McMaster University School of Engineering Practice

MEPP Inquiry

Infrastructure Report Cards –

A Comparison of Canadian and International Experiences

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Final Submission

September 11, 2012

Abstract

The inquiry reviews the use of report cards as a reporting mechanism of asset management systems and the adoption of report cards prepared by national organizations to advocate on behalf of individual stakeholders and municipalities for changes to infrastructure policies. Five national infrastructure report cards are summarized and a discussion on the advantages of the different approaches of each is provided. A list of factors is offered for consideration in future national report cards, including the use of subjective factors to establish grades, the desire to obtain poor grades, the decision to discuss monetary issues, the repeatability of subsequent iterations and the decision to advocate on behalf of individual stakeholders for policy changes. Finally, the following recommendations for the methodology and content of future report cards are provided:

- Where possible, report card results should be based on quantitative measures to increase the comparability and repeatability in subsequent iterations, and to remove personal bias from the results.
- The use of a direct survey of individual groups or stakeholders should be adopted when feasible. The complexity of the survey should be limited to ensure that the individual stakeholders can respond to the survey with a reasonable effort.
- Report cards should discuss the investment required in relation to the total value of the infrastructure and provide some context for the values that can be understood by the general public.
- Report cards should include recommendations for changes to relevant infrastructure policies to capitalize on the attention that will be garnered in the media, general public and political environment.

1. Introduction

Infrastructure is the backbone of our communities. It provides services essential to our community and economy, from transportation networks to move goods and service, water and wastewater systems to provide clean drinking water and treat our waste, and a whole host of different types of buildings that provide health and recreation services to improve our quality of life. The relationship between the quality of a nation's infrastructure systems and the prosperity of their economy is widely accepted.

Civil engineers are responsible for planning, designing, constructing and operating the vast majority of a nation's infrastructure. In this role they function as the stewards of the well being of both individual citizens and the economy as a whole. The efficient operation of infrastructure across its entire life span is essential to minimize the costs that must be paid and to ensure that the infrastructure is sustainable in perpetuity.

Historically, municipal infrastructure was constructed and ignored. These assets typically have life expectancies of between 30 and 100 years, and are therefore very easy to remove from the current consciousness of society and governments. Over the past two decades the international civil engineering industry has begun a transition to manage infrastructure in a more effective manner. Systems are being conceptualized and designed to take a full life cycle cost approach to these long-lived infrastructure assets. These systems aim to not only lower the costs associated with the life cycle construction and maintenance, but more importantly to develop a framework to allow for discussions surrounding what services should be provided, at what level they should be provided, how we determine if we are achieving that level of service and what are the trade-offs - economically, environmentally and socially - to establishing levels of service that are different from what has traditionally been provided or expected. This approach is referred to as asset management or infrastructure management. A key tool of asset management systems is the use of reporting mechanisms to convey to stakeholders the degree to which the infrastructure that they own is achieving their objectives. Many individual municipalities use monitoring reports to influence local infrastructure policies. National groups that are formed by groups of individual stakeholders develop national infrastructure reports that are used to influence infrastructure policies at higher levels of government. A more in-depth description of asset management systems provided in Section 2 of this paper.

2. Structure of this Report

In 2012 the inaugural Canadian Municipal Infrastructure Report Card was released to provide insight into the current state of municipal infrastructure and the management systems that are being practiced by infrastructure owners. This report first provides an overview of asset management systems in order to provide the reader with some context around the role of report cards in managing municipal infrastructure. Next, a summary of both the Canadian infrastructure report card and other national report cards from around the world will review the methodologies to develop the report cards, what asset types are included, the differences in structure of the report cards, and how the report cards differ in how they make recommendations for changes to infrastructure policies. The report cards that will be reviewed are from Canada, the United States, Australia, the United Kingdom and South Africa. Finally,

this report will consider the implications of the various approaches to the national report cards with respect to the degree to which they impact infrastructure policies and provide recommendations to improve future infrastructure report cards.

3. Progression of Asset (Infrastructure) Management

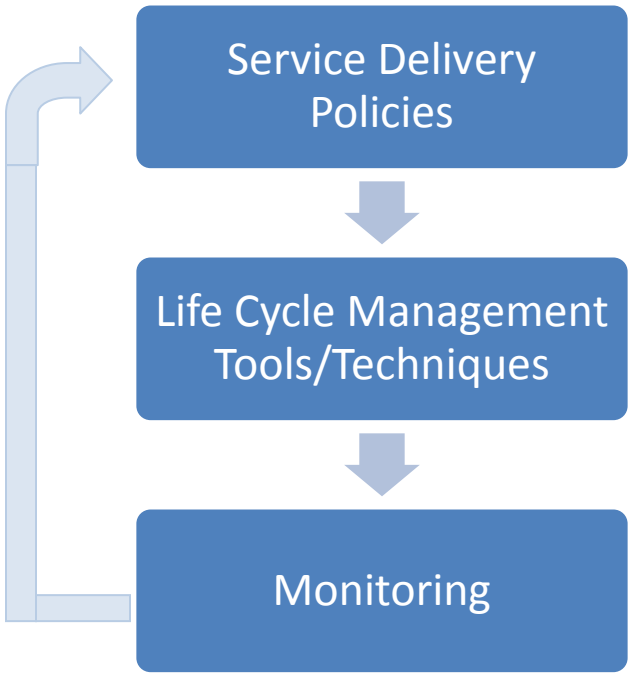
The past two decades has seen a significant rise in the field of asset management with respect to municipal infrastructure. In the field of civil engineering, asset management is concerned with the management of the infrastructure assets that are owned by the municipality or other level of government. This is very different from asset management in the financial sector, which is primarily related to the movement of asset resources to ensure an adequate return on investment.

Many municipalities have asset management individuals or groups that are responsible for ensuring that services are delivered in a cost effective manner, and that the decisions that are made regarding capital, maintenance and operating investments are taken with a full understanding of the impact they will have on service delivery. National groups have subsequently moved to act as a single voice to advocate for changes in infrastructure policies to address the issues that all municipalities are facing. These groups are comprised of engineers and public works officials that are working in municipalities to advance asset management systems.

Design of Asset Management Systems

Asset management systems have at their core three basic sections (Figure 1). The first is an over-reaching service delivery policy component in which the service levels are established according to the particular priorities of the service provider. The second is the functional section of infrastructure management where tools and techniques are used to generate asset inventories, perform condition and risk assessments, and investigate intervention options to ultimately arrive at an informed decision as to where resources should be allocated. The final section of infrastructure management is a monitoring program to assess how effective the infrastructure is at meeting the service delivery standards that are established in the first section.

Figure 1 - Asset Management Framework



All asset management systems rely on some type of framework to show how individual infrastructure management activities can work together in a holistic manner. The progression of asset management has focused on taking what has generally been done within the engineering industry (i.e. condition and risk assessments) in the context of a comprehensive management framework. These frameworks have helped organizations to assess their current status and provide direction on what should be done next in order to improve long term infrastructure management.

International and Canadian Asset Management Systems

One of the primary groups that have been responsible for progressing asset management systems over the past decade is the National Asset Management Strategy (NAMS) group from Australia and New Zealand. NAMS has published manuals to guide the industry and lead organizations to the continual improvement of service delivery and the management of the infrastructure that provides the services. The NAMS approach and framework is currently being used in most jurisdictions in Australia and New Zealand, as well as several municipalities in Canada.

Jurisdictions in the United Kingdom developed the Public Available Standard (PAS) 55 to guide asset management systems and practices. It is widely considered to be the only international asset management system. The main drawback to the PAS 55 methodology is the large commitment that must be made in terms of time and internal resources to roll out the full program. PAS 55 is currently in the process of becoming an ISO standard (ISO 55000).

In 2003 the Canadian Federal government commissioned a series of documents called *InfraGuide* to collect best practices and prepare guidance documents in a number of fields relating to the operation of municipal governments. One of these manuals was *InfraGuide 7: Managing Infrastructure Assets* published in October 2005. While *InfraGuide 7* does not explicitly describe a graphical framework or mention report cards as a form of reporting mechanism, it does emphasize the need to report on the degree to which infrastructure is delivering its target service levels.

Monitoring Mechanism of an Asset Management System

The monitoring mechanism is a key part of an asset management system because it monitors and provides feedback on the quantity and quality of the services that are being delivered. The results of the monitoring process are used to adjust the service delivery policies, which in turn will adjust the life cycle management tools and techniques. The monitoring mechanisms can cover a wide array of report styles at various levels of detail. Examples of monitoring mechanisms are performance indicators, customer satisfaction surveys, state of infrastructure reports, and infrastructure report cards. Each of the three asset management systems previously described (NAMS, PAS 55, InfrasGuide) articulate the need for some type of reporting mechanism to be part of the infrastructure management process.

Why report cards?

Report cards have been used in several jurisdictions to provide an indication of the state of the infrastructure for a number of reasons. First, report cards are designed to provide a high level evaluation of the degree to which the expected performance is being achieved. With respect to school report cards, they provide an indication of how well a student is performing against the desired target level. This same approach is used as the reporting mechanism of asset management systems to convey how well the infrastructure systems are meeting the target service level. The structure of report cards is also generally consistent which allows for progress to be tracked over time. Finally, it is also generally accepted that report cards are a time when attention should be directed toward the issues that are presented. It is a time to reflect and change direction if the results of the report card are not acceptable.

Infrastructure report cards can differ significantly with respect to the scope of assets that are included, the methodology and level of detail used to determine the grades/ratings, and the depth of recommendations for changes to infrastructure policies. The following sections provide a summary of several report cards that have been developed over the past decade across the world.

4. Canadian Municipal Infrastructure Report Card[1]

History

The Canadian Municipal Infrastructure Report Card is sponsored by a consortium composed of the Canadian Society for Civil Engineers, the Federation of Canadian Municipalities, the Canadian Construction Association, and the Canadian Public Works Association. Other groups that formed the

[1] Canadian Municipal Infrastructure Report Card available online at: www.canadainfrastructure.ca.

advisory board for the Report Card are: Transportation Association of Canada, Association of Canadian Engineering Companies, Canadian Association of Municipal Administrators, Canadian Automobile Association, Canadian Urban Transit Association, Canadian Water and Wastewater Association, Canadian Council of Public-Private Partnerships, Canadian Institute of Planners, Engineers Canada, and Canadian Network of Asset Managers.

Scope

The 2012 report card covers 4 asset categories:

- Water
- Wastewater
- Stormwater
- Transportation (roads & bridges)

Methodology

The data for the Canadian Municipal Infrastructure Report Card was collected using a survey that was distributed to senior representative at all municipalities in Canada. The web-based survey required the respondents to register and populate a number of fields associated with the four asset types. A total of 346 municipalities registered to take the survey, however the amount of information that each municipalities provided varied greatly. 123 municipalities of the 346 that registered to take the survey provided sufficient information to be used in some form to contribute to the analysis.

The questions generally related to the inventory, condition and capacity of assets, the sources used to collect the data and the value of the assets. For examples, the survey asked each municipality to report on the percent of their systems that were in very poor, poor, fair, good or excellent condition. The survey provided definitions on what the condition states represent, for example a “poor” condition represents assets where “Deterioration has a significant effect on performance of assets. Requires significant maintenance to remain operational”. There were also additional questions that related to the state of practice of asset management in the community, such as the degree to which the survey responses were based on an established computer-based asset management system.

The responses from the individual municipalities were aggregated to produce the report card results. A rating was assigned to each asset group based on the percentages that were in very poor to excellent condition. The condition information was the only data that was used to determine the overall ratings. The results of the other questions that were related to capacity and data sources were summarized and used in the general discussion of the state of asset management systems in municipalities.

Results

The Canadian report card is the only report reviewed in this paper that did not use letter grades to rate the state of the infrastructure. Instead, the authors opted to provide the results in a more descriptive format. The condition of the water and wastewater systems were described as being “Good: Adequate for now”, the roads was described as “Fair: requires attention”, and the stormwater system was described as being “Very good: fit for the future”.

The Canadian report card provides a very good summary of the value of the infrastructure systems that were evaluated. For example, the replacement cost of the infrastructure that was in Fair, Poor or Very Poor condition was estimated to be $171.8 billion at a national level. The report card also provides replacement values of infrastructure based on the value per household. For example, the replacement cost of drinking water infrastructure that was in fair to very poor condition was estimated to be $25.9 billion, or $2,082 per household. This approach provides context to the very large dollar values that are associated with municipal infrastructure, and helps readers of the report to better relate to the content of the report.

The Canadian report card does not provide any policy recommendations for how to change the way infrastructure is planned, designed, funded or managed. The report does point to the need to continually invest in municipal infrastructure to avoid large future expenditures that can result from chronic underinvestment, as well as the need to develop better municipal asset management systems.

Discussion

A total of only 123 municipalities provided information that was used in the condition assessment of the various types of infrastructure. This suggests that it was difficult for the majority of municipalities in Canada to respond to the survey, most likely due to one of two contributing factors. The first is that the survey itself was very detailed. The number and depth of questions would likely have taken most municipalities several hours to complete even if they have information readily available. This is difficult to prove outside of conversations with the individuals that were tasked to reply on behalf of each municipality. The second contributing factor is the lack of existing asset management system within the municipalities that could be used to readily respond to the survey. This factor is difficult to verify without direct communication with the municipalities that registered for the survey but did not input any data.

The Canadian report card has some unique features when compared to the other national report cards. The first is the transparency of the report card ratings. There is a very clear methodology described in the document. The average person can look at the results of the condition reporting and understand how it was used to determine the ratings. Another unique feature is that the Canadian report card does not include any recommendations to direct infrastructure policies. The authors chose to let the document be factual in its results and to leave the infrastructure policy discussion for individual municipalities, national groups, or other stakeholders to prepare. Lastly, the Canadian report card is also the only document of the five report cards reviewed in this report to present the total value of infrastructure that is being reported in conjunction with the investment need. This provides a useful backdrop to any discussion on infrastructure funding policies.

5. Australian Infrastructure Report Card[2]

History

The Australian report card has played a role in shaping infrastructure policy in Australia for almost 15 years. The 2010 Infrastructure Report Card was the fourth iteration (previous versions were published in 1999, 2001 & 2005). Engineers Australia has been the report author since its inception. The reports have historically been a venue for the Australian engineering community to voice its concerns with respect to the direction of infrastructure policies and to advocate for a strong, national voice to provide independent advice to infrastructure stakeholders.

The previous (2005) national report card recommended that the Council of Australian Governments establish a National Infrastructure Council to provide independent advice on policy, planning and delivery of infrastructure in Australia. In 2008 the Australian Government established Infrastructure Australia though an act of Parliament to provide this independent advice. This was noted as a major success for Engineers Australia and the national report card.

Scope

The 2011 report card covers 11 asset categories:

- Roads
- Rail
- Airports
- Ports
- Water
- Wastewater
- Stormwater
- Irrigation
- Electricity
- Gas
- Telecommunications

Methodology

Previous Australian report cards were completed on a national level by Engineers Australia. From 2003 to 2005 report cards were published for all States and Territories. This process was repeated again in 2010 for each State and Territory. The 2010 Australian national report card was developed by conglomerating the eight individual State and Territory report cards that are all produced following the same prescribed methodology. The overall weighting of the results of each State/Territory report card are based on the relative size and economic importance of each jurisdiction. This is possible in Australia

[2] *Australia – Infrastructure Report Card 2010*, produced by Engineers Australia, access at http://www.engineersaustralia.org.au/sites/default/files/shado/Infrastructure%20Report%20Cards/Australian/2010%20Australian%20IRC%20Report.pdf

due to the advanced nature of asset management systems across the country and the support provided by Infrastructure Australia to all levels of government.

The report card grades were developed using a comprehensive flow chart that produces infrastructure grades based on the planning and funding concerns of future infrastructure, and the performance and funding of existing infrastructure. The grades have been established based on an assessment of condition, availability, reliability, sustainability (economic, environmental & social issues), and resiliency. The assessments are based on consultation and research, including interviews with key stakeholders.

The infrastructure grades are assigned based on the "fitness", which is defined as the degree to which the infrastructure is meeting the current needs of the community, economy and environment in terms of sustainability, effectiveness, efficiency and equity. For example, an "A" is defined as infrastructure that is fit for its current and anticipated future purposes, where a "C" is defined as infrastructure that requires major changes to be fit for its current and anticipated future purposes. In the Australian report card, future purposes represents the future needs of the community, economy and environment in terms of sustainability, effectiveness, efficiency and equity.

Results

The 2010 report card gave an overall grade of C+, unchanged from the overall grade in the 2005 report. The ratings from the individual State and Territory reports show that there has been limited movement in the infrastructure grades with the implementation of Infrastructure Australia and the economic stimulus spending that was targeted to infrastructure. The report does not identify the total value of infrastructure in Australia or discuss the required infrastructure investments.

The discussion in the report highlights the significant under-investment in infrastructure, which imposes constraints on all parts of the economy and community. There are several important policy recommendations in the Australian report card, including a call for coordinated planning frameworks, cooperation between governments, and the establishment of a national infrastructure council to provide independent advice about infrastructure priorities of national significance.

Discussion

The Australian Infrastructure Report Card is a document that aims to direct infrastructure policies across the federal, state and local governments. The report provides a complicated framework that the State governments use to evaluate the performance of the infrastructure, but there are no specifics about why a specific grade was assigned to each asset class. This results in a less transparent report card process when compared to the methodology of the Canadian report card which develops the infrastructure grades based on a quantitative measure of the condition state of each asset type. Another concern with this approach is that it becomes difficult to determine what the appropriate grade should be for each infrastructure type and to have a clear understanding of how to raise the grades of each asset class. In addition, the use of grades to qualitatively establish the "fitness" of infrastructure to meet a number of determined needs is a subjective process that is not repeatable.

The Australian report card does not include any discussion on asset value or provide a thorough discussion on infrastructure funding requirements. There is only a brief mention of an estimated $700 billion infrastructure deficit that is caused by systemic underinvestment in maintenance and capital activities over the past years. There is no information provide in the report about how the $700 billion infrastructure deficit was calculated.

The major theme of the report card is to draw attention to the lack of long-term strategic planning, coordination and integration between levels of government. The authors recommend a more holistic regulatory framework that can be used to set priorities between levels of government and across infrastructure sectors. The report card also identifies specific policies that should be adopted, such as requiring infrastructure owners to have adequate data that can be utilized to plan effective maintenance and renewal activities. It also discusses the need to have the financial and operational risk of infrastructure projects split between both the public and private sectors in cases where private sector companies are benefiting from the infrastructure.

6. 2009 ASCE USA Report Card[3]

History

The first instance when infrastructure grades were produced in the United States was in 1988 when the National Council for Public Works Improvements prepared a report titled *Fragile Foundations: A Report on America's Public Works*. The original report provided grades for 9 infrastructure categories. The American Society of Civil Engineers (ASCE) published the first *Report Card for America's Infrastructure* in 1998. Subsequent versions were released in 2001, 2005 and the latest in 2009. The American report card is authored by the ASCE with the help of an advisory council comprised of subject matter experts from the private, academic and public sectors. Beginning in 2001 the cost to improve the infrastructure over 5 years was identified in the report card at $1.3 trillion, rising to $1.6 trillion and $2.2 trillion in the 2005 and 2009 reports, respectively.

Scope

The 2009 report card covers 15 asset categories:

- Water and the environment
- Dams
- Drinking water
- Levees
- Solid waste
- Wastewater
- Transportation
    - Aviation

[3] *Report Card for America's Infrastructure* – 2009, produced by the American Society of Civil Engineers – ASCE, access at http://www.infrastructurereportcard.org/sites/default/files/RC2009_full_report.pdf

    - Bridges
    - Inland waterways
    - Rail
    - Roads
    - Transit
- Public facilities
    - Parks and recreation
    - Schools
- Energy

Methodology

The infrastructure grades are based on seven factors: capacity, condition, funding (compared to need), future need, operation & maintenance, public safety and resilience. Existing data was collected and used to assess existing grades, identify current and required funding, identify capacity problems, quantify the asset inventories and assess the impact of doing nothing. The data was then compiled to determine initial grades which were then validated before establishing the final grade of each infrastructure class. The assessment of infrastructure resiliency was based on risk and consequence management, life cycle management, sector interdependencies, and the time, ease and cost of recovery. As with the Australian report card, the grades are developed in a subjective manner. For example, a "C" represents a grade of "Mediocre" while a D represents a grade of "Poor".

A key feature of the American report card is the calculation of a five year infrastructure investment requirement. This is accomplished by reviewing various reports on each asset group and amalgamating the investment requirements that are provided. There is no indication if the five year investment is to bring the existing assets up to an acceptable state of repair or to expand the systems to achieve a target service level.

The report has a very prominent theme to describe how to "Raise the Grades", with five key themes including increasing federal leadership in infrastructure, promoting sustainability and resilience in infrastructure to protect the natural environment and withstand hazards, develop a national vision for infrastructure, address life cycle costs and ongoing maintenance to meet the needs of the current and future users, and increase and improve infrastructure investment from all stakeholders

Results

The grades of each infrastructure group ranged from a D- to a C+, with an overall grade of D. The report does not describe how the grades and corresponding single word descriptors relate to the performance of each infrastructure class. The report does describe each infrastructure class in detail to outline the challenges faced by each sector with respect to investment needs and to identify stresses caused by under-investment in maintenance activities.

Discussion

The American report card is a very well designed document that produces attention-grabbing headlines. The report card and investment backlog leave the reader with a clear indication that there are major issues with infrastructure across the country. However, the emphasis on the $2.2 trillion investment requirement does detract from the other key policy recommendations on how to raise the grades, such as federal leadership and a coordinated infrastructure vision. Most readers who do not read the report thoroughly are left with the value of the investment need as the primary message.

The description of the five year investment requirement is another area of the American report card that is not clearly described in the report. There is limited discussion on how the $2.2 trillion investment was calculated and whether it is to bring existing infrastructure up to a state of good repair or to expand existing systems. There is also no mention of the fact one of the tables in the report indicates that approximately 50% of the $2.2 trillion investment requirement is already being funded.

It is not headline news in the civil engineering industry that municipal infrastructure systems are very large and require large amounts of money over time to continue to provide services. The fact that a considerable amount of the investment need is already being funding should be highlighted as a good news story to the general public. Unfortunately, the American report card does not use the opportunity to mention the investments that have been made and the benefit they have brought to the general public. This can have a negative impact on the discussion around infrastructure funding because decision makers who direct the large volume of resources into infrastructure projects are not being applauded for doing so. Instead, the public hears that they have a huge problem and the money that has been spent does not seem to be working. This could make decision makers less willing to make infrastructure investments if there is no perceived political benefit.

7. 2010 ICE UK Report Card[4]

History

The United Kingdom's *The State of the Nation – Infrastructure 2010* was prepared by the Institution of Civil Engineers (ICE). ICE has been producing State of the Nation reports on an annual basis since 2000 for individual asset groups. The 2010 report was the first time a group of assets have been combined into an overall infrastructure report. The report was developed by a panel of experts in relevant fields from the membership of ICE. The goal of their reports is to stimulate debate on infrastructure policy and to call attention to the actions that should be taken to improve the UK's infrastructure and the services that it provides.

[4] *UK State of the Nation Report 2010*, produced by the Institution of Civil Engineers, access at http://www.ice.org.uk/getattachment/c198a95f-69bd-4c46-8110-51b057ec20f1/State-of-the-Nation--Infrastructure-2010.aspx

Scope

The 2010 report card covers 6 asset categories:

- Energy
- Strategic transportation networks
- Local transportation
- Water & wastewater
- Flood risk management
- Waste and resource management

Methodology

The ICE report grades are described as being evidenced-based considering the condition, capacity of infrastructure networks, as well as their resiliency, sustainability and inter-dependency. The report also indicates that funding concerns are incorporated into the overall grades. The general methodology is similar to the American report card and the Australian report card as it relies on a qualitative assessment of the fitness or adequacy of infrastructure to provide services. For example, a grade of "A" indicates that the asset class is "fit for the future" while a grade of a C indicates that the asset class "requires attention". Overall, the methodology of the ICE report card is poorly documented.

Results

The grades range from B for strategic transportation networks to D for energy systems. There is no overall grade provided for all asset groups. There are also no figures provided for the size of the asset portfolio or the investment requirement. The report does provide three recommendations for how to improve the grade of each of the six asset classes.

Discussion

The ICE report card is a much smaller document than the other report cards that were reviewed. The short length creates a document that is very readable and easy to understand. However, the small size of the report results in a very limited discussion on the methodology that was used to determine the grades and only a few sentences for each asset group on how to improve the grade.

The lack of any indication of the infrastructure investment backlog suggests that the report was designed to focus the attention of the reader to the explanation of why the infrastructure grades are poor and the three recommendations for how to improve the grades for each asset class. There are no cohesive policy recommendations throughout the individual sections for each asset class, resulting in a total of eighteen total recommendations for the six asset classes. The result is a lack of a primary take away policy recommendation after reading the report.

The ICE report does highlight the policy changes that are required to improve the performance of infrastructure, most notably the need to provide greater clarity and coordination over the planning, prioritization and enabling of infrastructure investments. The report also mentions the anticipated benefit from the Federal government establishing Infrastructure UK in June 2010 with the mandate to develop a short and long term infrastructure strategy to prioritize investments.

8. SAICE Infrastructure Report Card for South Africa[5]

History

The original SAICE report card was released in 2006 and contained 9 infrastructure classes and a total of 21 sub-classes. In 2011 the South African Institute of Civil Engineering published the second iteration of their national infrastructure report card and slightly expanded the scope of the report. The original report card received wide spread media attention and helped highlight issues surrounding infrastructure assets that are unique to South Africa, notably the contributing factors of skills shortages and the insufficient maintenance of assets.

scope

The 2011 report card covers 10 asset categories:

- Water
- Sanitation & wastewater
- Roads
- Airports
- Ports
- Rail
- Electricity
- Healthcare Infrastructure
- Schools

Each of the 10 primary infrastructure areas outlined above are further broken down into 27 appropriate sub-classes.

Methodology

The report card grades are developed by a research team comprised of SAICE representatives. The grades are then reviewed and revised by field experts drawn from the SAICE network. The grades are developed for each of the 27 sub-classes using a qualitative ratings system. The rating system is based on a subjective assessment of the "fitness" of the infrastructure, with "A" being defined as "world class" and a "C" being defined as "satisfactory for now". The "fitness" is described as being a combination of condition, maintenance levels, capacity concerns, and the robustness to deal with unusual or unplanned events. The individual grades of the 27 sub-components are then amalgamated to provide an overall grade of the entire infrastructure in the country. There is no detailed description of the methodology and there is no discussion on infrastructure deficits or funding levels.

Results

There is a wide variation in the grades associated with the 27 sub-classes, from B+ to E. The overall infrastructure grade was a C-, a slight increase from the 2006 report card which gave an overall grade of

[5] *SAICE Infrastructure Report Card for South Africa 2011*, produced by the South African Institution of Civil Engineers – SAICE, access at http://www.csir.co.za/enews/2011_jun/download/infrastructure_report_card_sa_2011.pdf

D+. The report provides a summary of each of the 10 major asset types with a brief summary of why each asset class and sub-class achieved the grade that was indicated. There is no mention of the monetary value of the infrastructure investment requirements.

Discussion

The SAICE report card is similar to the ICE report card in length and content. The short length allows the reader to quickly understand why the infrastructure grades are poor. The report does not provide a detailed methodology, which has the benefit of not taking the emphasis away from the results as there is no opportunity to scrutinize the process.

The report card calls attention to the issues that are prevalent in the nations' infrastructure, and emphasize the importance of infrastructure to the prosperity of the country. It outlines three important factors that contribute to the poor infrastructure in the country, namely the lack of skills to properly plan, design, procure, construct and maintain infrastructure, the lack of maintenance funding and the deficiencies that this causes in terms of an overall asset management approach to infrastructure, and the relationship between the sustainability of infrastructure and the environmental impact of infrastructure.

9. Summary on the Report Cards

The previous sections provided an overview of five infrastructure report cards. This section provides a summary of the similarities and differences of the reports cards in order to inform recommendations about how future report cards should be developed. Table 1 provides a summary of six key elements of the report cards: date of first release, number of asset types, the presence of letter grades, the level of monetary discussion, the factors that influenced the grades, and the level of policy recommendations present in the report cards.

Table 1 - Summary of Infrastructure Report Cards

Jurisdiction	Year of First Report Card (number of iterations)	Number of Asset Types	Letter Grades Provided	Level of Monetary Discussion	Factors that Influence Report Grades	Level of Policy Recommendations
Canada	2012 (1)	4	No	Moderate	Condition	Minimal
Australia	1999 (4)	11	Yes	Minimal	Condition, capacity, reliability, sustainability, funding, resiliency	Significant
US	1998 (4)	15	Yes	High	Condition, capacity, funding, need, public safety, resilience, maintenance	Significant
UK	2010 (1)	6	Yes	Minimal	Condition, capacity, resiliency, sustainability, inter-dependency, funding	Significant
South Africa	2006 (2)	10	Yes	Minimal	Condition, capacity, maintenance, resiliency	Significant

History

The earliest report cards were released in the United States and Australia in 1998 and 1999, respectively. These two countries have completed several iterations of their report cards which has allowed for the structure of the reports to be modified based on the feedback that was received from media and the general public. The regular report card preparations are useful to track how the policy recommendations that are included in the advocacy sections are being considered by the relevant stakeholders.

It is evident from the comparison that in general the development of the report cards generally coincides with the advancement of asset management systems in municipalities. The report cards articulate the unified position of all of the small, individual stakeholders in the civil engineering industry that plan, design, operate and maintain infrastructure.

Asset Types

All of the report cards include core municipal infrastructure of water, wastewater, storm water and transportation assets. These four asset groups represent the vast majority of the municipal infrastructure inventories in developed communities. Rail and energy systems are common to all of the report cards except for Canada. These assets are very important to the national economy, however in Canada the report card was developed by municipalities who do not own rail networks or generate electricity. The other asset groups in each report card are included based on their unique importance to each country.

Use of Report Card Letter Grades

All of the report cards except for the Canadian report use actual letter grade to convey the state of the infrastructure. The Canadian report uses condition descriptors that can be indirectly tied to letter grades (i.e. "Very Good" can be assumed to mean a grade of "A"). The letter grades are an important consideration because they are often the most significant piece of information to come out of the report card. In addition, when the general public read a report card they expect to see a letter grade.

Level of Monetary Discussion

All of the report cards include some level of discussion on monetary concerns with respect to funding deficits or investment requirements. The US report card makes the five year funding requirement a highlight piece that accompanies the summary report card. This is much different than the UK, Australian, or South African report card which only mention the lack of maintenance funding as a contributing factor to the report card grades. The Canadian report card is the only report to provide an estimate of the total value of the infrastructure and the total amount of infrastructure that is in poor or very poor condition. This amount can be inferred to be the short term investment requirement.

Factors that Influence Report Card Grades

The Canadian report card is unique with respect to the inclusion of a clear description of how the condition of the infrastructure was used to determine the grade of each asset class. This is possible because the grades are based on the physical condition that was reported by the survey respondents. The physical condition of the infrastructure was established by each municipality during the course of developing their asset management systems or through estimation in cases where asset management systems were not established.

All of the other report cards develop grades based on a number of subjective factors that are combined to establish a letter grade. None of the reports provide a clear indication of the relative weightings that were given to each of the subjective factors.

Level of Policy Recommendations

All of the report cards offer some amount of recommendations for changes to infrastructure policy. The Canadian report card offers only a minimal level of policy generally related to encouraging the development of asset management systems in municipal organizations. The Canadian report card offers no discussion on how infrastructure policies should be changed to improve the report card grades. All of the other report cards include a significant amount of discussion and recommendations to direct public policies associated with the funding, planning, coordination and construction of infrastructure. The Australian and UK report cards have successfully influenced their respective Federal governments to establish national infrastructure agencies to assist in developing comprehensive and coordinated infrastructure policies for federal, state/provincial and local governments.

10. Discussion of Report Cards

The previous sections of this report provided a background of asset management systems and reporting mechanisms, and provided a summary of five national infrastructure report cards. This section provides a discussion on several considerations that are prevalent in the various report cards.

The desire for bad grades

A report card with good grades leaves a reader feeling like there are no pressing issues to be addressed. For example, a parent who reads a child's report card in which they receive straight A's is not likely to force a change in study behavior or provide incentives for higher marks. However, a report card with poor grades causes immediate reactions to attempt to improve subsequent iterations. This is also true in the infrastructure report card process. An infrastructure report card that has good grades is not likely to result in any reactions to change policies around service delivery standards, funding arrangements, or any other infrastructure policy. The incorrect perception that everything is acceptable is particularly worrisome idea for a reader to obtain from a report card on infrastructure because it is very easy to divert resources away from infrastructure projects due to their relatively high cost and long useful life. However, continual underinvestment in infrastructure will lead to a significant funding backlog that could take generations to overcome. Authors of infrastructure report cards could have a motivation, either consciously or subconsciously, to obtain poor grades that will lead to discussions on how to adjust infrastructure policies to improve the grades.

Infrastructure report cards can leverage the poor grades to encourage the readers to understand and adopt their policy recommendations that are provided to improve the grades. However, report cards that continually show poor grades and no improvement even after the adoption of the policy recommendations could work against the goals of the authors if governments are not able to perceive a positive impact from increased investments or changes in other infrastructure policy issues.

Report card grades should be established in a manner that reduces the potential for personal opinions to skew the results, such as through the use of independent third parties to complete the assessment. This will ensure that they are a true and independent representation of the state of the infrastructure regardless of the methodology that is used to arrive at the final grade. Report card authors should also understand that their policy recommendations will be less effective if they do not demonstrate reasonable improvements in the report card grades or provide an explanation of why the grades did not improve.

Subjective grades

The Canadian report card is unique in that it provides a clear indication of the methodology that was used to arrive at the infrastructure grades. The Canadian report card grades are based purely on a quantitative summary of the condition of infrastructure that was reported by the municipalities that responded to the survey. The establishment of infrastructure grades that are based on a subjective assessment of the fitness or adequacy of the future delivery of services is common to the four national report cards from the US, the UK, Australia and South Africa. These report cards all have lower grades for their infrastructure then the Canadian example. This suggests that the consideration of factors such as capacity and the ability to serve the future populations are contributing to the poor report card

grades. Subjective grades have an advantage because they cannot be directly challenged by the general public or other report card readers

Explicit description of methodology

One of the most common similarities in all of the report cards expect for Canada is the lack of an explicit description of how the report card grades were developed. The authors provide just enough information to make the readers appreciate that a lot of consideration went in to determining the grades, but do not provide a detailed description. The drawback from this approach is the lack of transparency and repeatability in subsequent iterations of the report card. The process becomes less defendable if it cannot be repeated or verified.

The Canadian report card was very explicit in its description of the methodology. This could result in considerable attention being paid to groups attempting to verify the results, as opposed to focusing on the policy recommendations. If the goal of the report card is to draw attention to the changes that are required to infrastructure policy, then the inclusion of a precise methodology in the report could distract attention away from the key policy recommendations. The authors should review the outcome of the response to the report card to see if the transparent methodology was a benefit to the report card process.

Discussion of Money

The US report card is the only report that makes the investment requirement and monetary issues a primary highlight. The report emphasizes a multi trillion dollar five year investment requirement in a number of locations throughout the document. This leaves the reader with the poor grades and large investment requirement as being the primary findings of the report, despite the fact that only one of the five main recommendations in the report is related to monetary issues. The emphasis on money has the negative impact of detracting from the key policy recommendations, such as increasing federal leadership and coordinating investment in infrastructure between jurisdictions investments.

The Canadian report card is the only report to provide an estimate of the total value of the infrastructure across the country and the amount of the infrastructure that is in poor or very poor condition for each asset type. The values provide context for the existing funding that is provided by the local, Provincial or Federal government.

A key consideration that is not included in the discussion of money in the US report is the need to put the investment requirements or asset values into a perspective that the average person understands. The US report card only provides the 5 year investment requirement, but does not provide any context in terms of the value against the total value of the infrastructure, nor does it put into perspective the amount of the investment that is required in term that the average person can comprehend (i.e. $/capita). This is something that can help people to understand the scope of the problem instead of talking in terms of trillions of dollars. The Canadian report card does a better job at putting these numbers into perspective by providing the value of infrastructure in terms of dollars per household.

The three other national report cards provide very little discussion or information on funding levels or investment requirements. This leaves the attention of the reader to be focused on the policy recommendations and other infrastructure concerns.

Repeatability & Comparability

A common approach to all of the report cards is the ability to repeat the process and facilitate comparison to previous iterations. This is an important consideration that seems to be addressed in all of the national report cards. The consequence of this is that it makes it very difficult and counterproductive to change the methodology in future iterations because a direct comparison will not be possible. For example, it will be less meaningful to compare future iterations of the Canadian report card if the authors transition to include other factors in addition to condition in the development of the grades. If the factors to that influence the grades of the next Canadian report card are changed then it may be possible to compare the two iterations if correction factors are applied to the results of the first report card.

The Australian report card provides an example of the most effective process for repeatability and comparability because the national government provides direction and a methodology for the state governments to complete during the report card process. The national report card is simply an average of the state report cards. This results in the ability for state government to compare against the national average.

All national governments should investigate the feasibility of establishing a report card process that is similar to the Australian model to enhance the repeatability and comparability of subsequent iterations. However it is noted that there will be limitations to the process due to the different nature of infrastructure ownership in various countries, such as the split between Provincial and municipal ownership in Canada, and the prevalence of private utility companies in the US and UK.

Recommendations for Changes to Infrastructure Policy

All of the report cards except the Canadian report recommend changes to current infrastructure policies based on the findings of the reports. Although each report card is unique in terms of the specific policy changes that are recommended, they all use the opportunity that the national report card presents to outline what they think should be changed. In the case of the UK and Australian report card, previous policy recommendations have been directly adopted by the state and national governments. The inclusion of policy recommendations is successful because the report cards are widely read by the media, general public and decision makers, making the reports and their recommendations difficult to ignore.

The Canadian report does not include any recommendations for how infrastructure policy should be modified to improve the ability to meet the needs of current and future generations. The authors of the Canadian report wanted to leave individual groups to use the results of the report card to recommend specific policy changes that they would like to see implemented. The drawback of this approach is that it makes for a disjointed response that may not get sufficient attention by decision makers and much

easier to ignore. The national report card is likely to be widely read and covered in the media, however the individual responses may not be heard from anyone outside of the small circle of stakeholders.

The authors of the Canadian report should review the degree to which the policy recommendations that will be made through individual responses are both covered by the media and implemented by governments. If the policy recommendations are being ignored then subsequent iterations of the Canadian report card should be revised to include a coordinated set of policy recommendations that will be highlighted in the report. This is one of the most important considerations that should be reviewed in the months after the release of the inaugural report card because there are not many instances when the national media and general public reflect on infrastructure policies. It is likely that the stakeholders that contributed to the development of the report may lose their opportunity to provide infrastructure policy recommendations that will be adopted by the Federal or Provincial government.

11. Conclusions and Recommendations

Reporting mechanisms are a key component of a successful and functioning asset management system. National organizations advocate on behalf of individual municipalities for changes in infrastructure policies at higher levels of government. National infrastructure report cards are an ideal venue to recommend changes to infrastructure policies.

This report has summarized five national infrastructure report cards and provided a discussion on the advantages and disadvantages of the different approaches of each document. The report has also provided a list of factors to consider including the use of subjective factors to establish grades, the desire to obtain poor grades, the decision to discuss monetary issues, the repeatability of subsequent iterations and the decision to include recommendations for changes to infrastructure policies.

The following recommendations are provided for future report cards:

- Jurisdictions or groups that are initiating report cards as part of the reporting mechanisms of their asset management program should carefully consider the factors outlined in this inquiry during the development of the design and strategy of their report.
- Where possible, report card results should be based on quantitative measures to increase the comparability and repeatability in subsequent iterations, and to remove personal bias from the results.
- The use of a direct survey of individual groups or stakeholders should be adopted when feasible. The complexity of the survey should be limited to ensure that the individual stakeholders can respond to the survey with a reasonable effort.
- Report cards should discuss the investment required in relation to the total value of the infrastructure and provide some context for the values that can be understood by the general public.
- Report cards should include recommendations for changes to relevant infrastructure policies to capitalize on the attention that will be garnered in the media, general public and political environment.

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