

CSIR contribution to the 2010 state of engineering infrastructure in South Africa report card

Kevin Wall (CSIR Built Environment), Chris Rust (CSIR Built Environment), Sam Amod (Development and Engineering Consultants), Dawie Botha (SAICE)

Corresponding author: Kevin Wall: kwall@csir.co.za

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Abstract

In 2006, the South African Institution of Civil Engineering (SAICE), utilising desktop research documentation prepared for this specific purpose by the CSIR, released the first ever “report card” of the state of engineering infrastructure in South Africa. This 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+ through E-. Overall, it gave the nation’s infrastructure a D+ grade.

The importance of infrastructure for social and economic development is underestimated and consequently its maintenance is often neglected. 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 – factors such as skills and finance, for example. The report card was a great success in that it received media coverage exceeding the highest expectations.

SAICE last year approached CSIR Built Environment with a request to again prepare desktop research documentation, on the basis of which the different infrastructure sectors could be graded. Agreement was reached, and, at the time of writing (June 2010) the research documents for most of the sectors have been completed or are nearly completed. SAICE will thereafter, with the assistance of the CSIR, grade each infrastructure sector, prepare the final document, and launch it towards the end of the third quarter of 2010.

It is anticipated that the 2010 report card will, as in 2006, be widely disseminated and debated. Even more so, because, since 2006, service delivery problems (and what to do about them), and in particular those problems attributable to inadequacies of operation and maintenance of infrastructure, have received heightened attention -- from communities, in the media, and from government.

Introduction

Report cards are reflections at points in time on the state of built environment infrastructure, i.e. that part of the nation’s public sector capital stock producing services consumed by households, such as hospital services, drinking water, sanitation, electricity, or facilitates economic activity, such as electricity, roads and ports. This infrastructure is a public asset. All citizens have a stake in its upkeep and operation, and all share in the expense of its construction and its ongoing maintenance.

Well-maintained infrastructure underpins quality of life and economic development. If maintenance is inadequate, social and economic growth will be impeded. The compilers of report cards intend these to be instruments to contribute to better-informed decisions on infrastructure development and maintenance. Thus the purpose of the report cards is 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 – factors such as skills and finance, for example.

While the link between engineering infrastructure and economic growth may be clear, it is not always obvious that a similar link exists with social health. It is obvious, though, that cleaner drinking water, proper sanitation, better shelter, access to transport and electricity, all improve the quality of life. There is an old saying that somebody pays for maintenance, whether it is done or not. The consequences of neglect are severe, affecting the very lives of people, through outbreaks of water-borne disease, reduced safety on roads and rail, inconvenience and inefficient commercial activity. Research by SAICE indicates that, in general, developing countries have more doctors than engineers, whereas the opposite is true in developed countries. The inference is clear: proper infrastructure prevents disease and sickness.

Neglect is also costly in financial terms -- from 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.

International practice

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 its first “Report Card on America’s Infrastructure”. Since then, it has released a new report every second or third year. The reports have gradually become more detailed and broader in scope so that now reports are produced for many of the individual state and, in some instances, counties.

ASCE has also produced an action plan appealing to Congress for such actions as establishing a National Commission on Infrastructure, increasing funding for specific improvements and, most notably, promoting certain Acts that are presumably under consideration by the legislators. The ASCE initiative is well funded and is an integral part of the lobbying process that is so much a part of the American public participation culture, as the following excerpt testifies:

"Congested highways, overflowing sewers and corroding bridges are constant reminders of the looming crisis that jeopardizes our nation's prosperity and our quality of life. our nation's infrastructure has shown little to no improvement since receiving a collective D+ in 2001, with some areas sliding toward failing grades."

In the United Kingdom, the Institution of Civil Engineers (ICE) has annually, since 2000, published a “State of the Nation” Report. The report is compiled each year by a panel of experts drawn from the various fields of civil engineering expertise across ICE’s membership. Its aim is to stimulate debate and to highlight the actions that civil engineers believe are needed to improve the state of the nation’s infrastructure. The report is issued to a wide audience of stakeholders, including politicians, civil servants, local authorities, trade, regulatory and consumer bodies as well as the media.

ICE, like ASCE, has also progressively elaborated its product to regional reports, and has made the grading more sophisticated by incorporating trends and sustainability aspects.

At the launch of the 2006 Report, then ICE President Gordon Masterton stated:

“We need to start answering the questions posed in this report. How do we intend to reconcile rising demand for water with dwindling resources? Where is our electricity going to come from in

the future? How can we stop our rubbish piling up on landfill sites? How do we tackle congestion on our roads and railways?

“To accomplish this transformation would require changes to the law to simplify planning processes, and joined-up government with the vision to see the necessity and economic benefit of long-term infrastructure improvements. And it would need the public to be made aware that improvement programmes ... will reward them, their children and generations to come.”

Engineers Australia produced a national Infrastructure Report Card in three categories in 1999 (roads, rail and water), and in 2003 and 2005 increased this to seven categories. They have also subsequently produced State and Territory report cards.

In all the cases quoted, the intention has been for engineering professionals to provide a public opinion on the condition of infrastructure in the manner of “expert witness”. The media reception has at times been sensationalist, and the reaction from much of the public sector has ranged from full agreement through to strong denial. By contrast, reception of the first SAICE report card in South Africa can only have been described as “mature”.

The 2006 report card

Late in 2006, SAICE, utilising desktop research documentation prepared for this specific purpose by CSIR, released the first ever “report card” of the state of engineering infrastructure in South Africa. This report 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+ through E-. Overall, it gave the infrastructure a D+ grade. (SAICE 2006)

The process intentionally did not comment on the legacy that gave South Africa an imbalanced infrastructure distribution. The past cannot be managed -- only the present can be managed, in the hope and with the objective of creating a brighter future. Since 1994, huge strides have been made by the democratic government to correct this imbalance. Ambitious plans have been made and implemented. Drinking water, sanitation, energy and transportation access have received focused attention, and, acting on its mandate, the government is continuing to invest at a rapid pace in infrastructure for disadvantaged communities.

The report also did not make any comment on levels of service, or of technologies -- for example as to whether these might be appropriate or inappropriate. Nor did it take into account stated intentions of many agencies to improve infrastructure in the future -- intentions need to be implemented, and this implementation will be reflected in improved grades in future report cards. The focus was entirely on the then current condition of infrastructure.

The 2006 report itself is available on the SAICE website (www.civils.org.za), so all that is annexed to this paper are a MindMap of the grades and a table (below) with brief explanations of only the water-related grades.

Water	D+ for DWAF infrastructure	Well maintained but ageing bulk infrastructure reaching end of useful life, and requires refurbishment or replacement. 43% of dams have safety problems and require urgent refurbishing. Serious concerns about funding.
	C+ for major urban areas	South Africa is one of few nations where in most urban areas water can be drunk directly from the tap. Major, and ongoing, strides in provision of water and sanitation
	D-	

	for all other areas	since 1994. However, erratic compliance with water quality requirements in most municipalities. Water wastage (leakage) is much too high. Shortage of skilled personnel.
Sanitation (including wastewater)	C- for major urban areas	Serious problems with management of many wastewater (sewage) treatment works. Wastewater leakage and spillage much too high, and frequent problems with on-site sanitation. Inadequate operation and maintenance capacity, and shortage of skilled personnel. Major urban areas grade is pulled down by Cape Town and Sebokeng.
	E for all other areas	
Solid waste management	C- for major urban areas	Landfill sites in major urban centres well managed, but many municipalities, especially rural municipalities, have uncontrolled dumpsites with attendant health risks. More widespread waste avoidance and recycling initiatives required.
	D for all other areas	

Finally, an overall grade for built environment infrastructure as a whole:

Overall Grade	D+	Although South Africa's built environment infrastructure is very good, even world class in parts, the relatively poor overall grade reflects extensive maintenance and refurbishment backlogs. These backlogs are caused primarily by funding and skills shortages.
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Two key themes ran as a thread through all the grades. The first was the great shortage of skills and the impact of this on planning, procurement, design, construction and care of infrastructure. The second was the inadequate funding of maintenance of the existing asset base and the new assets that constantly come on-stream. The allocation of maintenance funding was with very few exceptions simply not sufficient, especially in circumstances where it was expected to also cater for a maintenance backlog, requiring upgrading, repair or refurbishment in addition to routine maintenance.

The report card highlighted that South Africa suffers an acute skills shortage in the infrastructure sector. Two examples to illustrate this:

- A 2005 survey by SAICE showed that more than one-third of all 231 local municipalities then did not have a single civil engineer, technologist or technician. Vacancies in local government for engineering practitioners exceeded 1 000.
- South Africa has only half as many engineers as doctors. By comparison, Australia, America, Western Europe and even China or India, have a similar number of engineers to doctors, or more engineers than doctors. The ratio of population to engineer in South Africa is of the order of 3 200 to 1, 20 times less than some of the countries just mentioned. Furthermore, while the ratio amongst the South African white population is approximately 300 to 1, similar to America and Western Europe, the ratio in the black population is in the order of 50 000 to 1, amongst the worst in Africa, never mind in the world. The case for transformation, starting with fixing the basic education system, cannot be clearer.

The 2006 report card was published under intense time pressure and without the comfort of a defined budget. Maximum use was made of extensive primary and secondary research already documented, some of it for projects that the CSIR had undertaken. Various key public sector and parastatal executives supplied strategic information.

The grading was uneven to the extent that it was in some areas based on research, whereas in other areas, taking the view that a synthesis of the perception of sector experts is at least as credible and

informative as primary research data, the grading relied heavily upon the opinion of a small number of key SAICE members and/or CSIR staff practising in those sectors.

The intent had been to inform the public, including decision makers who are technical lay-people, about the importance of infrastructure in their daily social and economic intercourse, by highlighting the current status of its condition. It was hoped that this would lead to better informed decisions being made with respect to maintenance management and planning for new expenditure.

The following were the primary achievements:

- For the first time ever in South Africa (or, for that matter, in Africa), a consolidated report on the state of a broad range of infrastructure nationally was published by a credible institution, drawing attention to its condition and importance, and headlining issues requiring attention in a manner understandable to technical, decision-making and lay persons.
- The primary objective of informing the public and decision makers was very successfully achieved if the numerous live interviews and presentations, print, visual and audio media exposure and discussions with client and sector organisations could be taken as any kind of indicator. A measure of the reach of the initiative was the acknowledgement of the report card at the May 2007 Presidential Imbizo in Johannesburg by the many Ministers and MECs present.
- The exposure received by SAICE was the greatest it had received in many years, if not ever, all of it overwhelmingly positive. The credibility of the Institution as a learned society with the authority, indeed the duty, to comment broadly on engineering infrastructure was undoubtedly enhanced.
- Invitations were received from government departments and others for SAICE to engage with them in order to address issues raised in the report card.
- Building on and reinforcing the message from the excellent work done by SAICE Past-President Lawless in the SAICE Numbers and Needs project (Lawless 2005 -- and, subsequently, Lawless 2007), the awareness of the public, parents, learners, educators and government to the urgency of the crisis, e.g. in education of engineering practitioners, was raised.

Did the report card lead to better informed decisions being made with respect to maintenance management and planning for new expenditure? That, it was agreed, would be impossible to gauge except indirectly, such as in the results of the next report card, and in particular any trends revealed thereby.

The 2010 report card: overview

In the euphoria following the good reception of the 2006 report card, SAICE entertained thoughts of expanding the scope of the next report card -- such as more detailed analyses of one or more provinces, or of a sector, such as all municipalities. Also suggested was extending the process to SADC neighbours. However, as was acknowledged at the time, "Clearly, these are ambitious objectives and some, if undertaken, go beyond the mandate of SAICE and will require external authority and especially substantial funding." (Amod and Wall 2007)

Deliberately left undefined was the publishing interval. Infrastructure condition does not alter significantly in the space of a year, so it would not be cost-beneficial to undertake another report card for at least three years. When the next report card should appear was a decision that could safely be left to future SAICE leadership.

In 2007, SAICE and the CSIR stated as follows:

"After decades of decline, construction and infrastructure provision seem set for decades of growth, with construction forming the fastest growing sector of the economy. Construction also generates more jobs per rand spent than almost any other sector of the economy. It is imperative that we do not continue to build only to permit decay. On the contrary, adequate budgets and maintenance management plans are required for existing and new additions to the infrastructure asset base." (Amod and Wall 2007)

In 2009 the decision was taken that, whereas so much construction had been taking place in preparation for the 2010 FIFA World Cup, the next report card should as closely as possible reflect the situation around the end of 2009/beginning of 2010. In making this decision it was fully appreciated that primary research findings inevitably lag reality -- that is, several months have ordinarily passed by the time research findings become available. Thus research is inevitably at the very least to that extent out of date by the time that it can be used.

Budgetary constraints also led to a cutting back on ambitions with respect to the coverage of the report card. It was in the end decided that the objectives would best be served by:

- Sticking with the same sectors covered in 2006 (viz water services - including sanitation and wastewater - and resources, solid waste, roads, major airports, major ports, rail, electricity, and hospitals and clinics), and adding only schools.
- Incorporating a trend score (improvement, decline or unchanged grades since 2006) and possibly a stability or "resilience" score (an assessment of the prospects of infrastructure in the sector receiving the maintenance and refurbishment needed in order to continue to perform at least at the level indicated by the grading now given).
- Ensuring that the process of grading would be more rigorous than in 2006, with greater consultation and finer definition of the process and particularly the grading.

On the latter point: as mentioned earlier, SAICE and the CSIR were taken aback (and felt somewhat complimented) by the ready acceptance of the gradings given. That is, there was hardly any criticism or attack on the gradings, or even a questioning of these. There was not a single call for SAICE to even name the research upon which it had relied -- never mind calls for that research to be made available.

However that was in 2006. Since then, the issue of reportedly deteriorating infrastructure in some areas has come much in the public eye. It has also become much more political than before. Some sector infrastructure owners have proven very sensitive to criticism, irrespective of whether they perceive it to be fair or unfair.

The water services sector has received particular attention, in political circles, in the media, and in the eye of the public. To give a good example, the sterling efforts of the Department of Water Affairs in undertaking the Blue Drop and Green Drop analysis processes, and releasing the reports to the public domain (DWA 2009b, DWA 2009, DWA 2010), have, rightly, been highly praised. The suspicion surrounding the Department's delay of the Green Drop report has dissipated now that the report has been released.

This time round, the process of gathering and analysing research, and the subsequent process of allocating the gradings, has had to be not just more rigorous in itself, but also more rigorously documented -- just in case it is queried. Trends will for sure be interrogated.

SAICE once again recognised that the CSIR is the organisation best able to assemble and analyse the body of data required -- as indeed was the case in 2006. Thus an understanding was reached between SAICE and CSIR Built Environment that the CSIR would prepare research reports in respect of each of the specific infrastructural sectors. At the time of writing (June 2010) these research reports have for most of the sectors been completed or are nearly completed. SAICE will soon commence preparation of its overview report on the state of South Africa's engineering infrastructure, and will as part of the process solicit input from its extensive membership of infrastructure professionals. SAICE will then perform the grading, and will towards the end of the third quarter of 2010 -- well after the end of the soccer World Cup -- publish and publicise the report.

To emphasise -- the CSIR will not do the grading. This will be the responsibility of SAICE, which is at the time of writing setting up the necessary groups of experts, drawn from membership of its own technical divisions. SAICE has reserved the right to not agree with all findings of the CSIR research.

It was decided that the CSIR would cover the costs of the research reports, whereas SAICE would cover its own costs, including preparation and publication of the eventual report.

It is anticipated that the 2010 report card will, as in 2006, be widely disseminated and debated. Even more so, because, since 2006, service delivery problems (and what to do about these), and in particular those problems attributable to inadequacies of operation and maintenance of infrastructure, have received heightened attention -- from communities, in the media, and from government.

The 2010 report card: terms of reference

In brief, the sector research reports are covering available desktop research documentation, each in respect of its specific sector, on whatever can be gleaned on:

- Who owns what;
- Some idea of quantification (e.g. number of treatment works, kilometre of roads);
- Some idea of replacement cost of infrastructure;
- What has been done to monitor conditions (e.g. roads condition monitoring reports);
- The state of infrastructure;
- Something about causes (e.g. of roads -- overloading);
- State of management (including comments about resources, skills, leadership, etc);
- Trends since 2006;
- Is the current condition stable? Is the trend stable?
- Any other pertinent comments about the condition – e.g. anything that drives the holding of certain standards, including, particularly, legal and/or regulatory compliance requirements (for example, in respect of airports, the International Civil Aviation Organisation standards; for another example, the standards for drinking water quality);
- If information is not available, what does that say about the owners of the infrastructure? And what does it say about the authorities whose job it should be to monitor the owners of this type of infrastructure?
- The range of conditions that the infrastructure is in, and if any patterns can be discerned within that (e.g. urban versus rural; e.g. municipalities in a certain area as opposed to municipalities in a different area). And point out that the average conceals this range.
- If any policies or mechanisms are in place by infrastructure owners in order to cope with the difficulties they face, or in order to make best use of what they have available, these are captured where they are known. (For example that some provincial roads authorities are said to be consciously focusing their resources on the more important roads, and have in effect, because of little or no budget allocations, abandoned maintenance of the least important roads.)

In some sectors, the utility of the infrastructure is determined by more than the physical condition of the infrastructure. For example:

- The physical condition of a facility might be good, but the facility is not usable because there is no staff, or there is no equipment.
- The infrastructure might not be "fit for purpose" -- for example, it is in a good physical condition, but is the wrong type of structure, and/or in the wrong place, and/or technologically obsolescent, and/or overloaded. The infrastructure might be in good physical condition, but operation is hampered by frequent shortages of raw materials (e.g. fuel, chemicals).
- Productivity and operational inefficiencies retard the utility of the infrastructure -- i.e. the infrastructure isn't delivering as it should, not because of the state of the infrastructure, but because of other factors: such as inefficient scheduling, underutilisation of assets, etc, that together constitute this operational inefficiency.

The research team has been asked to comment on all of these, and to flag that these are issues, but has been asked to comment only on the physical condition.

The CSIR staff and SAICE members are the best judges, for each of the infrastructure sectors, as to what is "fair", and hence deserves to be graded at the midpoint (i.e. "C"). There is a need in some way to define what that "fair" means -- and also what would merit the giving of a higher or lower grading.

It must be noted that the research is not taking account of intentions -- even if these are in the form of programmes, with budgets. The report card is strictly focused on the current situation. What infrastructure owners say they are going to do in order to rectify or improve the current situation, is not taken account of this time round. SAICE and the CSIR want to see implementation, and results, before account is taken of plans or programmes.

It was stated above that, since 2006, some sector infrastructure owners have shown themselves to be very sensitive to criticism, irrespective of whether they perceive it to be fair or unfair. One of their "defence mechanisms", it seems, has been to restrict access to information. The CSIR team has in 2010 found that an unfortunate result of this has been a reluctance on the part of professionals in certain areas to as readily share information with the team, compared to the relatively freer access that they, or their predecessors, granted in 2006.

A disappointing finding -- but it must be made clear that this is in respect of a only a few of the infrastructure sectors, and not of the majority -- has been the discovery that less monitoring is taking place of the state of infrastructure than was the case even a few years ago. One sector in particular, where the CSIR in 2006 was able to rely with considerable assurance on then fairly recent reports of a reasonable sample of the infrastructure estate, was found in 2010 to have in the interim done hardly any condition monitoring. As a result the CSIR was forced to undertake its own primary research.

On the other hand, it is pleasing to report that condition monitoring has greatly improved, both in breadth of coverage and in quality, in respect of at least one sector -- viz the water services sector.

Conclusion

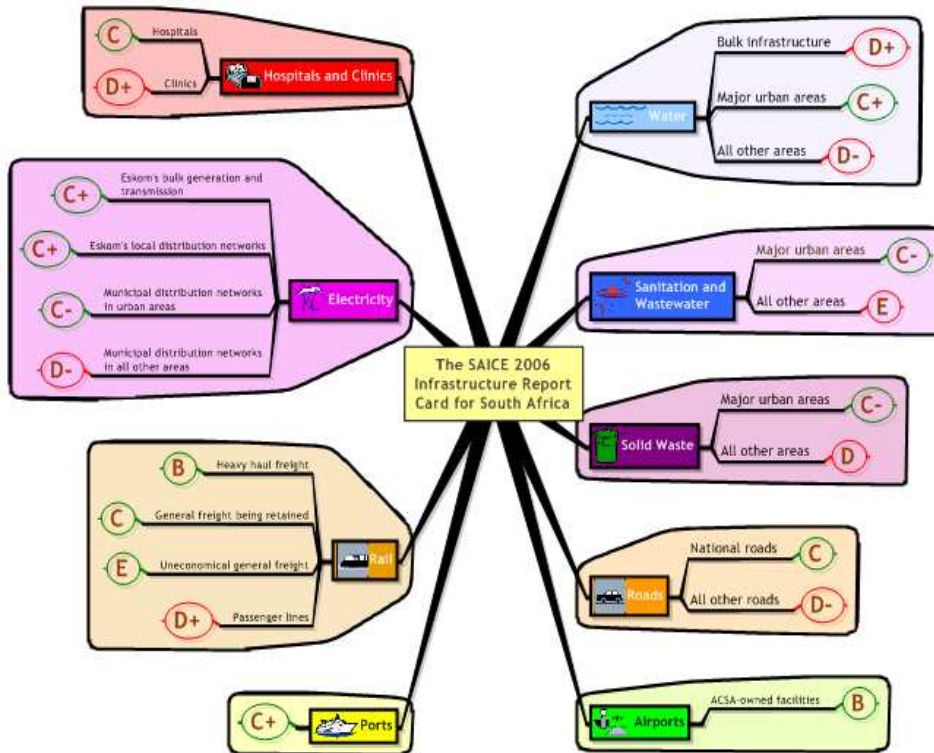
The impact of the 2006 report card was very positive. There was broad recognition that the first national-scale credible benchmark against which progress (or regress) could in future years be measured had been provided.

The CSIR is well advanced with work on the next generation of research reports, and these will all have been completed well before the CSIR Biennial Conference. However the grading process, by SAICE, will at the time still be under way. Grading must first be done within each sector. Thereafter, taking a view across all sectors, these grades must be moderated. (For example, how does one compare a "C+" given for airports with a "C-" for roads? The grades of some sectors may be shifted up, and others down.)

Whereas release of the findings by SAICE is aimed for after the CSIR Biennial Conference, delegates to the conference would no doubt appreciate presentation of the preliminary findings, and would welcome the opportunity for discussion of these findings, and in particular of any trends observed within sectors.

It is already 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 that is dysfunctional for want of sound operation and adequate maintenance in the past, and that therefore needs rehabilitation or replacement at considerable cost, will increase rapidly.

2006 report card for South Africa's built environment infrastructure



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