Improved Decision-Making Through Effective Asset Management

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Abstract

This paper explores the idea of roadway inventory management from an enterprise-wide perspective and, overviews some real-life examples of municipalities—like Region of Waterloo and City of Hamilton, Ontario—who are using this enterprise approach. Whether it is a linear or segmented data model, providing your engineers with a complete picture of your roadways, including inventory of all related asset infrastructure, is critical to maintenance management. Also covered in this paper are considerations for applying condition assessment tools and strategies to your major roadway assets, such as pavement, for deterioration modeling, rehabilitation analysis and tracking the surface condition of your roadways. The results of an effective Pavement Management System can enable you to accurately predict your roadway capital and rehabilitation expenditures several years into the future.

Key Words: Enterprise, Asset, Pavement, Condition, Expenditures

WHAT ARE THE KEY STEPS TOWARDS MANAGING YOUR ROADWAY INVENTORY?

It's always easier to manage something knowing what it is, that requires managing. Such is the challenge for today's transportation professionals in government. Today's professionals typically have roads and right-of-ways (ROW's) that are occupied with many types of assets; streetlights, hydrants, sidewalks, signs, furnishings, all having original states of condition and declining rates of condition with age and the environment.
To invoke an effective roadway asset inventory management process today's manager requires to know some fundamental things:

- What are the assets?
- Where are the assets?
- What condition are the assets in?
- What maintenance activity is required to sustain the asset?
- What is the value of the asset?

The first four bullets are fairly straight forward and pose the majority of the effort from field level perspective. The final point is relatively new in Canada and calls for a financial approach to managing the asset – life cycle depreciation.

Tracking and managing the inventories can effectively be done through a number of specialized software solutions in the market place that specialize in asset or infrastructure management solutions. There is a difference between Maintenance Management and Asset Management when it comes to practice and software. The first deals more so with

work management and real-time activity based costing only, the latter with activity based costing against the asset and longer term planning tools.

Most of the expense in Asset Management comes from data; collecting it and, maintaining it. Government agencies have employed many methods towards collecting their data on the roadway, everything from manual collection; walking, riding or driving, to advanced vehicles equipped with sophisticated camera technology and on-board computer programs. Your preferred option is dependant on your timelines and your budget.

One consideration may be addressing the third point, condition of the asset, when you are collecting the inventory – no sense going back again! Here too, the number of ways condition data can be collected depends on a number of things including time, budget and, standards that your agency is adhering to – standards such as pavement condition. A serious and beneficial consideration here would be to not only look within the realm of the pavement folks in your organization, but beyond. Will this information be important to other departments and how so? Ask around before setting out to collect this data.

Maintenance, maintenance, maintenance. How much is reactive and how much is planned? Once you have the answers or the data for the first three points then you can begin to apply your maintenance standards whether developed internally or, adopted from industry associations or provincial ministries setting levels of service standards. Again, how much you can do is tied to your financial capacities. However, you as a manager, are in a better position to justify your program. You have the data to support your case and only the politicians can make decisions contrary to sound maintenance practices.

Finally, the value of roads, streetlights, signs, etc, can all be calculated over their life span. Your world on the roadway is not however made of disposable assets. In fact, supplemental activities to extend life to assets are always part of a sound program. Therefore any depreciation of assets must go beyond straight line considerations and incorporate and rehabilitative activities which renew the life of the asset.

An effective Asset Management Program will allow you to facilitate all these components.

BUSINESS FUNCTIONS THAT BENEFIT FROM PAVEMENT CONDITION DATA AND OTHER INSPECTIONS.

Pavement condition data is typically collected for a specific purpose, that is, to support a pavement management system (PMS). A small technical faction within the agency normally manages a PMS. It is difficult to secure funding for frequent updates to this data because the PMS is viewed as a small part of the overall enterprise. In order to help justify the cost of collecting this type of data, it is important to identify other business functions in the agency that can benefit from the data. Various business functions that can be supported and improved by pavement condition data are discussed below.

Pavement Management System: Rehabilitation Analysis

A PMS is the most obvious place to utilize pavement condition data. A PMS always includes the calculation of a condition index based on the pavement condition data. Rehabilitation analysis involves predictive analysis, decision logic for activity selection, prioritization, development of the rehabilitation program based on budget constraints, and the modeling of the resulting effect on network condition. The primary benefits of a PMS are improved decision making and justification of funding needs to upper management and/or political bodies.

Pavement Management System: Maintenance Analysis

Some PMS's include an additional analysis tool for maintenance analysis. Maintenance analysis is based on the latest condition assessment. It is used to determine current maintenance needs in terms of cost and quantity. Decision models in the maintenance analysis act on each individual defect type and select zero to many individual maintenance activities for each street segment or length of road. Since the maintenance analysis estimates both cost and quantity of maintenance activities, the level of detail of the pavement condition data must include separate severity and density components.

Appendix 'A' provides a functional comparison of Rehabilitation and Maintenance Analyses.

U.S. Example - GASB 34 Financial Reporting

GASB Statement 34 provides guidelines for the financial reporting of infrastructure assets. Since streets and roads are built and managed in perpetuity, the traditional model of "purchase-depreciate-salvage" may not be the most appropriate for financial reporting. GASB 34 offers an alternative method that involves reporting both the condition of the asset and how much has been spent on maintaining the asset in an attempt to keep it at a desired level.

If an agency intends to use the alternative method under GASB 34, then they can use the same information gathered by the pavement condition assessment program, provided that the level of detail required to meet the GASB 34 needs are taken into account when the condition assessment program is designed.

Level-of-Service (LOS) Programs

Many agencies in Australia, New Zealand and Europe have utilized the concept of LOS as a method to ensure comparability with other agencies and accountability to managing authorities; and to support performance-based maintenance contracts. In the United States, LOS programs are most common at the State DOT level. Unlike a PMS, which focuses on the condition of pavement assets, LOS involves the assessment of a variety of asset types. Further, LOS programs may also measure a variety of parameters,

not just condition. For example, a LOS score on a roadside may be based on the frequency of a maintenance activity such as mowing or litter pick-up.

For those cases where LOS scores are affected by the condition of road assets or roadside assets, it should be determined whether some of this data can be gathered as part of the pavement condition assessment strategy.

WHO INFLUENCES PAVEMENT CONDITION ASSESSMENT STRATEGY?

There are two major influences on pavement condition assessment strategies today; government-sponsored research standards and pavement management software. A third influence is the agency that is managing the road network. The agency managing the road network must exert more influence on the condition assessment strategy if they are to benefit from sharing the data with other business functions.

Government-sponsored Research Standards

Government agencies around the world have long promoted the idea of a standardized pavement condition rating method. In North America, standard procedures have been developed as part of research programs such as the Long-Term Pavement Performance Program (LTPP). Pavement condition rating manuals generated by these types of programs describe the types of defects to be evaluated for different pavement types. The valid severities and units of measure are defined so that the pavement condition assessment can be consistent and repeatable. These procedures do not specify how to convert this data to a condition index; this is left up to the pavement managers who utilize the data.

Pavement Management Systems Software

There is a wide variety PMS software that is available for purchase. Some systems have both initial costs and on-going support costs while others are initially free of charge with users paying for on-going support and system upgrades. Some systems are provided by government or academic entities, while most are sold commercially as a single package or, as part of an enterprise suite of transportation software solutions.

Pavement Management Systems can be categorized based on characteristics that affect the potential for sharing the data with other business functions, as shown in Table 1.

	Condition Data	
PMS Software	**Independent:** Data may be collected by in-house forces or by the data collection vendor of choice	**Turnkey:** Software vendor provides data collection services and software together as a combined package.
Configurable: Defect types and analysis algorithms are configurable allowing the system to adapt to various data formats and analysis methodologies.	Most Potential to share condition data with other business functions	Less Potential for sharing condition data with other business functions
Fixed Format: Defect types and analysis algorithms are fixed and rely on compatible condition data	Less Potential for sharing condition data with other business functions	Least Potential for sharing condition data with other business functions

Table 1. Data sharing potential of different categories of PMS software and data.

Condition data that is independent of software and that is utilized by a configurable PMS offers the most potential for sharing data with other business functions.

The Agency Managing the Pavement Network

To date, the agencies managing our road networks have exerted little influence on their own pavement condition assessment strategies. This is due to the following factors:

Isolated Software Systems

The fastest and easiest way to implement a system is to isolate a business function and install a stand-alone software product to meet that need. This has been done repeatedly throughout transportation agencies of all sizes. The resulting problems are obvious and well known to transportation managers and consultants alike.

1. Isolated databases.
2. Duplication of data.
3. Minimal data sharing.
4. Minimal agency benefit from the data.

Reliance on Government Methods or Vendor Recommendations

Pavement management systems often exist in isolation because they are maintained and used by a small technical faction within the organization. Because of this, the process of developing a condition assessment strategy simply defaults to a published standard or whatever the vendor recommends.

Lack of an Enterprise View of the Agency

Agencies have allowed systems to exist as isolated “islands of information” because they were not required to share the information and they

may not have had the technology to support multi-user systems. Today, the agencies must view themselves as an enterprise and use technology to share information easily. This is necessary is ensure that they can meet new requirements for accountability and financial reporting.

Agencies must take control of their condition assessment strategies and design them so that the data collected can be shared and used to support multiple business functions.

DESIGNING YOUR CONDITION ASSESSMENT STRATEGY

Rather than following a given strategy and later discovering whether or not it meets your needs, take control and ensure that the strategy will meet your needs. Follow these guidelines:

Research the needs of various Business Functions

Don't isolate yourself; think of your agency as a larger enterprise. Contact other managers and tell them you are planning a condition assessment effort. Ask which of their business functions may require condition data.

Develop Requirements for each Business Function

As an example, the business function of Pavement Management is discussed here. Use a similar approach for each function.

1. Start at the end. Identify the decision processes and reporting requirements that will be supported by the condition data.
2. Rule of Thumb for selecting data elements. Do not collect condition data unless it either supports a decision process or it is needed for information/reporting purposes.
3. Level of Detail. For each observation of a defect, will one number suffice or do you need both severity and density information?
4. Frequency. At what interval do you want the data collected? At what interval do you want the data summarized into a condition index?
5. Refresh Cycle. How often does the data need to be refreshed?

Design the Field Data Collection Plan

If you are using in-house forces, you are free to develop your strategy based on the business function requirements. You also must work with constraints of manpower availability, training, available technology and regional weather.

If you are using a data collection vendor, find one who is willing to work with you to collect data in the format that meets your needs. Left to themselves, vendors will collect data in a manner that minimizes variation from their preferred method and therefore maximizes efficiency and profit. It is up to you to ensure

that the condition data delivered by the vendor meets your requirements and does not include extraneous data that you do not need.

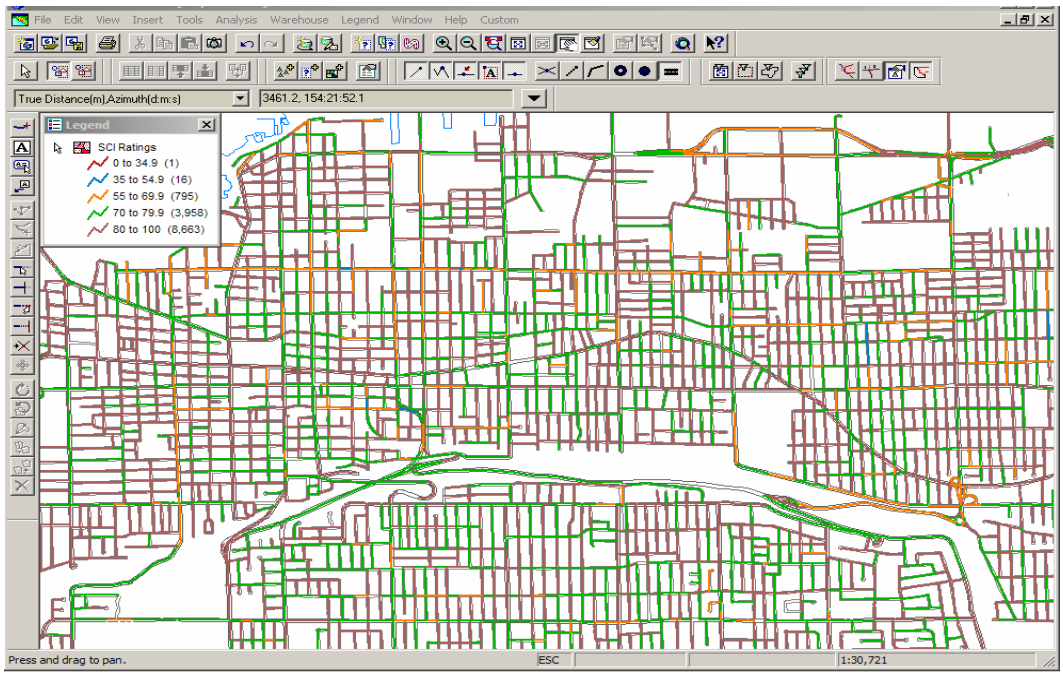
HOW A GEOGRAPHICAL INFORMATION SYSTEM (GIS) INTEGRATION CAN HELP YOU

A GIS, for simplicity sakes, is an intelligent series of maps. These maps are made more so intelligent when integrated to systems like asset management. Tremendous opportunities are presented to the users through GIS in how they can extract, manipulate and present data in an easy to view format.

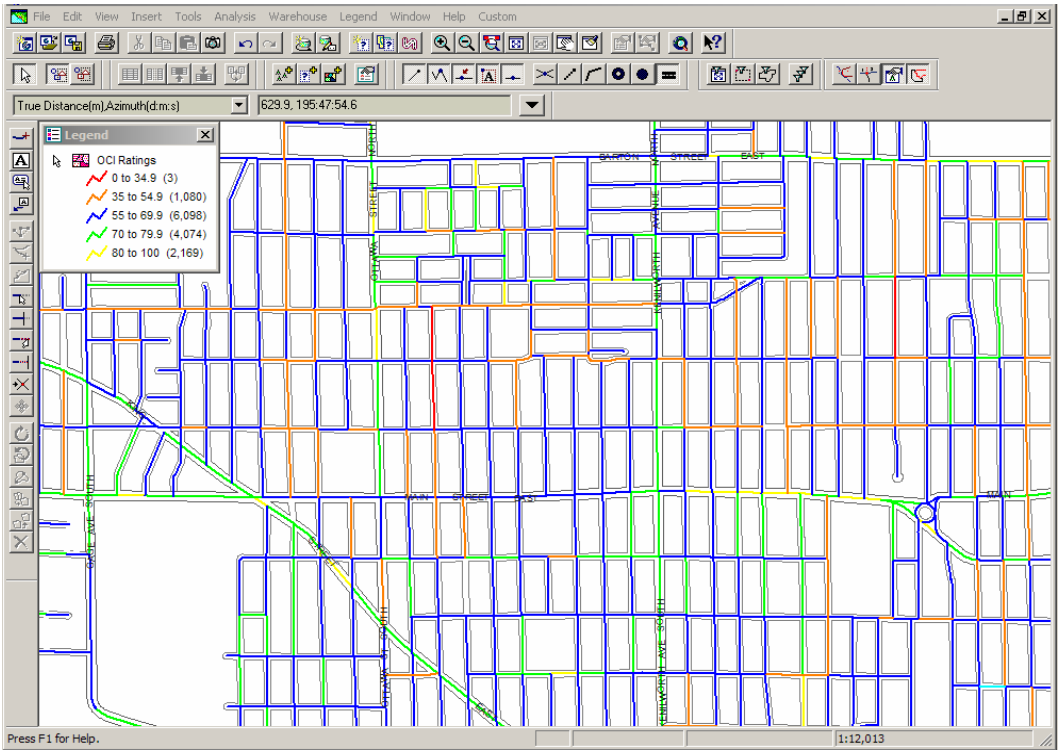
A GIS may have been your original source of data when populating your asset inventories. Such is the case in many government agencies that have robust GIS running due to large commitments to spatial data over the years. Integrating the spatial to tabular data such as asset attributes including conditions and work histories can add significant benefit to an organization. In today's world of databases (ie. Oracle Spatial), both can co-exist in a seamlessly integrated environment.

Hence the benefits are numerous, from data maintenance savings through to data presentation for key reports and meetings with politicians or constituents. Typically the challenge is a co-operative environment and documented workflow processes which have been agreed upon and communicated across the organization.

The following is an example that illustrates how specific condition data and, program results from a Pavement Management System can be effectively portrayed in a GIS environment.



Overall condition representation of a road network is also easily represented in a GIS environment through tabular results of a Pavement Management system.



CASE STUDIES IN ONTARIO : WATERLOO AND HAMILTON

Region of Waterloo, Ontario has adopted an enterprise Transportation Asset Management / Pavement Management system approach by selecting a single vendor solution. This approach has provided them with seamless integration of data and consistency of standards and forms. They have collected data through a number of means including pavement condition data using a specially equipped vehicle that measures items such as IRI (Roughness Index) for rutting, cracking and surface distortion.

Waterloo has also worked diligently to integrate their linearly referenced road (LRS) system to their GIS application to provide an enhanced view of condition analysis results and, other unique queries performed on their asset management data.

The City of Hamilton, Ontario has been a pioneer in Asset Management since the late 80's. Although initially practiced at the Regional level, today the newly amalgamated city has adopted an enterprise approach by bringing together both above-ground and underground assets for a network approach. The city has also standardized on a single vendor solution to benefit from seamless integration and ease of connectivity to GIS.

CONCLUSION

Municipal asset managers can benefit tremendously from the approach of an enterprise Asset Management philosophy. Although pavement condition data strategies were only discussed in this paper, it is a representative example of how all condition assessment strategies (sewers, water, storm) may need to be addressed across departments before implementation. Ideally, a network view of all the asset conditions and their life-cycles (planned repairs/renewals) will give the engineering and public works planners, the power to make decisions that could save millions of dollars.