

THE PAVEMENT MANAGEMENT COMPONENT OF AN ASSET MANAGEMENT SYSTEM

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Abstract

A Pavement Management System (PMS) can be considered a sub-system within an agency's Asset Management System specifically structured to support the decision making requirements with regard to pavement assets.

Local Government in Australia is responsible for the management of about 84% or 679,000 kilometres of the country's road network with State and Territory authorities responsible for the remaining 16%.

With the non-bulk road freight task projected to increase by 82% in tonne-kilometre terms between 2003 and 2020 (average 3.6% a year)¹ the importance of the responsible management of the road network can not be overstated.

The asset management principles of knowing what you have, where it is, and what condition it is in, are fundamental to the most basic decisions required to ensure expenditure is directed in the most appropriate manner.

Those decisions will be influenced most significantly by two factors, the first being the policy statements of the agency and secondly by the information made available through analysis of data. It is critical therefore that data utilised for this purpose be carefully selected and considered an important asset requiring appropriate management.

Introduction

The International Infrastructure Management Manual, (IIMM), describes Asset Management as "The combination of management, financial, economic, engineering and other practices applied to physical assets with the objective of providing the required level of service in the most cost effective manner."²

To further examine what this means it is helpful to define more precisely the *physical assets* we are managing, the *levels of service* we are aiming to provide, and the *practices* applied to provide this management.

From the same source the following definitions are helpful in this examination.

"Infrastructure Assets: Stationary systems forming a network and serving whole communities, where the system as a whole is

intended to be maintained indefinitely at a particular level of service potential by the continuing replacement and refurbishment of its components. The network may include normally recognized ordinary assets as components.”

“Level of Service: The defined service quality for a particular activity (i.e. roading) or service area (i.e. streetlighting) against which service performance may be measured. Service levels usually relate to quality, quantity, reliability, responsiveness, environmental acceptability and cost.”

“Advanced Asset Management: Asset management which employs predictive modelling, risk management and optimized decision-making techniques to establish asset lifecycle treatment options and related long term cash flow predictions.”

The Austroads Integrated Asset Management Guidelines for Road Networks, AP-R202, describes Road Asset Management as “a comprehensive and structured approach to the delivery of community benefits through management of road networks” (Austroads 1997). It goes on to state “Integrated Asset Management (IAM) is a process for ensuring the requirements of road agencies, road users and other stakeholders are clearly understood and integrated into an asset management framework that optimises the outcomes achieved from policy and investment decisions. In general, IAM focuses on integrating all applicable asset management components into a comprehensive planning framework.”³

Components of a PMS

A Pavement Management System could be described as a framework for the implementation of the management processes that constitute the sequence of events required to sustain a road network through its life cycle to defined performance criteria.

In general terms the management function includes the Planning, Programming, Preparation and Operations elements that are implemented in a repeating cycle of activities.

In this paper I will limit our consideration to the planning phase of the cycle and attempt to bring some focus on the critically important and, in my opinion, often undervalued aspect of data management.

Planning

Planning involves the analysis of the road system as a whole and typically includes the preparation of medium to long term plans and estimates.⁴ In order to undertake the planning process it is critical that a reliable *asset inventory* be available for the task.

Dr Peter Kadar in his paper “Asset Management in Long Term Maintenance Contracts” discusses information required for the planning process in the following way. “All planning tools, be they network or project level, require information. The required information includes the following categories; administrative, inventory, condition, traffic and financial.”⁵

Administrative Data

Administrative data typically relates to service level policy objectives pertaining to design, maintenance and safety standards, road hierarchy classification and other strategic network priorities.

Inventory Data

Inventory data defines the individual components that make up the network. Inventory management is a challenging aspect of road asset management as the inventory stock of a road network changes frequently with the installation of new signs and safety appurtenances, new road surfacings and pavement markings, road widening projects and new roads constructed to cater for growing populations. “As Constructed Drawings” and other project completion reporting is an essential element in closing the loop of the construction phase of the cycle and is absolutely essential for the accurate maintenance of inventory data.

Condition Data

Condition data is important in providing information regarding the present state of a network, noting however, that the data collected in its raw form usually needs to be analysed and transformed into data that can be used in a relational sense with other data sets. Because road asset condition change is subject to multiple influences and future condition cannot be easily predicted, it is critical that the appropriate selection of data to be captured is made. The data collection process is expensive and due consideration should be given in the determination of what data should be collected and how it will be utilised.

Typical condition indicators for pavements and the type of measurements that can be captured with high speed and/or automated equipment include:

Roughness (or unevenness) measured as the International Roughness Index (IRI) is a standardized means of reporting pavement ride quality. In Australia roughness is sometimes also expressed in terms of NAASRA roughness counts.

Rutting is the permanent surface deformation of the road surface due mainly to deterioration of the pavement and/or subgrade, and attributable to the traffic loading.

Texture measurements are most often defined in two categories, microtexture which describes the texture of the surface characteristics of the constituent particles in a road surface and macrotexture which relates to the void spaces between the stone particles in the surface treatment.

Cracking is measured by extent and severity and usually categorised by type, typically longitudinal, transverse, crocodile also referred to as alligator or fatigue cracking.

Skid Resistance is a measurement of the frictional resistance correlated to a tyre skidding on a wet road surface. There are several devices available to capture network level condition data including Griptest, SCRIM and Norsemeter-ROAR.

Structural Strength is calculated by measuring the response to loading. The devices used most commonly are the Falling Weight Deflectometer (FWD), Benkelman beam, Deflectograph and the Pavement Strength Evaluation vehicle (PaSE).

In addition to the parameters listed above, pavement distress features such as potholes, edge-breaks, deformations, localised pavement failures and other surface defects are often collected with either automated video capture equipment or manually by visual observation and recording.

Traffic Data

The prediction of the performance of a pavement asset requires the analysis of its behaviour and condition over time. In addition to the instrument measured condition data, other information is required in order to undertake predictive modelling. Importantly, an appreciation of the remaining service life of a pavement is necessary as this will influence, when considered with predetermined intervention threshold values, at which point in time maintenance intervention or rehabilitation is required.

“As pavement management decisions, economic optimisations, and works programs are concerned primarily with when problems will arise or works will be undertaken, it is common practice to express the life of an asset in units of years.”⁶ (Austroads Technical Report AP-T77/07). The report goes on to describe the fact that structural capacity of a pavement is consumed by the application of traffic (usually expressed in terms of equivalent standard axles, ESA, or heavy vehicle axle groups, HVAGs) in conjunction with environmental effects such as seasonal weather variations, temperature, the movement of moisture and the passage of time.

Appropriate traffic count information, whether from actual counts or best reasonable estimates, is a necessary input for a pavement management system. The more accurate the data, particularly on the more heavily trafficked roads, and those with a high proportion of commercial vehicles, the higher

the confidence level in the results of modelling will be.

Financial Data

Prediction of future pavement performance is an important element of pavement life cycle cost analysis. It is necessary that the PMS analysis accounts for all cost estimates including construction, maintenance, rehabilitation and reconstruction. The remaining life assigned to road assets will influence the determination of the depreciable amount applicable to it. A significant effort is currently being made by the NAMS.AU committee and its association members to better align the engineering component with the financial accounting and valuation component of asset management for local governments in Australia. Reliable and accurate data is equally important for both the engineering requirements and accounting requirements of asset management.

Data Management

Having identified some of the data sets, and the list is by no means exhaustive, that are required in order to implement a pavement management system effectively it should be easily understood how important the accuracy and reliability of those data sets become.

Norm Eason in his book "Maintenance and Asset Management Information Systems"⁷ contends, that "data and all its derivatives are valuable assets in any organisation, and must be recognised as such."

To explore this analogy a little further we can see that a number of the criteria we establish to maintain and manage physical infrastructure assets have parallels with our data assets.

In the questions posed below consider the asset as a data set included in the PMS.

For example the rationale of having it in the first place, do we need it?

Does the acquisition of the asset satisfy a predetermined need for it?

Having determined that we do need it, have we made appropriate provision for its storage and maintenance?

Have we provided the appropriate personnel who are trained and competent in the management, use and maintenance of the asset?

Do we provide for routine inspections (data quality checks) to ensure continued fitness for purpose?

Have we determined the quality/performance requirements of the asset and established at what stage the asset will have reached the end of its service life and needs replacement?

Summary

It is my contention that these are valid questions and all too often not considered seriously enough at the commencement of the development and implementation of a pavement management system. When considering that we are dealing with long life assets that demand huge sums of the communities' financial resources to maintain and manage, surely it is incumbent on asset management professionals to exercise the same degree of professional care and responsibility in managing the data sets that underpin the decision making processes that in turn determine the investment strategies for our physical infrastructure.

The quality of outputs from the expert systems, deterioration models and other predictive tools utilized in the pavement management system will be directly proportional to the quality of the data that is fed into them.

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The company provides services in pavement management including data management, network modelling and treatment selection and design. The Company also provides training in Pavement Management Systems, Road Condition Survey, Asset Management & Maintenance Management Systems.

