Analyzing Approaches Used by Ontario Municipalities to Develop Road Asset Management Plans: Initial Insights

Report

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Executive Summary

Ontario has made significant progress in increasing awareness of asset management planning throughout its municipalities. This included a substantial effort on behalf of the government, non-governmental organizations (NGOs), and many professional and educational institutes in spreading the culture as well as developing guidelines and best practices. These efforts culminated in enacting a mandate to develop asset management plans and tie them to access to provincial funding—an extremely progressive policy.

Over the last two years, 400+ municipalities in Ontario successfully developed and published asset management plans. These asset management plans provided an opportunity to study the nature and depth of the culture, understanding, and the logistics of asset management in Ontario.

While our analysis focused only on the road sector, it is obvious that there is an adequate understanding (in fact, a belief) in the concept of asset management and its importance. However, a few gaps need to be bridged before we can adequately conclude that asset management has moved from the stage of “we believe in it and understand that we need it” into a stage of “we understand how to do it, are implementing it and it drives our decision making”; as adequately stated by one of our interviewees. Chief among these gaps are the following (please note that these are limited to the scope of this study and should not reflect a general finding regarding the overall implementation of asset management practices in Ontario):

The lack of adequate human resources: it is obvious that there are insufficient staff resources to handle the work required to drive the development of the plans let alone the actual implementation of asset management systems. Many smaller municipalities, do not have staff that can be dedicated to handling the task. In many larger municipalities, existing staff is overwhelmed by other tasks. In both cases, and in particular smaller municipalities, it is very difficult to qualify and/or find adequately qualified staff even if financial resources are available.

Lack of a common asset management model: while the Ontario directive has specified a common outline for asset management plans, there is no clear guidelines to help municipalities in conducting technical aspects of plan development. While it is not expected from the Province to develop a standardized means for conducting each step (such as data collection, deterioration modelling, financial forecasting, etc.), having common technical specifications is helpful. The means by which many municipalities have conducted these tasks differ widely even though many of them shared the same boundary conditions. Many municipalities did not have the ability to evaluate the merit of different approaches and ended up using “what seemed logical.” This will create a major problem in the future for any decision maker—how will they be able to compare the findings of these reports? More importantly, how will they be able to evaluate the reliability of these findings?

Inadequate use of technology: while the gaps outlined above are long-term issues and could consume extensive effort, the use of standardized technologies in data collection and representation is a quick and very efficient first solution towards addressing these gaps. Municipalities used a variety of methods for data collection (with varying degrees of reliability) and different data standards for representing data—which can make future analysis of performance and comparisons of asset conditions across the Province a very difficult task.
Based on the findings of this report, it is obvious that Ontario needs to progressively invest in creating the technical specifications for asset management practices and promote the development of human resources. Some of the options that should be considered for further investigation include issuing a set of flexible specifications for interoperability in representing asset data attributes (from location, to conditions, to costs, etc.). This approach should be coupled with a clear manual on the methods of using such data for assessing conditions, remaining life, and estimating maintenance costs. The Province can even consider developing a cloud-based smart system that requires municipalities to upload their standardized data to its server which would return relevant analysis. Asset management issues are similar and as such using standardized (yet flexible) data representation and collection methods as well as streamlined analysis tools make sense.

The main roles of the Province in the next phase, it can be argued, are to support interoperable representation of data, pool resources to foster active use of such data, and invest in the training of existing and new staff.

**Acknowledgements**

We would like to acknowledge the support of Marmak IT and Ontario Good Roads Association (OGRA) through providing the required resources and reviewing this document at its various stages. We also thank representatives from various municipalities for voluntarily participating in the survey.
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Introduction and Purpose

Municipal asset management refers to the efficient, long-term analysis of civil infrastructure systems to optimize their performance from engineering, economic, and environmental perspectives. Asset management planning is a sustained systematic process of designing, operating and maintaining assets/facilities effectively. It streamlines decision-making through the life cycle of an asset to provide the best value to system users and an optimum budget performance. Asset management is tied to a “best value” and “service delivery” model which encompasses the following paradigms (Esmaili 2012):

- **Service delivery**: addressing the social, environmental, and economic needs of stakeholders;
- **Life cycle approach**: assessing the operating and maintenance requirements, and the implications of eventual replacement or retirement of assets;
- **Integrated approach**: coordinating service delivery, across all assets and all governmental agencies by looking beyond stewardship of individual assets and examining the collective performance of the total asset base during decision making; and
- **Accountability for asset investments**: requiring and providing greater transparency and quality in accounting and reporting practices.

The practice of asset management gained momentum in the last two decades with the realization of the pressing need to preserve our infrastructure, which is deteriorating at an increasing rate. However, knowledge about asset management is relatively new in Ontario with drastic variances in the aptitude and capacity to understand and develop asset management plans. Lately, the Government of Ontario has tied provincial funding to the development of asset management plans. This includes requirements for collection of data, assessment of current state of infrastructure systems, and assessment of needed changes along with investments. A summary of the Province's directive is available in Appendix A: Ontario's Asset Management.

This study maps current asset management plans to a set of criteria, and looks beyond the plans themselves with emphasis on the process used to develop the plans. The scope of this study is limited to roads and bridges, and some emphasis is placed on municipalities with very small (less than 10,000) and small (between 10,000 and 50,000) population sizes.

This report describes the method and outcomes of this study which involved a review of a sample of asset management plans by municipalities in Ontario. The report presents criteria suggested for categorizing current plans while taking into consideration municipality sizes, the level of detail of the asset management plan, and the comprehensiveness of the plan development process. These criteria were used for assessing current asset management plans and development methods, and more importantly as a guide to municipalities for developing future plans and updating current plans.

This assessment produced a number of recommendations including a shift in direction towards more scenario-based planning and user-based definition of levels of service. More importantly, it is evident that a standard for asset management plans is a necessary tool for moving forward, especially with respect to data management and exchange.

Objectives and Methodology

Municipalities in Ontario have developed asset management plans per the provincial directive. However, there was no standardized method or process for developing these plans. A wide range of diversity exists
in the submitted plans in terms of structure, level of detail, and overall goals. Analyzing these plans presents a unique chance to understand the manner by which municipalities perceive, understand and conduct their asset management planning. If analyzed effectively, the plans could also be a source for identifying needs of municipalities and exposing gaps in provincial support programs.

This study aimed to develop a macro-level analysis of the asset management plans submitted by Ontario municipalities. This includes:

1. **Sampling:** this step was necessary as it was not feasible to analyze over 400 plans in a short time frame. The first task was to select a representative sample of asset management plans that span the main categories of municipalities: large and small, urban and rural, recent and older (developments).

2. **Analysis of the plans:** reviewing the selected plans and developing an analysis of the following aspects:
   a. **Structure of the plans:** what were the contents of the plans?
   b. **Data collection methods:** what means were used to collect data?
   c. **Data models:** is there consistency in definitions of asset attributes?
   d. **Deterioration modelling:** what tools were used to estimate the level of service (LoS), current conditions, and expected life of infrastructure systems?
   e. **Cost estimation:** what parameters and approaches were used to estimate the budgets required for rehabilitating existing systems?

**Selecting Municipalities**

Ontario hosts 444 municipalities that vary in size from the City of Toronto, its largest municipality, with 2,615,060 residents (2011 census) to much smaller municipalities with fewer than 5,000 residents.

In selecting municipalities for analysis, we used the following categorization approach:

1. **Size:** we divided municipalities into four categories: large, medium, small, and very small. Very small municipalities are those with populations of 10,000 or less, forming most of the municipalities in Ontario. Small municipalities are those between 10,000 and 50,000 in population while medium municipalities are those between 50,000 and 150,000. The smallest number of municipalities represented are large municipalities with over 150,000 inhabitants.

2. **Location:** we generally categorized municipalities as northern and southern with the aim of maintaining a proper geographic spread.

3. **History of asset management planning:** the selection of municipalities in this category was the most subjective in this study. It depended on anecdotal evidence and input from experts about municipalities that have had a track record of using and implementing asset management plans.

4. **Implementation of data management:** Municipalities that have implemented data management software packages were categorized separately. This categorization provides a chance to investigate correlations with the use of various software packages.
A total of 24 municipalities were selected for review, including one county. Of these municipalities, some were selected for further surveying through predefined questions (Appendix C: Supplementary Survey). These municipalities were divided into four categories based on their population as shown in Figure 1. The municipalities are also categorized based on their municipal status as shown in Figure 2.

Figure 1. Number of municipalities analyzed by population category

Figure 2. Number of municipalities analyzed by municipal status
Analysis: Rating System
In addition to the initial analysis, a score was assigned to each of the five primary sections of the plan. A 5-point scale was used to indicate whether the coverage of each subject is addressed adequately, if at all, and if it was addressed in a comprehensive manner. The objective of using this rating system is to facilitate a comparison within broad municipal categories, rather than rating individual plans. The result of this rating are presented in broader categories as a tool for municipalities to identify where they fall with respect to similar municipalities and how their plans can be further developed.

An example of this rating system is illustrated in Table 1. The rating sheet components and full list of rating scales are provided in Appendix B: Evaluation Criteria.

Table 1. Description of rating levels for the structure of the plan

<table>
<thead>
<tr>
<th>Plan Structure</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Inadequate</td>
<td>Plan contains a list of unstructured elements; no vision</td>
</tr>
<tr>
<td>2. Evidence of Presence</td>
<td>Most components are present without a satisfactory level of detail; no vision</td>
</tr>
<tr>
<td>3. Adequate</td>
<td>Presents vision; rating criteria; condition assessment; plan has structure that is adequate but lacks crossreferencing between sections or references to data</td>
</tr>
<tr>
<td>4. Somewhat Comprehensive</td>
<td>Well-structured with vision but may lack reference to vision in other sections or extensive details of data modelling and collection</td>
</tr>
<tr>
<td>5. Comprehensive</td>
<td>Very well-structured; vision cited; references to LoS and data models</td>
</tr>
</tbody>
</table>

Aggregated Analysis Results

Structure
A typical structure included an introduction, qualified and quantified state of infrastructure, current service levels, and an overall asset management strategy. Almost all plans contained financial plans. Larger municipalities with a longer history in asset management also presented a historical overview accompanying level of service definition and condition rating with awareness of targets. These municipalities also included a more advanced financial plan consisting of financial projection and financial strategies to close the gaps, with several recommendations for every part of the plan.
Levels of Service (LoS)
In some cases, municipalities were more concerned with basic condition assessment and LoS definition was missing; this was more common for municipalities in early stages of asset management. Basic LoS definition was common in medium-sized municipalities as well as some larger municipalities, with minimal customer involvement. More advanced LoS definition was less commonly used by larger municipalities focusing on defining services based on user-defined parameters.

All municipalities either mentioned or defined a basic form of Levels of Service. In the context of roads and bridges, Minimum Maintenance Standards for Municipal Highways were used to define LoS in many cases with an emphasis on the physical aspects. Larger municipalities incorporated some level of community consultation but generally limited attention was placed on the customer satisfaction with the services provided. There is limited evidence that the LoS definition has impacted the decision making and planning process.

Data Management and Representation
A number of smaller municipalities relied on casual staff such as summer students for data collection over a limited period of time. Larger municipalities were able to allocate dedicated staff, or additional tasks to operators, for defined time frames and monitoring intervals. Data management systems seemed to improve the ability of municipalities of all sizes to identify gaps and address them.

Several asset management plans contained no reference to data collection methods. Some of the plans also relied on manual collection with limited use of geographic information systems (GIS) or data management software. There is no simulation or modelling of the network or traffic system in many cases and no clear mention of methods or measures used. Measurements in some cases used rating systems from 'good' to 'fair' to 'poor' that were simple yet easier to communicate. However, these measures seem to present a challenge in maintaining objective data inventories across time and locations. For roadways some data collection was comprehensive and compiled across different time periods, especially for larger municipalities. For sidewalks in some cases an age-based analysis was performed due to the lack of data on conditions. In the case of bridges and culverts, an inspection for the bridges and culverts was completed either manually or through the use of imaging.

Deterioration Modelling
Many municipalities depended on deterioration curves in place of more formalized analysis or assessment of overall deterioration. In a few cases where more sophisticated models were used, probability of failure or expected life of each facility/asset were not supplemented to condition assessment. Cross-system assessment of deterioration and expected life was also absent from many of the plans despite its importance in budget planning. Generally, the level of detail used to describe the methodology for this section as well as data collection and budget estimation was not sufficient to break down the results according to methodology-based categories.

Cost Estimation and Budgets
Most budgets were based on historical costs, while future scenario planning absent in many plans. Consultants seemed to improve the ability of municipalities to plan using specific scenarios and identifying associated costs.
All asset management plans contained an estimate of the required investments (costs) to meet rehabilitations and replacements for assets included in the plans. Quantitative data about the distribution of sources such as taxes and user-based fees were not available in some cases. Some municipalities sought to develop a municipal cost index (MCI) to include inflation and the purchasing power of local government. The use of grants was also considered as a source of funding by some municipalities.

**Results Aggregated by Municipal Status**

The Ontario Ministry of Municipal Affairs and Housing classifies municipalities into a structure where some municipalities have a single tier structure while others have an upper and lower tier that differentiates the services provided.

**Upper-Tier**

According to Ontario's 2001 Municipal Act, an upper-tier municipality is one with two or more lower-tier or single tier municipalities. This status usually represents counties or regional municipalities. Only one municipality was analyzed at this level; hence it is not being compared in this type of aggregation.

**Lower-Tier and Single-Tier**

Lower-tier municipalities form part of an upper-tier municipality while single-tier municipalities, which are fewer in Ontario, are those that are not part of an upper municipality. Our analysis shows that single-tier municipalities generally developed plans with a more enhanced structure and better defined levels of service compared to lower-tier municipalities.

The results of this assessment are summarized in Table 2. Rating scores are on a 5-point scale rounded to the nearest 0.5 points.

<table>
<thead>
<tr>
<th></th>
<th>Single-Tier</th>
<th>Lower-Tier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Level of Service</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Data Collection</td>
<td>2.5</td>
<td>3</td>
</tr>
<tr>
<td>Deterioration Modelling</td>
<td>3.5</td>
<td>3</td>
</tr>
<tr>
<td>Cost Estimation</td>
<td>3.5</td>
<td>3</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td><strong>3.5</strong></td>
<td><strong>3</strong></td>
</tr>
</tbody>
</table>

**Results Aggregated by Municipal Population Size**

As mentioned in our methodology section, municipalities were also analyzed based on their population size into four groups. The following are general observations followed by the scores for each category presented in Table 3.

Municipalities with populations smaller than 10,000 inhabitants were the most represented group. The variation within this group resulted in an average rating that was similar to other categories. However, many municipalities within this group scored lower for deterioration modelling and level of service. Interestingly, municipalities in the next category with populations between 10,000 and 50,000 inhabitants
scored lower overall. This was mostly due to some inadequate plan components in the areas of deterioration modelling and data collection. Larger municipalities scored higher in terms of structure and data collection, with municipalities with the largest populations scoring highest especially due to the incorporation of more extensive funding and cost estimation plans.

<table>
<thead>
<tr>
<th>Table 3. Rating scores by population size</th>
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<tbody>
<tr>
<td>Structure</td>
</tr>
<tr>
<td>Structure</td>
</tr>
<tr>
<td>Level of Service</td>
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<tr>
<td>Data Collection</td>
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<tr>
<td>Deterioration Modelling</td>
</tr>
<tr>
<td>Cost Estimation</td>
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<tr>
<td>Overall</td>
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</table>

It is important to note that the subjectivity of these scores and rounding presents a limitation to further analysis based on the scores. A qualitative analysis was used alongside the rating system to drive more solid conclusions.

**Interviews and Surveys**

A number of municipalities agreed to engage in a more detailed analysis through the survey presented in Appendix C: Supplementary Survey. This survey allowed us to investigate the five assessment categories in more depth to arrive at the factors involved. The following observations presented common points across most responses:

- All were aware of the required structure of the plan through guidance provided by the Province.
- It was indicated that very little support was provided beyond the guide, and very limited feedback was provided once the plans were complete.
- Consultants were usually hired due to the limited staff size or limited capacity to perform the work.
- Where an independent consultant was not hired, cost reduction was a major factor in addition to a desire to develop internal capacity for future planning.
- Roads and bridges were usually the most covered in terms of data in comparison to other assets.
- Those that were involved in projects such as PSAB 3150 indicated they found it easier to retrieve data they had already collected but many relied on historical records which could be outdated.
- Most municipal representatives expressed confidence in their data, especially when field observations and GIS were involved.
- Those teams that had a data management system indicated they were more consistent in gathering data regularly, and had more confidence in their data.
Analysis and Conclusions

This study highlighted the diversity of asset management plans in Ontario as a reflection of the variations between municipalities across the province in terms of size, asset classes, among other contextual parameters. These municipalities followed different methods to produce asset management plans to map their assets and the way they are managed. This study also revealed a number of other patterns in terms of differences in data collection methods. The availability of data was a major deficiency in some cases, and this pattern manifested itself along two dimensions: 1) outdated data, and 2) gaps in data for certain assets or geographic regions. Some municipalities launched programs to update data since readily available data was limited to the time of installation of certain assets.

Several municipalities used the aid of a consultant, especially for specifying future scenarios and estimating costs. Those that didn't use the aid of a consultant mostly limited their work to collecting inventories and basic modelling using data management and GIS software.

Generally, linking classes of assets across local zones or across road networks provided municipalities with a more efficient way of managing their assets. This was reflected in their strategic plan support in some cases. Levels of service definition did not necessarily improve data collection. However, there may be a correlation to how current the data is and the diversity of data points in terms of sources and metrics.

Larger municipalities within dense urban regions seemed to have more comprehensive data sets linked to levels of service. This can probably be attributed to their wider funding base. However, many of these justifications would need further investigation.

The plans are mainly well structured and contain the essential elements of an asset management plan. Most of the plans contain a summary, introduction and a set of visions. Furthermore, the infrastructure assets are categorized and the essential elements are expanded for each category of asset. To this end the provincial directive succeeded: most municipalities know the components, and what is needed to develop an asset management plan.

A substantial number of municipalities have retained a consulting engineering company to develop the plan. This is the first clear finding of this study: adequately trained human resources is the foremost and possibly most challenging issue for the success of asset management in Ontario.

Most of the municipalities presented a comprehensive inventory (especially for the roads and bridges) data consisting of the name of the assets, their value, condition and location. It is clear that much progress has been done in tracking municipal assets. Less has been done in adequately describing them. Performance indicators mainly represent the physical condition of the assets. None of the municipalities developed an acceptable advanced deterioration model for their infrastructure. There is limited or no formalized analysis or assessment of overall deterioration (probability of failure or expected life) of each asset. There is no integrated formal modelling of the system deterioration reflected in the plans nor is there cross-system assessment of deterioration and expected life. There was also a lack of robust quantitative safety measures, while some plans were missing real condition data of the assets.

Levels of service are not well defined in a large number of the plans. For those who included a fairly good definition, expected or desired levels of service are mainly attained through documents developed in industry or provincial or national regulations. Evidently, customer expectations did not play a key role in
determining these levels. It is likely that municipalities can take advantage of some guidance in terms of clear specifications for models of performance analysis and management of levels of service.

Municipalities mainly used manual methods for data collection. While a few municipalities used a standardized data model to represent their data, the majority relied on spreadsheets. Several municipalities used Geographic Information System (GIS) for recording inventory data. However, some of the municipalities do not mention the methods and tools of data management. It is also alarming that most municipalities did not include a sufficient evaluation of data quality or confidence levels as part of the plans.

This is clearly an area where the Province should invest very quickly. As part of this strategy, the Province should develop interoperable data standards and common information exchange systems to support the effective collection of infrastructure data and its interoperability for easier communication. Creating such common standard (as shown by many other industries) is one of the best government investments that can be carried out at the moment. It pools resources, creates a common language, enables comparative analysis and synthesis of infrastructure systems. These elements are needed to assure effective decision making and better communication with stakeholders.

In terms of budgets and funding, all municipalities presented an asset management strategy to plan the schedule and cost of maintenance and rehabilitations. Most municipalities attempted to tackle infrastructure deficits by incorporating a priority list for the maintenance, rehabilitation and replacement of their assets. Some of the municipalities also implemented a suitable quantitative risk assessment technique to determine the priorities, while others determined risk through a subjective or qualitative approach.

The financial strategies developed by most municipalities were satisfactory. These financial strategies mainly contained an estimate of the costs of maintenance, rehabilitation and replacement of the infrastructures and the available revenues and budgets. The plans also provided available sources to finance the infrastructures in some cases. Common sources included: infrastructure levy, debts, user fees, reserves, grants and assistances from federal or provincial government.

Finally, we emphasize that this report should not be looked at as an evaluation of the asset management plans of individual municipalities. It is rather a framework to develop these plans further through better knowledge of the neighbouring landscape, and area that need improvement.
References


Appendix A: Ontario's Asset Management Investment Strategy

Ontario's Municipal Infrastructure Investment Initiative provided a motive for municipalities to structure their infrastructure planning on the local level. This motivation took the form of a requirement to develop asset management plans by December 2013 for access to provincial funding as part of the initiative. This investment initiative is now permanently part of the provincial strategy as the Ontario Community Infrastructure Fund as part of plans to invest over $130 billion over the next 10 years in the development, maintenance and revitalization of public infrastructure.

The Province also provided a detailed document, "Building Together: Guide for Municipal asset management plans," to support municipalities through the process of developing their asset management plans. This guide provides a number of resources, including but not limited to:

- Tips on developing Asset Management Inventories
- Elements of an Asset Management Plan
  - Selected primary components:
    - State of local infrastructure
    - Desired levels of service
    - Asset management strategy
    - Financing strategy
- Sample reports
- A self-assessment checklist

The guide along with the tips and checklists provided municipalities with a set of important questions that drove the development of asset management plans. However, as mentioned in this report the resulting plans did not conform to a standard beyond the main document structure.

More details are available at:

Appendix B: Evaluation Criteria

Our evaluation criteria followed a unified template (Table A) for assessing all plans. The rating for each criterion followed a 5-point scale as shown in Table A.

Table A1. Assessment Template

| Municipality Name | Population | Link to AM Plan |

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Description</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure of the plan</td>
<td>What were the contents of the plan?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defining Levels of Services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data collection methods: what means were used to collect data?</td>
<td>Modelling and Managing data</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Levels of Confidence in Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Data collection methods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deterioration modelling</td>
<td>What tools were used to estimate the level of service, current conditions, and expected life of infrastructure systems?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost estimation</td>
<td>What parameters and approaches were used to estimate the budgets required for rehabilitating existing systems?</td>
<td></td>
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</tbody>
</table>
## Table A2. Criteria 5-point scale

<table>
<thead>
<tr>
<th>Plan Structure</th>
<th></th>
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<tbody>
<tr>
<td>1. Inadequate</td>
<td>Plan contains a list of unstructured elements; no vision</td>
</tr>
<tr>
<td>2. Evidence of Presence</td>
<td>Most components are present without a satisfactory level of detail; no vision</td>
</tr>
<tr>
<td>3. Adequate</td>
<td>Presents vision; rating criteria; condition assessment; plan has structure that is adequate but lacks cross-referencing between sections or references to data</td>
</tr>
<tr>
<td>4. Somewhat Comprehensive</td>
<td>Well-structured but may lack reference to vision or extensive details of data modelling and collection</td>
</tr>
<tr>
<td>5. Comprehensive</td>
<td>Very well-structured; vision cited; references to detailed LoS and data models</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Levels of Service</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Inadequate</td>
<td>No or limited mention of LoS</td>
</tr>
<tr>
<td>2. Evidence of Presence</td>
<td>LoS weakly defined and not linked to other aspects of the report</td>
</tr>
<tr>
<td>3. Adequate</td>
<td>LoS defined for some but not all sectors</td>
</tr>
<tr>
<td>4. Comprehensive</td>
<td>LoS defined traditionally and tied well to condition assessment</td>
</tr>
<tr>
<td>5. User-driven</td>
<td>LoS is well-defined and linked to customer satisfaction</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data Collection</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Inadequate</td>
<td>No or limited mention of data collection</td>
</tr>
<tr>
<td>2. Evidence of Presence</td>
<td>Limited discussion of data collected without a discussion of methods and tools</td>
</tr>
<tr>
<td>3. Adequate</td>
<td>Discussion of data collection methods but no mention of tools used to manage data</td>
</tr>
<tr>
<td>4. Somewhat Comprehensive</td>
<td>Adequate discussion of data collection tools, methods and level of confidence</td>
</tr>
<tr>
<td>5. Comprehensive</td>
<td>Detailed discussion of data collection tools, methods and level of confidence</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Deterioration Modelling</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Inadequate</td>
<td>No or limited mention of deterioration modelling</td>
</tr>
<tr>
<td>2. Evidence of Presence</td>
<td>Limited discussion of deterioration process and accounting</td>
</tr>
<tr>
<td>3. Adequate</td>
<td>Discussion of deterioration modelling but no mention of tools used</td>
</tr>
<tr>
<td>4. Somewhat Comprehensive</td>
<td>Adequate discussion of deterioration modelling and tools and methods used</td>
</tr>
<tr>
<td>5. Comprehensive</td>
<td>Detailed discussion of deterioration modelling, tools and limitations</td>
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<tr>
<th>Cost Estimation</th>
<th></th>
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<tbody>
<tr>
<td>1. Inadequate</td>
<td>No or limited cost estimation or budget</td>
</tr>
<tr>
<td>2. Evidence of Presence</td>
<td>Budget and cost estimates present</td>
</tr>
<tr>
<td>3. Adequate</td>
<td>Adequate discussion of cost estimates in addition to tables</td>
</tr>
<tr>
<td>4. Somewhat Comprehensive</td>
<td>Discussion of cost estimates includes investments and alternative scenarios</td>
</tr>
<tr>
<td>5. Comprehensive</td>
<td>Discussion of cost estimates includes investments and alternative scenarios, and distribution of finance resources and sources</td>
</tr>
</tbody>
</table>
Appendix C: Supplementary Survey

Asset Management Plans - Analysis Form

Thank you for dedicating some time to assist with this process. We are moving ahead with a review of asset management plans, and we have a number of municipalities of similar size who agreed to join us in this effort. Please take some time to note down a few comments for each of the following areas:

The Planning Exercise

Assess the value and lessons learned in developing the plans?

Questions to consider:

- Did you use additional support from a consultant? Why: do you have enough staff; how proficient is your staff with asset management concepts and tools?
- Did you receive enough support from relevant organizations (the Ministry, OGRA, etc.)? Now that you are finished with the plan, what needs do you have from relevant organizations? What tools/support do you need the most?
- What major changes (in staffing and work processes) have resulted or did you decide to install based on the experience of developing the plans?
- Did the size of your municipality require any special considerations or adjustments in all of the above?
Data Collection

How were data collected, modelled, and represented?

Questions to consider:
- How far back did they go with data collection and archiving?
- How would you rate the level of confidence in these data? How was it measured (if applicable)?
- What were some of your data collection methods (for example, field observation, SCADA, CCTV)?
- Have you used any specific software for documenting data? Have you used any data standard for representing the data?

Deterioration Modelling

What tools did you use for modelling? Which technologies did you depend on?

Questions to consider:
- What definitions indices did you use in measuring/assessing performance and/or levels of services?
- How did you use the data to predict remaining life and level of services?
Cost Estimation and Budgeting

How were budgets estimated? What tools were used?

Questions to consider:
- Why did you choose to use this method for developing the budget?
- What limitations did you encounter in presenting this information?

Additional Comments

Please include any additional information or comments in reference to your responses above.

Other questions to consider:
- Who uses the data management systems? Who inputs this information?
- Who uses the reports? What was excluded? And what determined which aspects of asset management to include?
- Any ideas to enhance the effectiveness of asset management plans in your context