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CANADA - NATIONAL REPORT

STRATEGIC DIRECTION SESSION ST 4

INFRASTRUCTURE
OPTIMIZING ROAD INFRASTRUCTURE INVESTMENTS AND ACCOUNTABILITY

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Canadian National Committee of the World Road Association in Partnership with Ontario Ministry of Transportation (MTO) and Applied Research Associates Incorporated (ARA)

1. INTRODUCTION

In Canada, many agencies including the Treasury Board of Canada Secretariat, Parks Canada and Transport Canada, provincial highway agencies such as Alberta, Saskatchewan, Ontario and New Brunswick, municipalities such as Vancouver, Calgary, Toronto and Ottawa and public-private partnerships such as the Sea to Sky, Highway 407 ETR and Route 1 Gateway have established asset management business frameworks to assist in the efficient and cost effective management of their transportation assets.

Transportation asset management is not mandated in Canada as it will soon be in the United States. In the United States, The Moving Ahead for Progress in the 21st Century Act (MAP-21) was enacted to integrate performance into many federal, state, and local transportation decision making programs. Specifically, MAP-21 requires federal, state, and local transportation agencies to establish risk-based asset management plans that include all infrastructure assets within the right-of-way of highways.

In 2014, the Transportation Association of Canada (TAC) initiated a study to develop a synthesis of best practices for transportation asset management in Canada. The study included a survey of the asset management practices of 25 roadway agencies across the country. A list of agencies that participated in the survey is shown in Table 1.

Table 1. Agencies Participating in 2014 TAC Asset Management Practices Survey

Provincial	Regional	City	Transit/Other
British Columbia	York	Vancouver	TransLink
Alberta	Waterloo	Edmonton	Calgary Transit
Saskatchewan		Calgary	S2S Transportation Group
Manitoba		Regina	Asset Management BC
Ontario		Toronto	Federation of Canadian Municipalities
Québec		Ottawa	Ontario Good Roads Association
New Brunswick		Hamilton	407ETR
		Vaughan	
		Barrie	
		Montréal	

The initial results of the survey have been used to prepare this national report on the optimization and accountability of investments for roadway infrastructure.

2. GENERAL ACCOUNTABILITY FOR ROAD INFRASTRUCTURE IN CANADA

Canada is a very large country with a land area of 9.985 million km^2. Canada ranks seventh in the world in terms of road network size with a two-lane equivalent length of 1.04 million kilometres. Canada ranks 37^{th} in the world by population, with 35 million people to support this infrastructure. The Canadian road network is largely rural in nature and the roadway infrastructure, as in many countries, is aging with associated demands for maintenance and rehabilitation.

In Canada, there is no central Federal authority responsible for road infrastructure. Transportation assets (i.e. roads, rail, airports, traffic control, transit, pipelines, ports, etc.) are generally the largest component of civil infrastructure. Provincial, territorial and municipal governments are responsible for a significant amount of the assets in Canada. Road infrastructure by jurisdiction is generally classified as follows:

- Federal – Roads under federal jurisdiction or under the jurisdiction of federal agencies;
- Provincial – Roads under provincial or territorial jurisdiction;
- Municipal – Roads under municipal jurisdiction;
- Access roads – Roads that are located on public land and are typically constructed and maintained by private industry to provide access to resources (forest, mineral extraction, recreation areas, etc.); and
- Private road infrastructure – Roads built and maintained by private interests.

Table 2 provides the approximate total centreline kilometres of roadways and bridge deck area in Canada (Hajek and Hein).

Table 2. Total Kilometres of Roadway and Number of Bridges in Canada

Responsibility	Centreline Kilometres	Bridge Deck Area (m^2)
Federal	12,500	Included in Provincial
Provincial	202,400	845,116
Municipal	806,800	1,597,435
Access Roads	201,000	226,547
Private Roads	~35,000	Included in Access Roads

While there are other components to the transportation infrastructure such as signs, drainage features, etc., roadways and bridges typically represent about 80 to 85 percent of the total value of the infrastructure. The provincial and territorial highway authorities in Canada are responsible for the construction and maintenance of approximately 20 percent of public roadway infrastructure. All of the provincial and territorial highway authorities have an asset management policy related to the management of transportation infrastructure. Some agencies a have strong desire and demonstrate leadership in the area of asset management, while others are hesitant to change, continuing to manage their assets in separate categories.

Some agencies such as the Saskatchewan Ministry of Highways and Infrastructure and the Province of Ontario have widely distributed asset management functions with all activities coordinated at a higher level. The Province of Ontario goes beyond a traditional safety and overall network health policy to include polices related to increasing transit ridership, promoting a multi-modal network and integrating sustainability. Each of the provincial and territorial highway agencies has created their own policy and asset management strategy for transportation assets.

As seen in Table 2, approximately 80 percent of the public roadways in Canada are maintained by municipal governments. In 2008, the Canadian Public Sector Accounting Board (PSAB) introduced Regulation 3150. The PSAB 3150 regulation was approved by the Canadian provincial governments and requires all municipal governments in Canada to record and include all tangible capital assets in financial statements under the care and control of the municipality. The Province of Ontario follows requirements of PSAB 3150

regulations. It requires that all assets be recorded at their historical cost and depreciated to the current period. Since 2009, all public sector municipal agencies in Canada are required to comply with PSAB 3150 regulations.

The *Guide to Accounting for and Reporting Tangible Capital Assets* was published by the Public Sector Accounting Group of the Canadian Institute of Chartered Accountants (CICA) to provide a handbook for municipal governments to comply with the PSAB 3150 standard. As a result of the logical development of asset management practices, the enactment of the PSAB 3150 regulations, and the general global move to sustainable infrastructure, a large number of public agencies are adopting an asset management approach to managing their transportation assets.

The current readiness status of Canadian provincial, municipal and private sector agencies as measured on a 0 – 5 scale (0 lowest and 5 highest) against the ISO 55000 standard fundamental elements of an asset management system is shown in Figure 1.

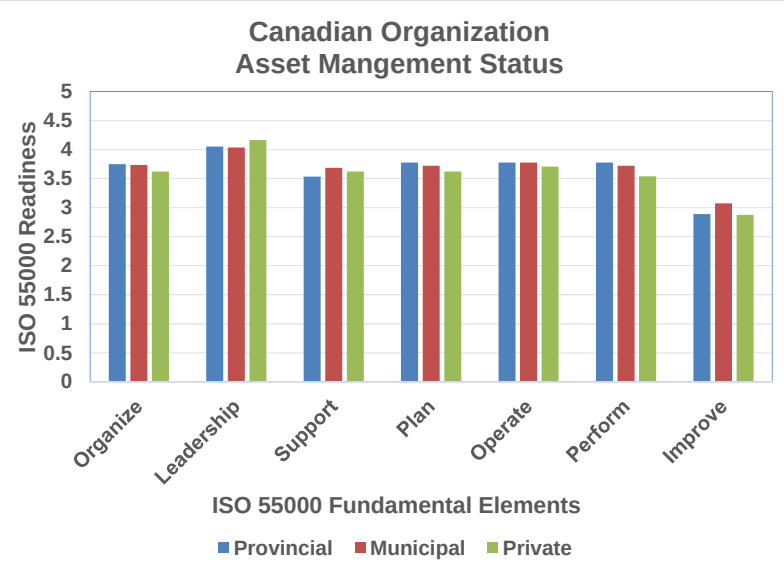


Figure 1. Canadian Organization Asset Management Status

From Figure 1, it can be seen that most Canadian transportation agencies are at a fairly high level of readiness for each fundamental element of the ISO 55000 standard. Leadership is strong in developing and implementing asset management systems. A lower level of readiness is reported for the last element of continuous improvement. This is due to the fact that most agencies are still in the development stages of their asset management programs. The improvement ranking is expected to increase as asset management systems become more mature.

3. PERFORMANCE INDICATORS

Performance measures are the backbone of asset management. The use of asset condition performance measures in planning rehabilitation investments ensures that the right investment is made at the right time in the right location over the long term. Asset condition performance measures allow the agency to gauge how well it is doing in providing a safe and effective road network.

As indicated above, transportation asset management typically has a focus on the higher cost infrastructure such as pavements and bridges. The agency bases its highway needs calculations and funding requests on meeting specific performance measures for pavement and bridge condition. It is also important to ensure that the agency can achieve a steady state "good" condition and eliminate the existing infrastructure debt over the long term. Infrastructure debt is defined as the cost of the backlog of rehabilitation needs when the budget is fully spent. Targets are set for both the short term on a year-by-year basis and to meet long term objectives. Targets are based on the life cycle of an asset, the amount of work that is reasonable in a construction period, reasonable funding levels, eliminating a backlog of deficiencies and maintaining any future infrastructure debt at a reasonable level.

As an example, the Province of Ontario sets performance targets for pavements and bridges in "good" condition to be 67% and 85% respectively. In general a pavement in good condition does not require rehabilitation/reconstruction for six or more years, a pavement in fair condition will require treatment in one to five years and a pavement in poor condition is currently in need of rehabilitation or reconstruction (in other words it has reached the end of its service life). This is based on a time interval of 15 years between significant pavement treatments. The need for rehabilitation or reconstruction is dependent on the age of the entire pavement structure (when was it originally built), the condition level to which a pavement is allowed to deteriorate, changes in traffic and local conditions, and the quality and timeliness of maintenance during the pavement life.

Setting a target of 67% of pavements in good condition is based on having two-thirds of the pavements not requiring any work for six or more years and 33% of the pavements in fair condition. Ideally there should be no pavements in poor condition.

The Ontario long-term target for the number of bridges in good condition is 85%. On average, bridges in Ontario require major rehabilitation every 30 to 35 years and replacement after 60-70 years. This represents an average annual deterioration rate of 3%. Based on a five-year planning cycle, it is desirable to have only 15% of bridges in need of rehabilitation at any time. This 85% threshold implies that the bridge network is in a steady state. Using this measure, a bridge with a Bridge Condition Index (BCI) greater than 70 is considered to be in good condition.

A municipal example is provided by the City of Edmonton which evaluates the condition of assets according to the following three criteria:

- Physical condition – Condition of the physical infrastructure that allows it to meet the intended level of service;
- Demand/capacity – The capacity of the physical infrastructure and its ability to meet the service needs; and
- Functionality – The ability of the physical infrastructure to meet program delivery needs.

Since 2002, the City of Edmonton has used a standardized rating system to determine the state and condition of its infrastructure. This five point system (A - Very Good, B - Good, C - Fair, D - Poor and F - Very Poor) is used to assess each aspect of municipal infrastructure in terms of physical condition, functionality and demand/capacity. Physical condition refers to the condition of physical infrastructure that allows it to meet an intended service level. Pavement surface distress and other condition ratings such as smoothness

are used to calculate a condition rating on a scale of 0 to 10. This scale is then divided to five equal portions to determine the rating categories.

Functionality refers to the ability of physical infrastructure to meet program delivery needs.

Demand/capacity refers to the capacity of physical infrastructure and its ability to meet service needs. The condition rating portions for functionality and demand/capacity follow guidelines outlined in procedures published by the Transportation Association of Canada (TAC).

All agencies have established procedures for asset condition assessment. In general, for pavement they include surface distress, smoothness and rutting. For bridges, condition ratings are completed on individual components with an overall bridge condition index developed.

The most comprehensive performance measure requirements in Canada are in the concession agreements for public-private-partnership (PPP) projects. For example, for the Sea to Sky Highway Concession which was established to support the 2010 Winter Olympics in Vancouver, British Columbia, highway sections are managed in 50 m per lane intervals with smoothness, rutting and distress asset preservation performance measures (APPMs) along with an overall distribution of condition required for the entire length of roadway.

The assets to be evaluated in PPP projects are defined in the concession agreements. Most agreements include all of the major elements within the right- of-way including:

- Pavements (main lanes, shoulders, side roads, pullouts),
- Structures (bridges, tunnels, retaining walls),
- Electrical systems (lighting, cameras, digital signs),
- Right of Way (landscaping, fencing, noise walls),
- Safety Appurtenances (barrier walls, pavement markings, attenuators, signs), and
- Drainage.

The maintenance and rehabilitation treatments for each asset are not specified. The Concessionaire is free to select the method of treatment as long as the result meets the requirements of the pre-defined asset preservation performance measure. The Ontario Ministry of Transportation has also established performance based measures / specifications for projects that have been delivered through a public-private partnership (also called Alternative Financing and Procurement projects) with performance requirements at hand back of the concession period (typically 30 years).

The majority of PPP concession agreements include some measureable condition indicators for the pavements. These typically include pavement surface condition as measured by some form of distress manifestation or index, smoothness which is usually measured in accordance with the International Roughness Index (IRI) and wheel path rutting. Some agreements may also include pavement surface friction and structural capacity. For the majority of PPP agreements in North America, the Concessionaire is required to measure the condition of the asset and take action when the condition state exceeds the maximum permitted in the concession agreement. Examples of simple, moderate and complex asset preservation performance measures (APPMs) from several PPP projects in North America are shown in Table 3.

Table 3. Examples of PPP Concession Asset Preservation Performance Measures

APPM	Intervention Criteria	Action	Response Time	Basis of Measure
Simple				
Roughness	Where the distortion reaches a severity level of “severe”	Rehabilitation	“immediately”	Determined based on visual observation
Distress	Where the pavement condition index is less than 60 Where the severity of an individual distress reaches “severe”	The concessionaire shall establish a schedule for immediate rehabilitation	“immediately”	Condition index measured in accordance with the owners established procedures
Moderate Complexity				
Roughness	For 80% of all sections measured, IRI, throughout 98% of each section is less than or equal to 1.5 m/km (95 in/mile) IRI measured throughout 98% of sections is less than or equal to 1.9 m/km (120 in/mile)	Permanent repair	Within 6 months	Measured in accordance with the owner’s procedures for inertial profilers (to allow for measurement bias, an adjustment of 0.15 m/km (10 in/mile) is made for concrete pavements before assessing compliance
Distress	Pavement condition score for 80% of sections exceeding 90 for mainlanes and ramps	Permanent repair	Within 6 months	Measurements are completed using procedures, techniques and equipment consistent with owner’s PMS manual
Complex				
Roughness	Where roughness exceeds an IRI value of 2.5 m/km (160 in/mile) Where roughness over any traffic lane exceeds the cumulative distribution curve for IRI (Figure 2)	Undertake physical works to address non-compliance	12 months	IRI collected for each wheel-path per specifications and averaged
Distress	Where pavement surface deterioration over any traffic lane exceeds the cumulative distribution limits curve for pavement distress index (Figure 3)	Undertake physical works to address non-compliance	12 months	Ratings performed in accordance with the owner’s procedures with PDI calculated according to the owner’s pavement distress index model

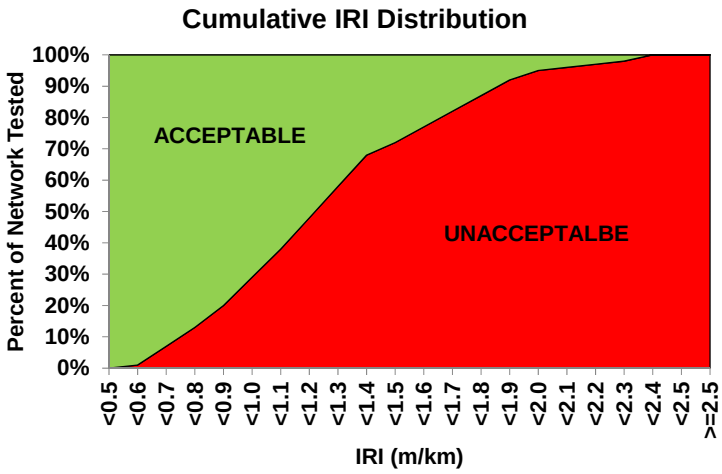


Figure 2. APPM Cumulative Distribution Curve for Roughness.

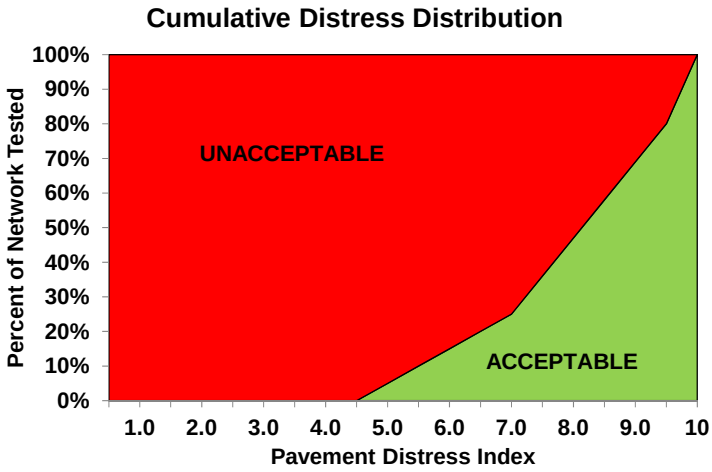


Figure 3. APPM Cumulative Distribution Curve for Pavement Surface Distress.

Regardless of the detail and complexity of the Key Performance Indicators (KPIs) and APPMs, most agencies "translate" the technical information into a more simple rating scale. The rating scales range from "good-fair-poor" to the simplest scale such as "pass-fail". These "general" rating scales are easier to use in explaining asset condition and investment needs to elected officials and the taxpaying public. An example reporting format (dash board) from the City of Ottawa, Ontario is shown in Figure 4 (Ottawa 2012).

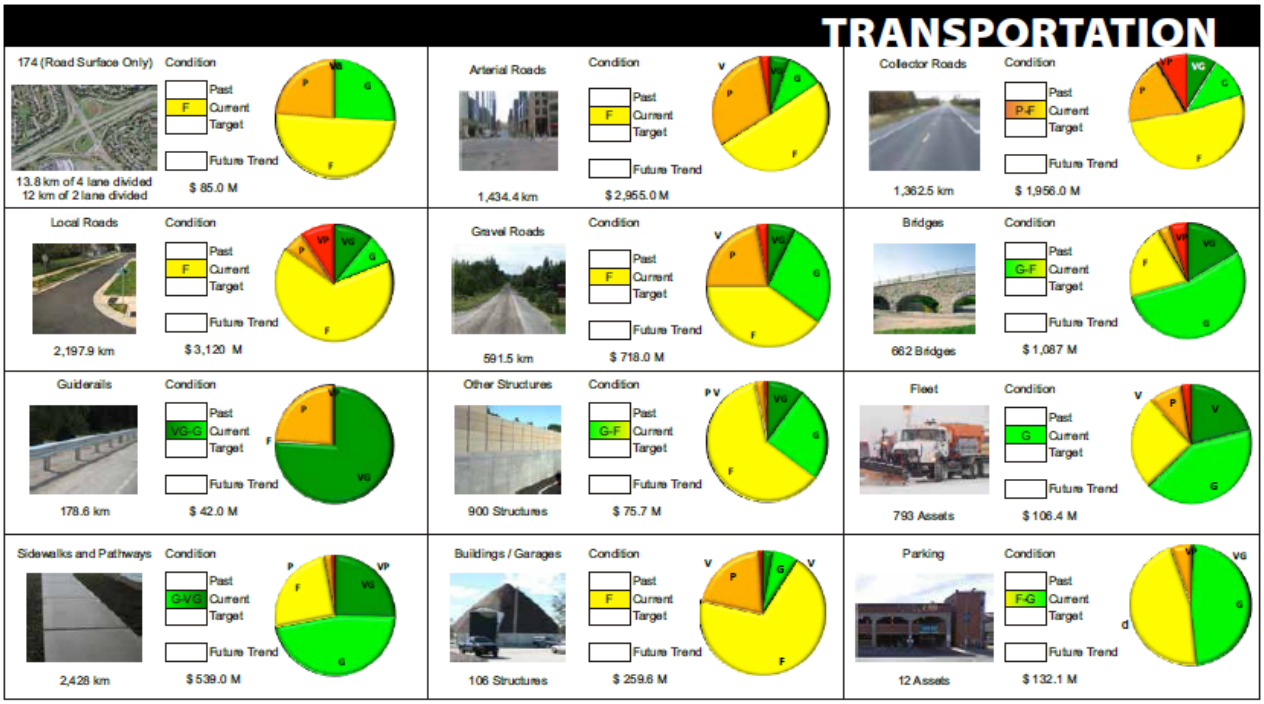


Figure 4. Asset Condition Distribution for Transportation Assets – City of Ottawa, Ontario.

The reporting shown in Figure 4 includes the distribution of current condition into five general categories ranging from very poor to very good, the past condition, the target condition (policy commitment by the agency), number of assets and the value of those assets.

Most agencies in Canada provide some level of information on the condition of the transportation infrastructure and the current and/or projected performance targets of the assets to help justify funding requests from elected officials or central agencies. For example, the Ontario Ministry of Transportation makes annual funding requests based on various funding scenarios in which funding requests are linked to the ability of the asset to meet performance targets (such as 85% and 67% good for bridges and pavements respectively) or highlight current performance of the asset based on current approved funding.

4. TOOLS TO ANALYZE INVESTMENT CHOICES

There is a large variation in the transportation asset management tools employed by agencies in Canada. The majority of agencies have different databases and software applications to manage their transportation infrastructure. The software systems used are typically commercial off-the-shelf applications, frequently modified for individual agency use. For most agencies, the most comprehensive system in use is for the pavement inventory. Pavement management is the most mature in Canada. The legacy of national coordinated efforts on pavement design and management date back to the 1950s and the Canadian Good Roads Association (CGRA) committee on pavement design and evaluation. This led to the Roads and Transportation Association of Canada (RTAC) Pavement Management Committee and the publication of the first *Pavement Management Guide* in 1977. Subsequently, the first two international conferences on managing pavement assets took place in Toronto, Canada in 1985 and 1987 respectively. The

current edition of the TAC *Pavement Asset Design and Management Guide* (2013) is one of the most widely used references on the subject in the world.

The Province of Alberta has the most comprehensive and integrated transportation asset management system, including an in-house asset management system (TIMS) that includes asset inventory, condition monitoring, performance modelling, risk analysis and costing all driven by a geographic information system (GIS) interface.

Over the last ten years, the Ontario Ministry of Transportation has implemented comprehensive programs for highway infrastructure assets using well developed principles and practices. The ministry has developed key asset management tools including a pavement management system and a bridge management system. The use of asset condition performance measures and targets in planning of rehabilitation investments ensures that the right investment is made at the right time in the right location over the long-term. The ministry is currently implementing an integrated asset management system in order to automate data extractions and manage pavement and bridge inventory data in one management system. In addition, the asset management system will integrate the program planning functions that are distributed geographically through five regional offices, and strategic level investment planning function under one system. This will provide the ministry with a tool to manage its assets on a provincial basis as one enterprise.

The City of Edmonton has separate systems for asset management components (roads, bridges, sidewalk, drains, traffic lights, etc.). The Sea to Sky Highway concessionaire has a centralized asset inventory and condition database for annual reporting of asset preservation performance measures to the Province. The City of Ottawa is in the process of completing the implementation of a comprehensive asset management (CAM) application. CAM is an integrated business approach involving planning, finance, engineering and maintenance and operations. The City of Calgary has adopted an approach that has integrated risk management and life cycle as the basis for their asset management.

Resources for transportation asset management vary widely across Canada. Some agencies have departments of asset management while others have identified a single individual with responsibility for asset management. Some have completed asset management gap analyses (e.g., Manitoba Infrastructure and Transportation and the City of Regina), to determine the necessary resources in terms of personnel, skills and software application to support their asset management objectives. The Region of Waterloo, in Ontario, is undergoing a reorganization to better align their services with asset management objectives. The majority of agencies in Canada use in-house developed systems or a combination of commercially available software and in-house systems for asset management. While most complete asset management activities in-house, others such as the Sea to Sky Highway concession use a combination of in-house and consulting engineering firms.

Most large Canadian transportation agencies have implemented GIS for pavement management. One example is Alberta Transportation's Transportation Infrastructure and Management System (TIMS). TIMS is a sophisticated web-based system that allows efficient user interaction with fully integrated data, information and expertise through internet enabled computers or wireless devices. The system uses a central data repository containing current and historical information. Data is accessed by both internal and, in some cases external clients, using integrated web based input, query, and analysis applications. This enterprise GIS, shown in Figure 5, provides a single consolidated data

warehouse architecture and the ability for clients to dynamically segment the road network based on attributes or performance criteria, query the database, and report the results.

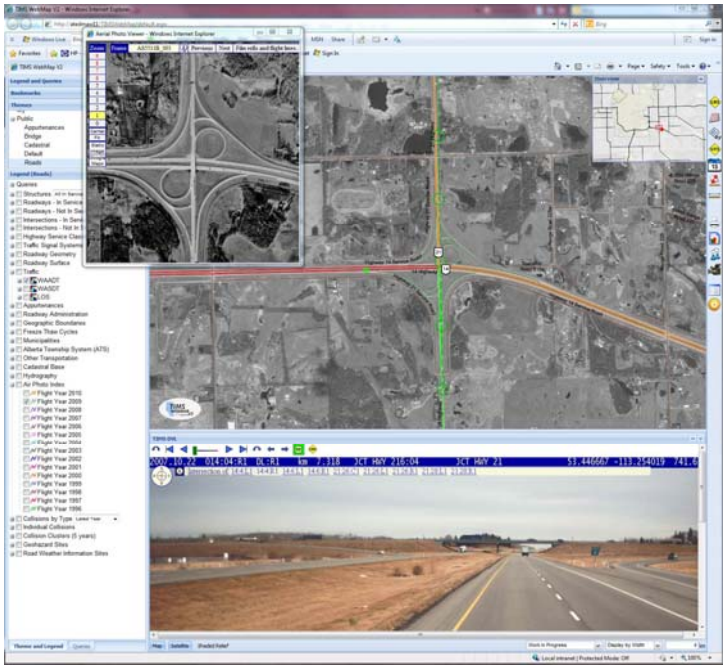


Figure 5. Alberta Transportation TIMS interactive Web environment.

At the municipal level, the GIS is rapidly becoming the user interface for all infrastructure related asset data. In some cases the infrastructure data and valuation is centralized. For example, the Ontario Good Roads Association (OGRA) has sponsored the development of Municipal Data Works (MDW). MDW is a web-based database and repository for asset inventory and condition information for bridges (317 municipalities), roads (234), Water Supply Systems (65) and Wastewater Systems (61).

While some agencies are working towards risk-based asset management and cross-asset optimization (between assets such as pavements and bridges), most still assess risk and optimization maintenance and rehabilitation programs within the individual asset classes, establish general program needs and budgets and then "customize" the final program based on local needs or other priorities. This is typically called "skilled intervention" looking at each asset class and making trade-offs or combining individual assets (such as pavements and bridges) when creating a work program or projects for delivery.

All of the agencies who took part in the TAC Synthesis of Asset Management Best Practices Study use asset management tools to complete funding impact analyses to determine the improvement or reduction in asset quality based on budget expenditures. This type of analysis supports budget requests or highlights impacts of budget restrictions on the condition performance of the assets.

5. USER SATISFACTION

A key factor in both the road authority's business plan and in a road asset management system itself is explicit recognition of stakeholder group interests through provision of service.

In terms of the understanding of the needs and expectations of stakeholders, most agencies have some sort of stakeholder surveys or public meetings to assist in meeting expectations. At the municipal level, stakeholders typically include the public, while at the Provincial level, the first-line stakeholders are typically regional offices or other government agencies with the public the end user and ultimate stakeholder.

For example, the Ontario Ministry of Transportation has immediate internal stakeholders for the Investment Strategies Branch (ISB) and the ministry regional offices. Annual asset management investment funding requests are developed by Central Head Office (ISB) and rehabilitation funding provided to regional offices. The program is developed and delivered by regional offices based on funding allocations provided. Ultimately the public and other stakeholder rely on a safe and reliable transportation network to ensure efficient movement of people and goods.

For the Sea to Sky Highway concession, the goals are set out by the Province of British Columbia. There is no direct relationship to the stakeholders (other than the Province), but the Province's requirements are intended to satisfy the stakeholders.

The City of Ottawa Asset Management Branch (AMB) has developed a comprehensive guide outlining the roles and responsibilities of the branch and to demonstrate the corporate linkages since many departments have a role to play in the overall management of the City's infrastructure assets. The AMB has also developed Service Understanding Agreements (SUA) with all client departments within the City. These define service expectations for different client groups.

The Vancouver transit authority (Translink) objectives are to maximize ridership, incur long-term ridership growth and provide access to transit services across the Vancouver region.

The City of Regina publishes a Roadways Preservation Flyer to explain the current City practices for pavement maintenance and rehabilitation. In addition, they complete a regular citizen survey to determine the public perception of the condition of the transportation assets within the City.

6. INVOLVEMENT OF CITIZENS IN DECISIONS

Other than providing annual state of the asset condition reports to citizens, few agencies include citizens in the asset management process, including decisions related infrastructure funding. Cities such as Regina, Saskatchewan have completed citizen surveys since 1988 which are used to assist with strategic planning, policy and program development and management of service (Regina 2009). Surveys of more than 500 households are completed by telephone. The condition of roads and sidewalks are frequently identified as one of the most important public issues facing Regina as a community.

There are a number of advocacy groups in Canada that are involved in infrastructure asset management to ensure that both provincial and municipal governments are being held accountable for the stewardship of Canadian transportation assets.

The Federation of Canadian Municipalities (FCM) has been the national voice of municipal governments since 2001. With over 2,000 members, FCM represents the interests of municipalities and program matters that fall within the federal jurisdiction. The FCM has

sponsored numerous applied research efforts to advance the state of municipal asset management in Canada.

The Ontario Good Roads Association was founded in 1894 and has substantially contributed to the leadership, advocacy and training for asset management in Ontario. The OGRA Academy was established to develop the skills and knowledge required to manage the financial, capital, and operational needs of public infrastructure assets.

The Canadian Network of Asset Managers (CNAM) is a national leader for infrastructure asset management. CNAM is a recognized source of knowledge, promotes innovation and collaboration, and provides a common voice to facilitate action. CNAM is a non-profit association, governed by a volunteer board of directors, established in 2009.

Asset Management British Columbia (BC) is comprised of local government representatives in administrative, technical, operational, financial, planning, and political disciplines as well as key industry associations. Currently, Asset Management BC is in the process of developing a toolkit for local governments which includes an asset management policy, self-assessment tool and roadmap. In the future, Asset Management BC will continue to facilitate educational opportunities, provide asset management resources and assist in knowledge transfer.

7. ACCOUNTABILITY

Many Canadian agencies are in the early stages of the development of their asset management plans. While there are some who have risk evaluation components for portions of their asset management plans, most plans are not advanced to the stage where an objective risk analysis can be completed. Alberta Transportation has identified a number of risks and opportunities that can be evaluated using rigorous engineering-economic-environmental evaluation of the programs. Saskatchewan Ministry of Highways and Infrastructure (MHI) staff meet annually as a part of their business process to discuss the effectiveness of their pavement preservation treatments. The Region of Waterloo has developed a corporate risk management framework.

Many agencies in Canada produce an annual state-of-the-infrastructure report (report card). Alberta Transportation has developed a network performance evaluation and decision application tool to support their TIMS in identifying and fine tuning performance measures. The Ontario Ministry of Transportation uses Results-based-Planning to report on asset performance. The Ministry also publishes annual reports noting past years accomplishments plus the planned highway work projects for the upcoming five years (Northern and Southern Highway Programs). The City of Edmonton developed an award-winning risk-based asset management system. The Region of Waterloo has developed, documented and reports on asset management objectives. While most agencies produce a report on an annual basis, the City of Calgary publishes theirs on a three-year basis.

Few agencies reported the standard practice of “auditing” asset management practices. The Saskatchewan MHI reported that they did audits of the compliance of strategic models in accordance with the asset management procedures. The Sea to Sky Highway concessionaire has a quality auditor on-staff to review work completed both internally and for retained consultant and contractor work.

The City of Ottawa AMB Reference Guide outlines all of the practices, processes and controls of the group to deliver the asset management program. In 2013/2014, the AMB

has documented asset management branch business model with intermediate level process models for all core asset management systems in the branch.

8. EXAMPLE - ASSET MANAGEMENT BUSINESS PROCESS, ONTARIO MINISTRY OF TRANSPORTATION

The Ministry of Transportation (MTO) strives to be a world leader in moving people and goods safely, efficiently and sustainably to support a globally-competitive economy and a high quality of life.

MTO is charged with the stewardship of assets that have a replacement value of approximately $80B. Pavements and bridges account for 88% of that replacement cost. It is critical that these two asset types are maintained in good repair to ensure the safe and efficient movement of people and goods, and to promote economic development. Sound asset management principles dictate that to obtain a high level of value for money and to maximize benefits over their lifespan, these assets must have regular rehabilitative maintenance performed to avoid or delay the need for larger more costly reconstruction or replacement.

The two major asset inventory and management systems are the Pavement Management System (PMS2) and the Bridge Management System (BMS) / Bridge Priority Tool (BPT). In the last five years the BMS and the PMS2 have undergone substantial upgrades. Most recently, the ministry is including partial integration of bridge management features into PMS2 to develop MTO's new Asset Management System (AMS).

The PMS2 contains an inventory for all pavement sections – their associated condition (Pavement Condition Index), history of construction and pavement design. It is a very powerful tool; using various deterioration models, decision trees, cost models and lifecycle models to perform various analyses.

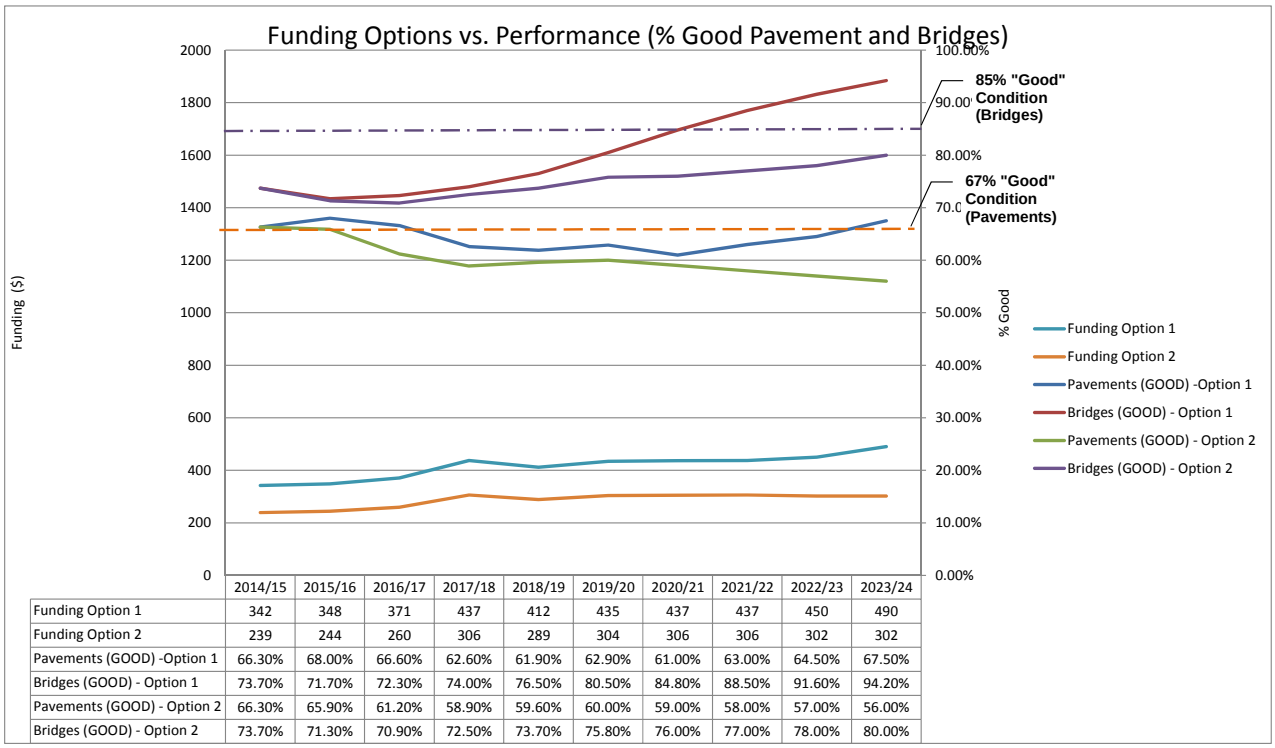
The Bridge Management System contains the inventory of all structures including bridges and culverts with spans over 3m and their condition. This includes the condition of various elements of a structure and their associated replacement value. The information is used to calculate the overall Bridge Condition Index (BCI). The condition data and inventory information from BMS is downloaded for use in the Bridge Priority Tool (BPT) which determines the long-term bridge rehabilitation needs.

Both PMS2 and BMS/BPT are state of the art tools and the information and analyses they perform are used to develop the rehabilitation needs for pavements and bridges on annual basis. Both contain an accurate inventory of bridges and pavements. Condition is measured every year for pavements and every two years for bridges.

Asset management tools and principles are used by MTO to make annual funding requests from Central Agencies. MTO bases its highway needs calculations and funding requests on meeting specific performance measures for pavement and bridge condition. The performance targets for pavements and bridges in Good condition are 67% and 85% respectively (example of various funding scenario vs. performance is provided in Figure 6). Asset management tools are also used to quantify asset performance based on funding scenarios, including current approved funding from Central agencies.

Once funding approvals is received (10 year outlook), funding allocations are provided to regional program delivery offices. Regional offices develop and deliver the multi-year capital rehabilitation program. Accomplishments related to the amount of pavements and bridges rehabilitated annually are reported to the Central Agencies.

MTO continues to explore opportunities to improve its asset management practices by researching and evaluating other jurisdictions' asset management practices, and reviewing / assessing current MTO asset management procedures and practices.



	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Funding Option 1	342	348	371	437	412	435	437	437	450	490
Funding Option 2	239	244	260	306	289	304	306	306	302	302
Pavements (GOOD) -Option 1	66.30%	68.00%	66.60%	62.60%	61.90%	62.90%	61.00%	63.00%	64.50%	67.50%
Bridges (GOOD) - Option 1	73.70%	71.70%	72.30%	74.00%	76.50%	80.50%	84.80%	88.50%	91.60%	94.20%
Pavements (GOOD) - Option 2	66.30%	65.90%	61.20%	58.90%	59.60%	60.00%	59.00%	58.00%	57.00%	56.00%
Bridges (GOOD) - Option 2	73.70%	71.30%	70.90%	72.50%	73.70%	75.80%	76.00%	77.00%	78.00%	80.00%

Figure 6. Funding Options vs Performance

9. SUMMARY

Roadway agencies in Canada are at various levels of maturity in the implementation of transportation asset management programs and systems. While in general, provincial highway agencies and the larger cities are more advanced as they have more resources than smaller municipalities, strong leadership and champions within the agencies are moving forward to implement comprehensive systems to assist in the stewardship of our aging infrastructure.

There is a strong movement in Canada for agencies to integrate investment planning and programming and move away from traditional silo-based infrastructure management systems into one comprehensive system. A move to systems that track asset performance from construction to retirement and use life-cycle cost to make whole life maintenance and rehabilitation investment decisions. These systems report on achievements in maintaining and improving asset condition as measured by key performance measures.

10. REFERENCES

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