



The Ohio Department of Transportation

*Office of Statewide Planning and Research
Research Section*

Executive Summary Report

Benefit Cost Models to Support Pavement Management Decisions

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Problem

A critical role of pavement management is to provide decision makers with estimates of the required budget level to achieve specific steady-state network conditions, and to recommend the best allocation of available budget among competing needs for maintenance, rehabilitation, and repair (MR&R) projects or among different networks such as among Districts.

The Ohio Department of Transportation (ODOT) has developed a comprehensive Pavement Management Information System (PMIS), which provides a collection of tools to support pavement management activities. These tools include reporting of current condition and deficiency, predicting future pavement condition, and estimating remaining service life (RSL). Predicted future pavement condition and estimated RSL allow decision makers to perform “what-if” analysis of the financial impact and level of service provided by a multiyear MR&R work plan. However, given the size of the pavement network and the number of competing project candidates, the number of feasible alternative work plans can be very large. A procedure that can quickly narrow down the alternatives is highly desirable.

Objectives

1. To develop and incorporate cost benefit models and optimization procedures to support pavement management decisions;

2. To investigate and quantify the mid-to long-term financial impact of selecting alternative projects;
3. To define and determine the “near optimal” multi-year work plans according to specified criteria such as maximizing state wide pavement network condition, subject to budgetary and other constraints;
4. To determine the required multi-year budget, by treatment category, to preserve the existing system at specified steady-state condition.
5. To improve the existing PMIS in terms of its capacity, functionality, and stability.
6. To implement the new rehabilitation treatment decision logic for each pavement priority category in all affected PMIS tools.

Description

This research study developed a model/procedure to determine the minimum total cost required and the corresponding treatment policy to achieve the desired target state of the network. The model uses the current state of the network and a specified future target state, condition deterioration trends (based on the MR&R treatments received) expressed as Markov condition transition matrices, and the unit cost of treatments.

The developed model can also determine the best network condition state achievable (and the corresponding treatment policy) with a given budget. The corresponding optimization problems with the objective of either minimizing total cost or maximizing overall network condition are formulated as linear programming problems, so that they can be solved very efficiently.

Three subsequent addendums to the original study addressed the PMIS database capacity issue, updated the PMIS code, streamlined and improved the user interface, implemented the new ODOT rehabilitation decision trees, and developed a separate tool for generation of Markov condition transition matrices to support ODOT’s enterprise pavement management system.

Findings

The network level optimization model provides a valuable tool to ODOT decision makers to determine the required network budget and optimal budget allocations. The network optimization model can be used by decision makers to assess the impact of different condition targets and treatment policies on the required network level budget. It can also be used to determine the optimal allocation of available budget among MR&R treatment categories and among Districts or between the Priority and General systems.

Conclusions & Recommendations

As a result of this study, ODOT can determine the budget level required to achieve a specific target of network condition state. Vice versa, future network condition states resulting from a given funding levels can be estimated and optimal treatment policy determined. Multiyear network level work plans based on the determined optimal treatment policy can then be generated. It is recommended that ODOT uses the result of this study to establish future budget needs, funding allocations, and treatment policy, in order to demonstrate best possible use of available budget.

Implementation Potential

The network level optimization models developed in this study can be readily implemented as part of a comprehensive Pavement Management System.