

INFRASTRUCTURE REPORT CARD GUIDE 2018



World Federation of Engineering Organizations
Fédération Mondiale des Organisations d'Ingénieurs

INFRASTRUCTURE REPORT CARD GUIDE 2018



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FOREWORD

The United Nations' Sustainable Development Goals (SDGs) are international development goals that all 193 member states have adopted at the UN Sustainable Development Summit September 25–27, 2015, in New York, USA, and agreed to achieve by the year 2030. 17 Sustainable Development Goals with 169 associated targets are integrated and indivisible, global in nature and universally applicable, taking into account different national realities, capacities and levels of development, and respecting national policies and priorities. Targets are defined as aspirational and global, with each government setting its own national targets guided by the global level of ambition, but taking into account national circumstances. Each government will also decide how these aspirational and global targets should be incorporated in national planning processes, policies and strategies.

Achieving the SDGs is almost entirely dependent on the presence of effective and fully operational infrastructure. Infrastructure is the assets that society develops, owns and utilises in order to improve the standard of living and the quality of life. It enables economic development and keeps society healthy. Infrastructure can only be an asset if it is maintained in optimum working condition. Governments have to report to what degree they achieve their set goals in terms of the SDGs, but they seldom report on the state of the infrastructure that is required to achieve these goals.

Infrastructure report cards have been used in various countries to report on the state of infrastructure. As long as this is done unemotionally, objectively and based on solid data, it serves the purpose of informing society whether or not they have the necessary infrastructure to achieve their aspirations. Engineering organisations are in the perfect position to produce infrastructure report cards, as they have access to a vast pool of knowledge and expertise, and can play the role of an honest broker between civil society and government.

This manual was produced as a guideline for individual engineering organisations to produce their own infrastructure report cards. It is a guideline with suggested minimum requirements, but is not intended to be prescriptive. At the same time, if the minimum requirements are adhered to, it becomes possible to combine individual scorecards into a regional, continental and even global scorecard that can be submitted to the UN General Assembly through the High Level Political Forum. In this way engineering organisations can make a real contribution in achieving the SDGs by focusing attention on where infrastructure is lacking or dysfunctional.

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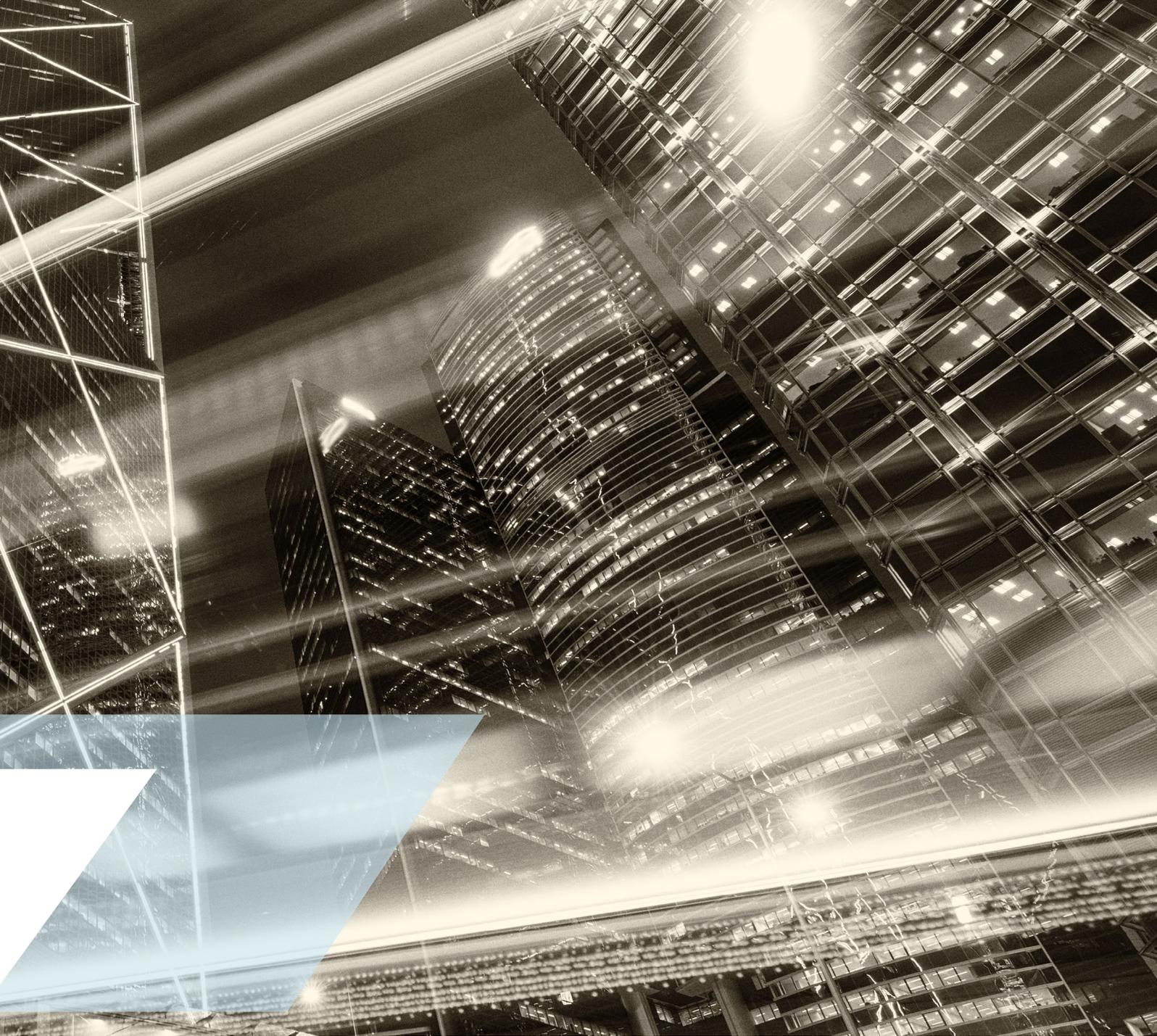
I INTRODUCTION

Infrastructure is the set of assets that society develops, owns and utilises in order to improve the standard of living and the quality of life. It enables economic development and keeps society healthy. Infrastructure can only be an asset if it is maintained in optimum working condition. If it is not worthwhile to maintain, it was not worthwhile in the first instance to allocate resources to establish it.

This does not refer to infrastructure that has reached the end of its economic or functional life

and is deliberately decommissioned. Infrastructure only remains an asset if it is fit for the purpose that it was built for. If it can no longer fulfil its function, it becomes a liability. Infrastructure can only remain functional if it is properly operated and maintained. Maintenance is often neglected because insufficient resources are allocated for this purpose.

There is a general lack of understanding amongst the public and decision-makers of the value of maintaining infrastructure in good working order. Resealing a road in time is far less costly



and disruptive than to have to repair potholes. There is generally inadequate knowledge of the condition of infrastructure amongst the public and decision-makers, which leads to poor maintenance of existing infrastructure and insufficient maintenance planning for new infrastructure.

There is also a lack of knowledge of the role of engineering and built environment professions in the provision and maintenance of infrastructure. This offers the opportunity for an engineering organisation to establish a profile as an independent learned society and fair arbiter of infrastructure evaluation.

Engineering organisations have a distinct advantage in that they have access to research and a large body of knowledgeable experts. The development of an infrastructure report card (IRC) has therefore two objectives, namely (i) to increase awareness of the importance of economic and social infrastructure and the associated role of engineering and built environment professionals, and (ii) to promote the professions and built environment as a career destination.

Lastly the IRC should provide assistance to decision-makers and their support teams in the built and natural environments.



2 INFRASTRUCTURE REPORT CARDS

Infrastructure report cards (IRCs) are abbreviated reports and commentary on the general condition of a nation's economic and social public infrastructure. Usually produced by the national institution of engineering, they vary in frequency, scope and detail depending on available resources and their objectives.

A number of developed countries conduct periodic infrastructure grading, including the USA, UK, Canada, Japan, New Zealand and Australia. In the developing world, South Africa has produced fairly detailed reports in 2006, 2011 and 2017. Nigeria produced its first IRC in 2015. In 2012 Zambia issued a framework for its reports, and its first IRC in 2017.

Although the research that underlies the reports are often detailed and technical, it is important to

note that the IRC is hardly a practical tool for the expert management of the assets they describe. It is mostly a communication device which is very powerful when used well. The reports are shared with the higher echelons of government, parliament, policy-makers, business, state implementers and the public in general in order to:

- Inform stakeholders on the current condition of a nation's infrastructure in a manner that is easily understood, normally similar to a school report card style, often accompanied by an overall nation infrastructure grade
- Enable policy-makers, through an evidence-based manner, to identify national infrastructure deficits
- Enable decision-makers to develop holistic remedial measures to close infrastructure gaps



- Identify potential threats and opportunities in trends towards defunct or lack of infrastructure.

In the global economy, profitable economic activity requires efficient and functioning systems of transport, energy, water and waste management, and social infrastructural services. There is also a positive relationship between buildings, infrastructure and human wellbeing. Well designed and maintained public buildings and infrastructure contribute very significantly to good social relationships, reduced crime and increased productivity. In short, good infrastructure improves the quality and length of human life – a fact acknowledged by the medical fraternity.

African countries' expenditure on infrastructure lags behind that of other developing nations. For example, in South Africa in 2010 public and private sector investments on infrastructure stood at a combined 19.6% of the Gross Domestic Product (GDP), with the public sector investing 7.4% and the private sector contributing 12.2%.

The National Treasury in South Africa holds that, based on experience from other developing countries, capital investments need to be equivalent to at least 25% of the GDP in order to spur a rise in per capita income. The critical importance of the local government sphere, with its considerable service delivery and infrastructural responsibilities, underlines the need for the overhauling of many municipalities.

The report card can therefore identify failings in the approach to delivery, as provision has too often been made on a flawed basis through an isolated focus on capital expenditure rather than through life cycle costing models.

3 MAIN OBJECTIVES

Producing an IRC cannot and should not be a once-off event. In the absence of catastrophic events or hyperactive development, the condition of public infrastructure does not normally change markedly in the space of a year or two. For this reason IRCs are not normally an annual publication.

The value of producing a report card lies in being able to report on either an improvement or a deterioration in the condition of the infrastructure, or that there was no change.

The intention is that IRCs should evoke discussions that would provide impetus for the required leadership, and action for a better sustainable lifestyle for all citizens. The role of engineers on infrastructure-related matters should at the same time be promoted and receive recognition.

The main objectives for producing an IRC are therefore:

- Promotion and recognition of the current condition and capacity of the nation's infrastructure in terms of:
 - Quality, performance, fitness for purpose
 - Health and safety performance
 - Social, economic or environmental impact
 - Policy imperatives that have influence
- Identification of activities and actions to elevate the nation's infrastructure to acceptable standards, such as:
 - Improved procurement systems and processes
 - Investment in appropriate professions, skills and competencies
 - Examination and improvement of maintenance and upgrading programmes.



4 STRUCTURE OF AN INFRASTRUCTURE REPORT CARD

Most countries have a strategic development plan of some sort. This plan will require the establishment of infrastructure in order to achieve its objectives. However, if existing infrastructure cannot be maintained in good working order, there is little benefit in establishing new infrastructure.

An IRC should therefore be structured according to the infrastructure development objectives of a country. There is no single or standard format, as every country is unique. The recommendations that follow, therefore, must be viewed as a guideline, not a prescription.

The IRC should at the least consider the sectors shown in **Table 4.I**.

However many the sectors and sub-sectors, the headline outcome for each is the same – a grade based on a five-point scale ranging from A to E, with C being the mid-point and representing a “satisfactory” or pass mark.

It is obviously preferable that infrastructure grading follows similar standards internationally, so that reports might be compared with consistency. But it is far more important that the grading used in any particular domain remains true to its definition of grades over time, so that trends of improvement (or deterioration) are meaningful for that target audience.

Grades awarded must also be comparable across sectors, e.g. a “C” given to national roads must

Table 4.1: Minimum Components of an IRC

Sector	Sub-Sector	Aspect
Transportation	Rail	Heavy haul
		General freight
		Passenger lines
	Roads	National roads
		All other roads
	Airports	
	Other sub-sectors	National ports
		Fishing and small-craft harbours
		Public transport
Water and Sanitation	Water supply	Bulk infrastructure
		Major urban areas
		All other areas
	Solid waste	Major urban areas
		All other areas
	Sanitation and wastewater	Major urban areas
		All other areas
	Other sub-sectors	Natural water courses
Environment		
Energy	Electricity	Bulk generation and transmission
		Local distribution
		Municipal distribution networks in major urban areas
		Municipal distribution networks in all other areas
	Other sub-sectors	Alternative energy
		Demand management
Buildings	Hospitals and clinics	Urban centres
		Rural facilities
	Institutions of learning	Schools
		Higher education
	Prisons and law enforcement	



provide a comparable picture of that asset as a “C” given to, say, solid waste in urban areas.

As a refinement of the five-point grading system, the use of “+” or “-” suffixes can lend nuance to the report card. These symbols might denote intensity or a trend, e.g. C+ is a “strong C” or “C and improving”, or robustness. The IRC has many subjective elements, so it is important that these elaborations are described in the context in which they are used.

Thus far we have dwelled on the condition of existing infrastructure at a point in time. Little

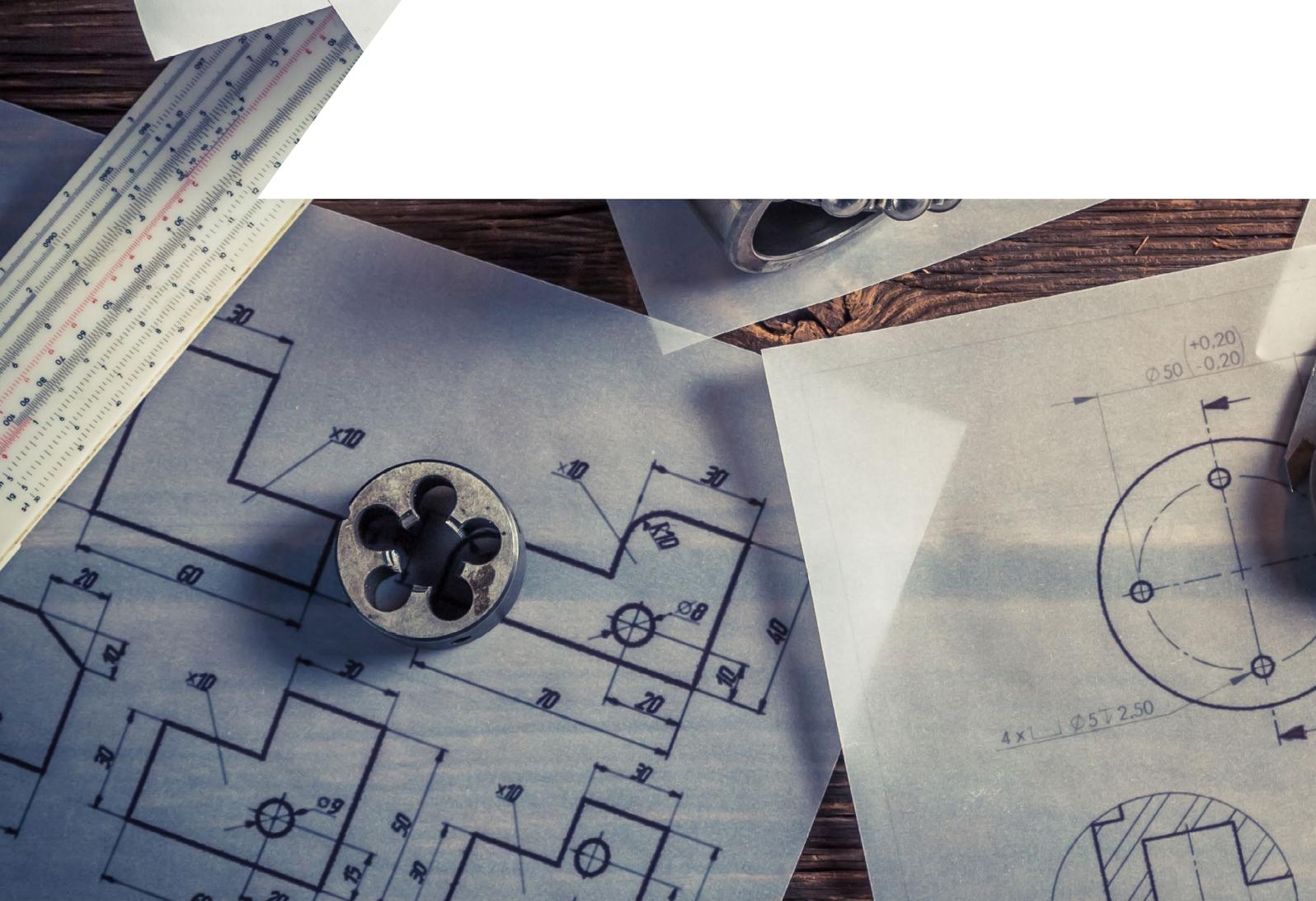
has been said about the reasons for its current condition, the extent to which it fulfils the nation’s needs, or how it responds to the future demands of a nation or a changing planet.

These are topics that are increasingly subjective and open to debate, depending on policy and socio-political orientation. It might be prudent to retain these sometimes controversial commentaries separately from the IRC to avoid unwarranted challenges on a report presenting objective reality. A description of grading that can be used is presented in **Table 4.2**.



Table 4.2 Grading Definitions

A World-class	B Fit for the future	C Satisfactory for now	D At risk of failure	E Unfit for purpose
<p>Infrastructure is comparable to the best internationally in every respect. It is in excellent condition and well maintained, with capacity to endure pressure from unusual events.</p>	<p>Infrastructure is in good condition and properly maintained. It satisfies current demands and is sufficiently robust to deal with minor incidents.</p>	<p>Infrastructure condition is acceptable, although stressed at peak periods. It will need investment in the current Medium-Term Expenditure Framework period to avoid serious deficiencies.</p>	<p>Infrastructure is not coping with demand and is poorly maintained. It is likely that the public will be subjected to severe inconvenience, and even danger, without prompt action.</p>	<p>Infrastructure has failed or is on the verge of failure, exposing the public to health and safety hazards. Immediate action is required.</p>



5 INFRASTRUCTURE REPORT CARD DEVELOPMENT PLAN

A credible IRC is underpinned by scientifically valid research. In the first instance, much of the relevant research is available through studies, conference papers, annual reports from public sector agencies and utilities and other research organs of state, non-governmental organisations and the private sector. So, a good deal of the research for each sector can be undertaken as a desktop study. Where this will not suffice, primary research must be done or the sector might be trimmed from the IRC.

Engineering institutes do have a unique and powerful voice that supplements this research in a plausible and cost-effective way. The knowledge of engineers in design, maintenance and in-field operations carries currency and authority. Their

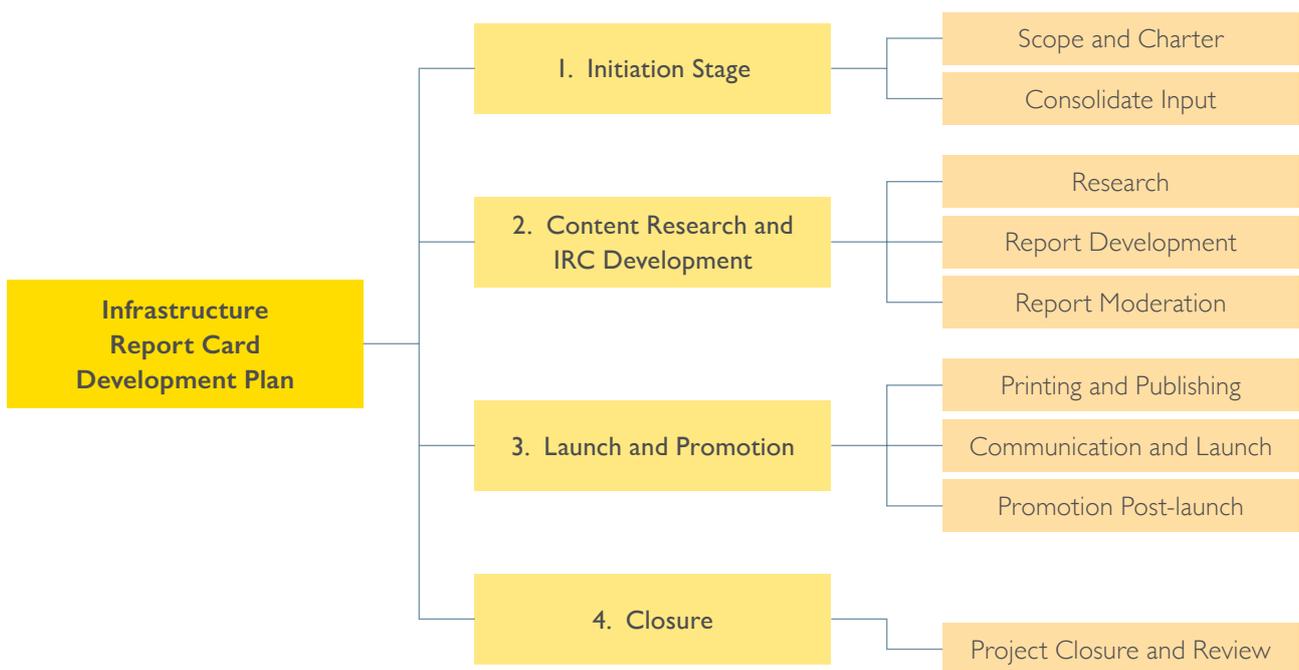
opinion is informed and more immediate than research studies or reports, and must not be underestimated.

On the contrary, a central tenet of the IRC is that it represents a broad survey of the opinions of the very professionals entrusted by society to design, construct and maintain its public asset. The validity of this aggregated opinion should not be underplayed. In the process that follows, these various sources of information are embraced.

The development of an IRC should be undertaken in four phases – Initiation, Research and Development, Launch and Promotion, and Legacy Management (Closure) as shown in **Figure 5.1**.



Figure 5.1: Schematic Layout of an Infrastructure Report Card Development Plan



5.1 Initiation Stage

The initiation stage is both philosophical and pragmatic. At the outset it is important that the medium to long-term objectives of the initiative are defined: What is the intended outcome? Where does it fit into the organisation's mission? At a pragmatic level we must ask: What are the attendant risks? What resources can we dedicate to the project? Who will champion it? What will be the organisational process, and so on? This Charter should address all these questions and more. The responsibility for developing the scope and Charter for the IRC rests with the organisation(s) that will publish the report card.

Infrastructure might be assessed on various levels, e.g. national, regional and local levels. This is not necessarily always the same in every country, and should be adapted to the local circumstances. Not everything has to be done at once. It may be necessary to start grading at the national level, and include the other levels in later report cards, or only provide comment about lower levels without a grading.

It is crucial that the institution manages the delivery of the IRC product in a manner that can be scrutinised by independent observers to satisfy or neutralise commentators with vested interests. The processes of research, development and moderation of the IRC should be kept separate as far as possible.

It is advisable that a Steering Group is established that represents the interests of the institution while encouraging a designated Project Leader to progress the production of the IRC.

5.2 Content Research and IRC Development

5.2.1 Research Reports

The scope of the IRC remains a draft until it is determined whether the required information is readily available or can be obtained. For each of the sectors and sub-sectors that are selected, the following research process might be followed:

1. A Research Team reviews and analyses available data, surveys and reports for each sector in order to develop the broadest and deepest

understanding of its condition. This is often a desktop study which might include:

- Identifying the scope and current condition of infrastructure (e.g. number of bridges, miles of pipe)
 - Reviewing current budgeted expenditures for maintenance and replacements, as well as the investment needed to replace existing infrastructure
 - Identifying investment needed to upgrade infrastructure to meet current and future capacity needs.
2. The data is further enhanced by an interview, workshop and survey of relevant professionals actively engaged in the initiation, design, construction and maintenance of the existing infrastructure and the planning of future requirements. This might be undertaken by setting up "Reference Groups" for each sector, e.g. Transport, Water and Sanitation, Energy and Buildings, who interrogate the desktop research analysis outcomes.
 3. Infrastructure stakeholders and industry leaders are interviewed to discuss the available data, trends and needs of infrastructure by:
 - Identifying all available data sources
 - Examining current trends and developments.
 4. The writing of research reports that capture all the relevant findings, including the condition, capacity and trends relating to the grading criteria that include:
 - Existing and future needs and current funding levels
 - Reasons for the current condition
 - Constraints to addressing the shortcomings
 - Consequences of inaction.

5.3 The IRC Report

The research reports are usually too detailed and technical for publication as the IRC commentary. Instead, flowing from the research reports, a succinct note on each sector and sub-sector is prepared that highlights points of public policy and general interest. This set of abbreviated reports combine to form the commentary to the super-abbreviated headlines that attach to each sub-sector grading, the process for which will be described shortly.

It is this team, the Report Development Team, which also provides the first grading framework and assessment of each sub-sector's grade. As more

IRCs are produced, they can also comment on the trends that are observed.

The sector and sub-sector reports will generally be prepared in isolation from each other. The grades that result are also likely to be parochial as a result. The Moderation Group, which might comprise a representative from the Steering Group and each of the Reference Groups, is tasked with ensuring that the final grades are consistent with their definition (i.e. a grade of “A” must refer to “world-class”), the report notes that are in the IRC commentary for that sub-sector and in relation to similar grades across all sub-sectors.

At the completion of this process, and after a final check by the Steering Group, the IRC is final.

5.4 Launch and Promotion

Once the content of the report card has been finalised, the report is prepared to be published. The report card has little value if it is not published widely, and some effort should be taken to involve the media. Attention should be focused on presentation of the IRC for maximum impact. This might include:

- A detailed (e.g. 16-page) brochure which includes the grades and the commentary notes for each sub-sector
- An abbreviated “pocket version” of the report that contains the grades and headline notes for each sub-sector
- Media releases, interviews on public radio and television, bulletins to industry and related interested parties
- Lobbying visits to policy- and decision-makers and influencers.

5.5 IRC Legacy

At the end, a legacy report is prepared that will serve as a guide for the next IRC. The report should contain information on what contributed to the success of the report card, and how challenges were overcome. It should also contain all the research reports, contact persons, sources of information and credits for work completed. Finally, there should be report back to the organisation that published the report card on whether or not the objectives as stated in the project charter were achieved.

6 ORGANISATION

The organisation of the project consists of a number of role players and committees.

6.1 Role Players

6.1.1 Project Sponsor

The Project Sponsor is the owner of the project. In order to achieve and maintain credibility, the project sponsor may not have a vested interest in the outcome of the assessment. The project sponsor cannot be any form of government or semi-government, and neither should the project receive any funding from this sector. A professional engineering voluntary association is the most credible project sponsor.

6.1.2 Project Manager and Convenor

The Project Manager is appointed by the project sponsor and reports directly to that organisation. His role is to make sure that the project is completed on time and within budget, while achieving all the agreed objectives.

6.1.3 Research Leader and Coordinator

This should be a professional services provider who leads a team that gathers the data and information which will be used to prepare the report card.

This consists of:

- Data gathering
- Data preparation
- Data analysis
- Information preparation.

6.1.4 Independent Observer

The role of the Independent Observer is to ensure that all processes are followed correctly, and that the outcome is credible. The Independent Observer could be from a different country in order to be perceived to be truly independent and objective.

6.1.5 Additional Nominated Resources – Strategic Direction

The Project Sponsor should appoint at least two credible persons to the steering committee. For

the sake of continuity and future strategy, it may be of benefit to appoint some individuals from outside the organisation of the project sponsor to participate in the execution and management of the project.

6.2 Committees

6.2.1 Steering Committee Mandate

- Represent the interest of the Project Sponsor
- Develop the project charter
- Monitor and advise the Project Manager on inherent and potential risks
- Set the boundaries on scope and risks for the project
- Confirm overall mandates for Project Manager and other committees
- Examine the project plan against the charter
- Confirm and monitor project budget, including sourcing external funding
- Monitor major milestones
- Final review of the report card against strategic objectives (via Moderating Group)
- Deliverables
 - Risk management
 - Project guidance
- Members
 - Project Sponsor
 - Project Manager and Convener
 - Research Leader and Coordinator
 - Independent Observer
 - Additional nominated resources – strategic direction.

6.2.2 Project Manager Mandate

- Develop and implement the project plan
- Champion the promotion of the product
- Deliverables
 - The IRC
- Members
 - Project Manager
 - Assistant.

6.2.3 Reference Groups (Sector Quality Assurance Teams) Mandate

- Contribute to sector content
- Comment on sector report draft
- Review accuracy and veracity of sector content

- Deliverables
 - Fair and accurate content
- Members
 - Division representative
 - Eminent engineering expert
 - Public “expert” or commentator.

6.2.4 Moderating Committee Mandate

- Review the penultimate draft for consistency and cohesion
- Ensure that gradings are sensible within categories and across categories
- Ensure that the final product is acceptable in appearance and content
- Ensure that the final product satisfies strategic and political objectives
- Deliverables
 - A final report card (Report) and gradings
- Members
 - Project Sponsor
 - Project Convener
 - Research Coordinator
 - One representative from each reference group
 - Independent observer
 - External reviewer (ASCE/ICE)
 - Quorum: at least 50% of the Steering Group is represented.

6.2.5 Promotions Team Mandate

- Delegate responsibility to individuals as spokespersons on the report card
- Create anticipation for the new edition of the IRC
- Communicate the report card to the broadest possible audience
- Manage the promotion activities and achieve the communication objectives of the IRC
- Deliverables
 - Brief nominated spokespersons appropriately
 - Plan and manage the launch and post-launch activities of the IRC
- Members
 - President
 - President-elect
 - Media Officer
 - CEO
 - Champion
 - Branch chairpersons
 - Nominated spokespersons.



6.2.6 Report Development Team Mandate

- Gather relevant research
- Review comments on and shortcomings of IRC 1
- Propose content and style of IRC 2
- Draft the report card and propose grades
- Deliverables
 - Research report
 - Report card framework for review by steering committee
 - Penultimate draft report card for review by moderating group
 - Final report card for publication
- Members
 - Research leader and coordinator
 - Additional research resources
 - Champion
 - Representative from reference groups
 - Additional resources: language and drafting experts

7 GRADING

The process of arriving at a final score for the infrastructure is as follows:

The final IRC that is published must be credible and beyond suspicion. The process to do the grading for the IRC must therefore be rigorous. The desktop research reports must be interrogated by the drafting committee in conjunction with the specialist divisions for each sector. Thereafter, the draft IRC report is passed through a series of revisions culminating in the allocation of grades. Finally these grades are moderated against previous grades for that sector and cross-sectoral grades. A Steering Group of eminent persons provides independent oversight.

There are a host of critical matters relating to infrastructure that cannot be discussed in detail

as part of the process to produce an IRC. These include the financial and environmental sustainability of infrastructure, its resilience, and the need for greater integration and coordination across different government departments and agencies. Some of these issues affect the grading of infrastructure, and can be noted in sector summaries. In some cases the grade will be for a narrowly defined, somewhat inappropriate competence (e.g. grading roads and not public transport, grading solid waste collection and not solid waste and resource utilisation).

7.1 Data

The grading of the report card has to be based on good, solid data and information in order to produce a credible scoring. There are a number of sources of information available that can be used to aid the scoring.

When it comes to infrastructure, data seems to be thought of the same way as maintenance – as a secondary concern following infrastructure build. However, this is fundamentally incorrect. Reliable, regular data collection and management is essential to the good governance and sustainability of infrastructure. Entrenching a data-driven culture is essential to creating a sense of civic responsibility and accountability around infrastructure. Even more importantly, it is central to promoting evidence-based, accountable decision-making from infrastructure providers and operators.

Infrastructure takes many years to build, requiring long-term planning and regular updates regarding the performance of current infrastructure that may need replacement. Data-driven processes are the only fair way to prioritise and plan projects across the country. Data is important at all stages of a project – in planning, monitoring and evaluating the infrastructure in terms of its full cost and performance.

Data should be collected and managed at the local level, but in a consistent way allowing comparison across different parts of the country. Data should also facilitate comparison with international peers, and enable policy-makers to build an understanding of the full costs of infrastructure projects, over

their life spans. In order for infrastructure to be sustainable, the costs of a project – financially and environmentally, in comparison with reasonable alternatives, and continuously over its life span – need to be understood.

Of course, collecting and managing data can be costly and difficult, especially in rural areas. The alternative is that the total out-turn cost of infrastructure projects is unknown, which prevents evidence-based infrastructure policy in the future. In the context of limited developing country resources, data availability will always be less than ideal.

Nonetheless, data collection should be reasonably prioritised, and (even if partial) data must be used in decision-making. It is unacceptable to allow a culture of failing to collect, or ignoring data, where decision-makers suspect it will support outcomes contrary to their preferences, or will indict them in mismanagement. Regularly assessing the project's full cost against its performance would increase transparency, and hence accountability, for all involved in the planning, construction, operation and maintenance of the infrastructure.

A data-driven discourse around infrastructure would also magnify the costs of neglecting maintenance, which increases the costs of infrastructure many times over, to all stakeholders. Unfortunately, those responsible for operating and maintaining infrastructure are likely to resist sharing (or even collecting) data if it will expose mismanagement. If data sharing is optional, then those who choose to publish data may be unfairly punished for good practice, while the worst performers remain invisible.

Finally, publicly available data would encourage infrastructure users to understand the costs of criminality and to hold providers accountable. Entrenching a data-centered discourse by publishing data regularly would shift the perspective of users, and encourage them to take ownership of the infrastructure they use. Empowering disadvantaged communities requires more than policy and infrastructure; it should include access to regular, reliable public data on that infrastructure. This is the only way for communities to understand and benchmark the costs and performance of their infrastructure.

7.2 Baseline Research

Baseline research is firstly aimed at determining what the norm would be with respect to infrastructure development, given the socio-economic conditions in the country that is assessed. For instance, there is little need for road infrastructure if road transportation is not significant. A case in point would be the Maldives Islands which consist of small islands where highways are of no use.

However, under normal circumstances there should be sufficient km of road per km² of country to service the population and the economy. The same goes for water supply and sanitation (level of service and reliability in terms of hours per day of availability), schools, etc. This baseline research is then used to assess the adequacy of the infrastructure, which is distinct from the condition of the infrastructure.

7.3 Desktop Research

Desktop research makes use of available reports and information. In most cases some form of an asset register will be available that can be used to extract the relevant numbers, such as kilometres of roads, number of schools, etc. A good source of information would be the annual reports submitted to parliament, provincial authorities and local authorities; also reports prepared by parastatal organisations and semi-government organisations. In some cases reports prepared by NGOs are a good source of information.

7.4 Internet Research

The internet has become a very handy source of information. Most public organisations publish their reports on their websites. It may require some very innovative searching around to find what is required, but in most cases it can be found without too much trouble.

7.5 Surveys

Surveys are based on semi-random questionnaires that are sent to a targeted audience. This can be general questionnaires, or sector-specific. The

questions must cover the same scope as the report, broken down by province.

7.6 Sector Reports

Based on the research and surveys, a sector report is prepared for each sector in the IRC. This report should examine the sector (e.g. water supply) and assess the existing infrastructure in terms of adequacy and condition. This is then used to determine the final score (grade) for that particular infrastructure.

The sectoral reports should consider the issues as listed below.

7.6.1 Water

Assess the following:

- Adequacy of bulk water supply in terms of quantity (design capacity versus demand – there should be at least a five-year supply horizon), as well as assurance of supply (domestic @ x%, industrial @ y% and irrigation @ z%)
- Access of population to clean water at desired service levels (stand pipes, yard connections, house connections)
- Reliability of supply (minimum hours per day and interruptions not lasting longer than x days).

7.6.2 Sanitation

Assess the following:

- Minimum service level (no open defecation, no bucket system) – at least a VIP
- Access to water-borne sewage system
- Proper collection, treatment and disposal of wastewater
- Design capacity of WWTW versus demand – there should be a five-year design capacity.

7.6.3 Solid Waste Management

Assess the following:

- Adequacy of collection of solid waste
- Solid waste disposal in properly operated and maintained solid waste disposal sites (% of waste)
- Transport and disposal of hazardous waste
- Waste recovery and recycling



7.6.4 Roads

Assess the following:

- Adequacy and condition of the road network on three levels:
 - Primary intercity level
 - Secondary intercity level
 - Local and rural level.

In the above, paved or unpaved will depend on local conditions and is not a primary indicator.

7.6.5 Airports

Assess the following:

- Adequacy of distribution of international airports

- Adequacy of distribution of regional / commercial airports
- Capacity to handle passengers (design versus demand)
- Capacity to handle freight (design versus demand)
- Condition of airport runways, pavement, lighting, and so forth
- Adequacy of supporting infrastructure (emigration/immigration, customs).

7.6.6 Commercial Ports

Assess the following:

- Design and maintenance of port entrances
- Adequacy and condition of berthing facilities



- Adequacy and condition of freight-handling equipment
- Adequacy and condition of roads and other support infrastructure
- Dry dock facilities
- Adequacy of transport infrastructure in and out of the harbours
- Freight storage facilities
- Support services, such as customs clearance.

7.6.7 Fishing Ports

Assess the following:

- Harbour entrances
- Docking facilities
- Storage facilities
- Off-loading.

7.6.8 Rail

Assess the following:

- Adequacy and condition of the rail network, including design axle loads
- Adequacy and condition of rolling stock

- Adequacy and condition of ancillary infrastructure (rail-over-road bridges, stations, roads, electric cables and equipment)
- Efficiency in moving passengers and operational performance
- Efficiency in moving freight and operational performance.

7.6.9 Energy

Assess the following:

- Capacity of generating equipment with regard to projected demand (time horizon of ten years)
- Condition of generating equipment
- Capacity of transmission equipment with regard to projected demand (time horizon of five years)
- Condition of transmission equipment
- Capacity of distribution equipment with regard to projected demand (time horizon of three years)
- Condition of distribution equipment
- Emission control
- Household accessibility to electricity
- Cost of power.



7.6.10 Hospitals and Clinics

Assess the following:

- Adequacy of facilities (number and geographical distribution in relation to population)
- Conditions and maintenance
- Staffing
- Facilities such as beds, equipment, etc.

7.6.11 Schools

Assess the following:

- Number of schools and geographical distribution, considering population numbers
- Adequately serviced (water, sanitation, power).

7.6.12 Higher Education

Assess the following:

- Adequacy and geographical distribution of facilities
- Adequately serviced (water, sanitation, power)
- Adequately equipped (laboratories, workshops)
- Residential facilities.

7.7 The Africa Infrastructure Report App (AIR)

This App enables National Infrastructure Reports to be developed from observations and assessments made by qualified professional engineers in the field.

The App allows engineers to capture data in a structured way on their mobile phones about the state of various infrastructure elements, during their work/travels. The data and a photograph of the infrastructure item are logged using the App, together with a precise GPS location and an expert assessment of the condition of the item being recorded.

After a moderator from the engineering institution has approved the content, the data is then made available through a web interface where it can be seen by the whole engineering community, the government and the public at large.

The web interface shows the individual infrastructure elements across a range of sectors – Transportation, Water and Sanitation, Energy, Buildings and Telecommunications. The website also provides an overall assessment across each sector.

Links to the App and associated website are as follows:

- **The App:** The *Africa Infrastructure Report App* allows engineers to capture data in a structured way on their mobile phones about the state of various items of infrastructure (a bridge, road, etc) during their work/travels.
 - Link to iOS version of the *Africa Infrastructure Report App*:
<https://itunes.apple.com/us/app/africa-infrastructure-report/id1252429189?ls=1&mt=8>
 - Link to android version of the App:
https://play.google.com/store/apps/details?id=org.infrastructure_africa.report&hl=en
- **The Website:** The *Infrastructure-Africa.Report* website gathers the accumulated data on a web interface where a moderator approves the content and then publishes it on a website available to all.
 - Link to the website:
<http://infrastructure-africa.report/>
 - Link to the manual that provides instructions on how to approve users and reports (amongst other things):
https://docs.google.com/document/d/1_eazByOs9DJ9ZwQTIRqZZRong8xpGkoZ8VdVGv-hzzc/edit?usp=sharing

8 CHALLENGES

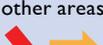
In preparing an infrastructure report card there are a number of challenges that have to be considered and overcome:

- Maintaining independence from external and internal influences
- Getting the baseline report correct
- Budget constraints – primary research can be costly and dependent on the in-depth analysis to be carried out
- Time and human resource to develop, conduct, draft, review and deliver the report card
- Accessibility to information, especially after the first publication
- Scope creep.

These challenges have to be considered during the initiation phase of the infrastructure report card, and have to be dealt with in such a way that they do not become a “fatal flaw”.

APPENDIX A

EXAMPLE OF AN INFRASTRUCTURE REPORT CARD

Sector	Sub-sector grade and trend	Comment
 WATER	D- for bulk water resources 	The unchanged low grade belies the further deterioration in the ageing bulk water infrastructure portfolio as a result of insufficient maintenance and neglect of renewal, partly due to funding shortfalls. A serious depletion of skilled personnel and officials at senior levels in the DWS (Department of Water and Sanitation) – and generally in the water sector – hinders decisive planning and development to avoid shortages. Systems are in general operated too close to failure.
	C+ supply in major urban areas 	Major projects are critically behind schedule, notably Phase II of the Lesotho Highlands Water Project. In most major systems even small drought perturbations are already creating substantial service disruptions. Growing water shortages mean that alternative sources, such as water re-use, aquifer exploration and desalination, some of which are energy-intensive and expensive, must enter the water mix.
	D- supply for all other areas 	Budgeting and spending on maintenance, rehabilitation and expansion remain inadequate for water supply in all areas. Damage caused by increased service delivery protests in urban and rural areas diverts funding from maintenance and expansion budgets. Consequently, given continually growing demands, communities face increasing risk of supply failures.
 SANITATION (INCLUDING WASTEWATER)	C- for major urban areas 	Water leakage and other contributors to non-revenue water remain unacceptably high (losses of up to 40%). Demand management requires concerted attention to be effective.
	E for all other areas 	The condition and functionality of sanitation infrastructure are of grave concern, especially outside the major urban areas. Although the unserved-households percentage has decreased significantly since 1994, due to growth in population and households, the actual number unserved remains at about 4 million.
 SOLID WASTE MANAGEMENT	C for waste collection in the major urban areas 	The quality and the reliability of water supply have decreased in small towns and rural systems. Incentives resulting from 'Blue' and 'No Drop' quality monitoring have assisted in improving municipal management of drinking water quality and water loss control. Regrettably, the 'Blue Drop' report is no longer available in a format which allows comparison between water services authorities.
	D for waste collection in other areas 	The condition and functionality of sanitation infrastructure are of grave concern, especially outside the major urban areas. Although the unserved-households percentage has decreased significantly since 1994, due to growth in population and households, the actual number unserved remains at about 4 million.
	C+ for waste disposal in metros 	'Green Drop' performance scores are generally in the "good" to "excellent" range around major urban areas. However, many urban facilities are unable to cope with increased demand. Many (up to 30% of all) WWTWs (Wastewater Treatment Works) are in critical condition, discharging increasing quantities of untreated waste into streams.
	D- for waste disposal in other areas 	The skills required to operate and manage sophisticated sanitation and WWTW technologies are often scarce outside of major urban centres; consequently downstream users and ecosystems are subjected to high pathogen loads and eutrophication, and endure higher treatment costs to achieve potable water standards.
		Inhabitants in some rural areas still do not have access to safe sanitation. Pit toilets in rural and informal areas are frequently under-serviced, exposing residents to disease.
		(Note: The grading for "all other areas" in 2011 ought to have been an E, and that grade remains.)
		The first goal of the National Waste Management Strategy is to prioritise waste reduction, re-use, recycling and recovery (in that order) over disposal in landfill. It appears that at present less than 10% of waste is diverted from landfill sites. Tariffs that better reflect the cost of services might prompt users to reduce waste generation.
		There has been some improvement in waste collection across major urban and other areas since the 2011 IRC. Overall, approximately 67% of households receive an adequate refuse removal service. In the major urban areas, the percentage is between 86% and 91%, while in the rural areas it is much lower at around 52%.
		Licensing of hazardous waste landfill sites, health care risk waste storage facilities, recycling facilities and transfer stations has improved, as has the compliance monitoring. Landfill sites in metros are generally licensed, but not all are well managed.
		However, many municipalities, especially rural municipalities, have unlicensed landfill sites or licensed sites not operated according to accepted standards. Around 64% of these general waste disposal sites are currently unlicensed.
		Although recycling is legislated, there are few incentives for users to change their behaviour from a bias towards disposal. It is encouraging that industry recycling and recovery programmes are showing progress, notably waste vehicle tyres, through Industry Waste Management Plans.

Sector	Sub-sector grade and trend	Comment
 ROADS	B for national roads 	Of the nation's network of approximately 750 000 km of roads, SANRAL (South African National Roads Agency Limited) controls 21 403 km and maintains them to a high standard. The proportion in "poor" to "very poor" condition has crept slightly above the international benchmark of 10%, mainly due to the further acquisition of provincial roads in poorer condition. Constraints on funding due to revenue shortfalls in toll operations may affect operational and maintenance requirements. Despite this, the overall change in condition of the national roads has shown an increase in "good" and "very good" sections.
	D for paved provincial roads 	A slight improvement in the paved provincial network score is due in part to the shifting from "fair-good" in 2011 to "good-very good" in Gauteng. Over 90% of sections in the Western Cape are either "fair", "good" or "very good", maintaining their standard. However, the condition in other provinces remains precarious or is deteriorating. There is a risk of further deterioration due to vehicle overloading, poor maintenance and the reduction of skilled personnel in provincial departments.
	C- for paved metropolitan roads 	Regarding municipal roads, data on asset management is difficult to come by, even for municipalities that might have sound practices in place for their road systems. A particular issue is the difficulty in discovering to what extent monitoring is conducted and, if it is, to what extent this is used for effective asset management. Furthermore, the data (as for so much of the infrastructure in this report) is not readily available to the public, and it is not conveniently accessible in a form that permits comparison across municipalities or against good practice standards.
	D- for other paved municipal roads 	
	E for provincial, metropolitan and municipal gravel roads 	South African gravel roads constitute 75% of the road network. There has been some improvement in the Western Cape, contrasted with extraordinary deterioration in the North West Province. Due to neglect, gravel roads are generally in a very unhealthy condition, with between just 2% and 12% in the "good" to "very good" condition, depending on the province. By contrast the "poor" to "very poor" condition applies to 40% to 90% of the category.
 AIRPORTS	B+ for ACSA-owned facilities only 	The three major international airports (OR Tambo in Johannesburg, Cape Town International and King Shaka in Durban) account for nearly 90% of the 39 million annual ACSA passenger movements. ACSA has proven to be a world-class aviation infrastructure provider, strongly driven by the need to meet international compliance requirements and by its own high internal standards. A profitable company, with sufficient funding and systems for condition monitoring and maintenance, and with capable technical and managerial personnel, it consistently receives international accolades. Relatively high tariffs and possible capital over-investment could pose a problem for the sustainability of these standards.
 PORTS	B- for commercial ports only 	There are nine ports in the Transnet stable – seven major commercial ports: Saldanha Bay, Cape Town (Table Bay), Port Elizabeth, Ngqura (Coega), East London, Durban and Richards Bay, and two minor ports: Port Nolloth and Mossel Bay. Even though much of the infrastructure has been ageing, TNPA (Transnet National Ports Authority) has made a concerted effort to repair and maintain its equipment and infrastructure, keeping it operationally serviceable. Demand and congestion have increased in most of these ports, but both the fixed and movable infrastructure still perform well in meeting the safety and operational standards. However, preventative maintenance will be required at the breakwaters. The ship repair dry-docks could be a greater revenue generator, but insufficient maintenance has led to deterioration of the assets.

Sector	Sub-sector grade and trend	Comment
 RAIL	B+ for heavy-haul freight lines 	<p>The 22 500 route-km freight rail network is owned by Transnet, of which 1 500 km is for heavy haul (for export of coal and iron ore), about 11 300 km for general freight and the remainder branch lines. Increased investment has been made or committed to acquisition of locomotives, rolling stock and refurbishment of infrastructure, including signalling, depots and maintenance of the network.</p> <p>The overall condition of the heavy-haul network ranges from average to good. Bottlenecks exist on certain sections of the network. However, most infrastructure disciplines are performing adequately and, with some upgrading, large volumes can be accommodated to meet increased demands.</p>
	C for general freight lines 	<p>The existing general freight line network is generally in a fair condition. However, poor signalling and electrical-related infrastructure along certain sections are the main contributors to section failures, and require special attention. There has been a steady increase (per train km) in collisions, with some decrease in derailments.</p>
	D- for branch lines 	<p>The branch lines are in a very poor state, with only approximately 55% “operational” – and even parts of this portion are in disuse. The lack of provision of rail services, maintenance and investment in supporting infrastructure to the branch-line network has resulted in a significant and increasing maintenance backlog of track infrastructure, stations and yards, and even theft of sections of rail track.</p>
	D+ for passenger lines – PRASA 	<p>The general condition of the PRASA passenger inter-city and commuter rail (2 228 track-km) network is fair. Signalling and building structures, in particular, are in a poor condition. Capital investment projects are under way to address the investment backlog. Operational issues, such as outdated equipment, theft, arson and vandalism, also need to be addressed in order to improve poor operational performance and an unreliable service. Mainline passenger services have dropped by more than half since 2010/11.</p>
	A for passenger lines – Gautrain (new sub-sector) 	<p>The Gautrain network (80 km), a rapid rail link in Gauteng, commenced service in 2010 and the system is in an excellent condition overall. The high accountability measures in the form of performance-based funding encourage efficient operation and sound maintenance practices. No major incidents affecting the structural integrity of infrastructure have been reported.</p>
 ELECTRICITY	C+ for Eskom's generating infrastructure 	<p>Eskom generates approximately 43 000 MW of electricity (95% of the country's total), and about 86% of this comes from coal. Demand for electricity supply has declined over the last decade. This, coupled with new-generation capacity, has afforded Eskom the opportunity to improve planned maintenance and refurbishment, which were sorely neglected between 2007 and 2015. Major capital investment will bring further capacity on stream in the next five years, and there is now surplus capacity.</p> <p>With the reliance on coal for power generation, environmental obligations will require further investment to achieve acceptable emission standards, particularly from the older coal-fired power stations.</p>
	B- for Eskom's transmission network 	<p>Eskom's funding gap and governance pressures remain a major risk. As renewable energy generation becomes cheaper, the move towards cleaner technologies and possible independence from a national utility will increase the pressure on Eskom.</p> <p>The national grid, comprising Eskom's approximately 32 000 km of high-voltage lines and 427 transmission transformers, is in an acceptable condition, with a reasonable maintenance regime. It can meet current demand and deal with minor incidents across the network. As an aged asset, major capital investment is required to meet needs in the next five years, with a focus on increased plant replacement, continued maintenance and ongoing refurbishment.</p>
	D for local distribution 	<p>Eskom's distribution network, which distributes about 52% of grid electricity directly to consumers, is on average in a significantly better condition than the local distribution network managed by the 187 municipalities. Inadequate operation and maintenance capacity, and shortage of skilled personnel, make the ageing and overloaded local distribution network vulnerable. Policy uncertainty has led to periods of low investment in the municipal infrastructure. Theft, vandalism and poor debt collection are a burden on operation and maintenance budgets.</p>

Sector	Sub-sector grade and trend	Comment
 HEALTH CARE	D+ for hospitals 	<p>There are 347 hospitals and 3 538 clinics and health care centres in the public service. Any condition grade of "C" and below in the context of healthcare facilities adversely affects patient care and safety, and places them and the staff at increased risk.</p> <p>Although data collection appears to have improved, its use appears unaligned to sustainable asset management practices, hampering proper prioritisation of spending. Furthermore, although investment in maintenance has increased, chronic underspending of budgets and neglect are continuing, causing rapid deterioration in hospital (especially tertiary and central) facilities, amidst a large maintenance backlog.</p>
	D for clinics 	<p>Intensive focus on selected clinics under the Ideal Clinic Realisation and Maintenance Programme has improved their condition from a severe state of disrepair. However, this often happens at the expense of other clinics, hospitals and specialised facilities, e.g. mental health, tuberculosis and malaria clinics. Much still has to be done to increase investment in specialised skills.</p>
 EDUCATION	D+ for public ordinary schools 	<p>There are approximately 24 000 public ordinary schools. Significant progress has been made in addressing electricity, water and sanitation service backlogs. However, this focus has in some areas deprioritised general maintenance programmes, resulting in maintenance backlogs and reduced reliability of water and electricity supplies at some schools. There has been little progress on ancillary infrastructure, such as fencing, libraries, sports and computer facilities and access to the internet.</p>
	C+ for universities <i>(new sub-sector)</i>	<p>There are 26 public universities and 50 public TVET colleges. Dramatically increased student intakes have placed a severe burden on infrastructure. Although a majority of university buildings are on average in good condition, this is partly due to new build. Asset management plans are in place at many universities, although the accuracy of information and compliance varies. Maintenance capacity is often insufficient outside of the main centres and tends to be reactive.</p>
	D+ for TVET colleges <i>(new sub-sector)</i>	<p>Infrastructure development and maintenance capacity is generally limited within the TVET sector. TVET colleges, especially in rural areas, generally lack sufficient funding and systems for maintenance, resulting in ad hoc repair. Their condition has generally deteriorated over the last ten years.</p> <p>Considerable damage is caused by vandalism and student protests at educational institutions. It is an unaffordable loss and diverts funding from maintenance and the construction of much needed new facilities.</p>
OVERALL GRADE	D+ 	<p>Although much of South Africa's built environment infrastructure is of high quality, the below-average grade reflects the continuing low maintenance levels, and even neglect in many areas, that is taking a toll on its resilience. A lack of commitment to long-term planning, adequate dedicated funding, proper management systems, data collection and skills deployment and collaboration are major contributing factors.</p>





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