management systems to prioritise their needs.
	<b>E</b> for all provincial, metropolitan and municipal gravel roads		Maintenance of gravel roads, which constitute 75% of the total length of the proclaimed South African road network, has been neglected. Condition data is scarce. Approximately 50% of the provincial gravel roads and 30% of the municipal gravel roads for which condition data is available are in a poor to very poor condition.

<b>Airports</b>	<b>B+</b> 9 State-owned commercial facilities only		ACSA is a model of excellent maintenance and operational practice. It is strongly driven not only by the need to meet statutory requirements, but also by its own high standards.
<b>Ports</b>	<b>B-</b> Commercial ports only		Expenditure on upgrading and providing new port infrastructure owned and operated by Transnet has continued at a steady pace since 2006. Ports' infrastructure is ageing but well-maintained.
	<b>C</b> Fishing harbours (new sub-sector)	None	The repair and maintenance programme completed in 2007 drastically improved the condition of the harbours. However urgent follow-on maintenance is required, particularly of mechanical installations such as slipways.
<b>Rail</b>	<b>B+</b> for heavy haul (ore and coal) lines		These lines are in a good condition and are well maintained. Recent capital expenditure has enhanced the condition of the network. Some operational issues do exist.
	<b>C+</b> for general freight lines on the core network		Condition of the network has improved slightly. Operational performance needs to improve, and more needs to be done regarding service levels and reliability.
	<b>D</b> for active branch lines		Transnet's focus on the core network means that further deterioration will occur to the active branch lines which are not concessioned or earmarked for expansion.
	<b>C-</b> for passenger lines (excluding Gautrain)		The capital investment programme is slowly starting to reduce the backlog, but not quickly enough. Operational inefficiencies do exist and passenger volumes are restricted by inadequate and failing rolling stock. Vandalism and safety are major concerns.

At this early stage (January 2016) of the third report card preparation, it is not possible to speculate on what might be found. However it is anticipated that, by the time of the 2016 SATC conference, some preliminary findings might be available. If they are, they will be shared at the conference.

## THE NEXT REPORT CARD

The process is now underway to prepare a third report card. As in previous years, the key roles of the two parties will be:

- The CSIR takes responsibility (including carrying its costs) for compilation of the basic research reports, and initial gradings; whereas
- SAICE takes responsibility (including carrying its costs) for moderation of the gradings and determination of the final gradings to be published, and for everything to do with writing of the report card itself, its launch, and any following up.

As emphasised earlier, the focus of these report cards is on the condition of the infrastructure. However increasing importance has over the years been accorded to recognising the factors which lead directly to this infrastructure being in the condition that it is.

There is little doubt that skills factors and financial factors will be shown to be playing an important role in the condition of infrastructure. Studies over the years, drawing attention to the inadequacy of the current technical skills base in the public sector (in some areas much more inadequate than in others) have regrettably made little



difference (e.g. Lawless 2007). Of particular interest is work recently undertaken on behalf of the Water Research Commission (WRC), which has come up with findings on the skills encountered in a small sample of water services institutions. The worst-performing municipality was found to have a "skills gap" of 92% – i.e. a gap determined by comparing the number of the current staff who possess the minimum qualification and years of experience against the "required staff" as determined by the infrastructure which the municipality is supposed to be taking care of. (Vienings awaiting publication)

The same study also looked at a larger sample of municipalities and other water services institutions (e.g. catchment management agencies), and found too many examples of appointees to technical posts who lack the necessary qualifications. Fingers were pointed at the appointment process – of particular concern should be that "40% of respondents said the minimum requirements of job profiles were overridden when recruiting staff". (Ibid)

The effect of this lack of skills on the condition of infrastructure, due to inadequate operation and maintenance of the infrastructure, can be imagined.

On the financial side, National Treasury has of late increasingly been voicing its concern about the financial sustainability of municipalities, and about factors which undermine that sustainability. For example, in the most recent of its annual assessments (a report which came out at the end of 2014), Treasury classified 86 of the 278 municipalities as "financially distressed". Nine of them, it said, are "in serial distress", having been on the list four years in a row. (Bruce 2014)

Financial distress of this type is likely to affect residents' quality of life quite profoundly. Shortage of finance could (and usually does) result in repairs and maintenance being neglected (sadly, this is often a favoured target for municipal cost-cutting). Together with inadequate systems, for example to send accounts and collect revenue due, and to pay bulk suppliers, it could result in inability to operate services. (A reflection of financial distress is that: "Sixty-one local municipalities and four metros have carried their collective debt of more than R2.8bn — owed to nine water boards — into the new year. This has prompted the National Treasury into threatening to withhold the defaulting councils' equitable share allocations." (Magubane 2016)

It is disturbing that many of the interventions to support ailing small municipalities and help them to function seem to have borne little fruit. The above-mentioned Treasury report stated that: "Over the last number of years, national government has made available substantial amount of money for capacity building. Yet there is very little indication that such funds ... have yielded the intended outcomes." (Bruce 2014)

## **FINDINGS**

The purpose of the infrastructure report card initiative has been for engineering professionals to provide a public opinion on the condition of infrastructure in the manner of “expert witness”. The professionals’ highlighting the current status of the condition of infrastructure informs the public about the importance of infrastructure in their daily social and economic intercourse. Furthermore, whereas many decision makers are lay people, and not technical, the reports empower those responsible to make better informed decisions, especially decisions regarding maintenance management and planning for new expenditure. At the same time, the report cards highlight the role and relevance of engineers and the professional engineering institutions.

The reports and the indicated trends from 2006 to 2011 made it possible to conclude that, while government should not change its drive to provide new infrastructure to address backlogs, the challenge is to supplement this by at the same time also focusing on the maintenance of both new and old infrastructure. If this is not done, the already considerable legacy of that infrastructure which is dysfunctional for want of sound operation and adequate maintenance in the past, and which therefore needs rehabilitation or replacement at considerable cost, will increase rapidly. Infrastructure, once created, is unrelenting in its demand for maintenance, and this demand will escalate increasingly the longer it is ignored.

Government needs to be aware of the opinion of the professions (as represented by SAICE and infrastructure professionals) on where maintenance or replacement is most needed, such as where infrastructure is ageing or approaching obsolescence, and what needs to be done to improve the condition of infrastructure and thereby service delivery.

This thinking is in line with government’s National Infrastructure Maintenance Strategy (Department of Public Works et al 2006) and with the National Immovable Asset Maintenance Management Framework "Maintenance Management Standard" which at the time of writing awaits MINMEC final approval. (Department of Public Works et al 2015)

## **CONCLUSIONS**

The process by which the third South African national infrastructure report card is being compiled has been well tested. The two cooperating organisations, viz the CSIR and SAICE, are well resourced, and have 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.

Whereas there is a wealth of information on infrastructure condition in the public domain for some sectors, for other sectors this is not the case. The research team is well positioned to compile a balanced view across all sectors, to identify trends, to identify key issues, and to make sound recommendations.

Publication of the third report card will only take place early in 2017. Delegates to SATC 2016 will nonetheless no doubt appreciate the description which may be found in this paper of:

- the background to and purpose of infrastructure report cards and the process by which the South African report cards are compiled and
- key findings of the previous report cards, with a particular focus on the transport sector.

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