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Iowa Pavement Asset Management Decision-Making Framework

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Iowa Pavement Asset Management Decision-Making Framework

Abstract

Most local agencies in Iowa currently make their pavement treatment decisions based on their limited experience due primarily to lack of a systematic decision-making framework and a decision-aid tool. The lack of objective condition assessment data of agency pavements also contributes to this problem. This study developed a systematic pavement treatment selection framework for local agencies to assist them in selecting the most appropriate treatment and to help justify their maintenance and rehabilitation decisions. The framework is based on an extensive literature review of the various pavement treatment techniques in terms of their technical applicability and limitations, meaningful practices of neighboring states, and the results of a survey of local agencies. The treatment selection framework involves three different steps: pavement condition assessment, selection of technically feasible treatments using decision trees, and selection of the most appropriate treatment considering the return-on-investment (ROI) and other non-economic factors. An Excel-based spreadsheet tool that automates the treatment selection framework was also developed, along with a standalone user guide for the tool. The Pavement Treatment Selection Tool (PTST) for Local Agencies allows users to enter the severity and extent levels of existing distresses and then, recommends a set of technically feasible treatments. The tool also evaluates the ROI of each feasible treatment and, if necessary, it can also evaluate the non-economic value of each treatment option to help determine the most appropriate treatment for the pavement. It is expected that the framework and tool will help local agencies improve their pavement asset management practices significantly and make better economic and defensible decisions on pavement treatment selection.

Keywords

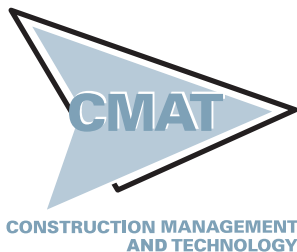
Asset management, Case studies, Condition surveys, Decision making, Local government agencies, Low volume road, Maintenance Pavement management systems, Preservation, Rehabilitation (Maintenance), Return on investment, pavement treatment selection

Disciplines

Civil Engineering

Comments

InTrans research project home page: <http://www.intrans.iastate.edu/research/projects/detail/?projectID=1934952583>



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tech transfer summary

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RESEARCH PROJECT TITLE

Iowa Pavement Asset Management Decision-Making Framework

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The Construction Management and Technology (CMAT) Program is part of the Institute for Transportation (InTrans) at Iowa State University. The mission of CMAT is to improve the efficiency and cost-effectiveness of planning, designing, constructing, and operating transportation facilities through innovative construction processes and technologies.

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A structured framework and tool that can reflect local requirements, practices, and operational conditions would greatly assist local agencies in making consistent and defensible pavement treatment selection decisions.

Problem Statement

Local agencies, such as counties and cities, need a systematic pavement treatment selection framework to justify and easily defend maintenance and rehabilitation decisions and to achieve the highest return value on their pavement investments.

Project Description

This study first conducted a comprehensive literature review and documented various treatment methods available in the industry and their technical application boundaries, costs, and expected life expectancies. In addition, pavement maintenance and rehabilitation selection practices were documented as part of the literature review.

A statewide survey questionnaire was sent out to determine common local pavement distress types, common treatment methods used by local agencies, and decision-making processes in selecting pavement treatments used by local agencies. In addition, follow-up phone calls and interviews were conducted.

The findings from the literature review and the survey and interviews were incorporated into development of a pavement treatment selection framework for local agencies.

Key Findings

- Most local agencies make their pavement treatment decisions based on anecdotal experience and judgement due primarily to lack of a systematic decision-making framework and a decision-aid tool.
- Most local agencies depend on visual inspection or data collected by the Department of Transportation (DOT).
- The majority of the survey questionnaire respondents indicated that they do not use any pavement level of service (LOS) indicators.
- It may not be feasible or reasonable for local agencies to use complex and highly accurate LOS indicators, so the use of simple LOS indicators need to be considered when developing a treatment selection framework for local agencies.

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- Local agencies do not need the data intensive asset management and treatment selection processes that are available for pavements managed by state agencies and a data intensive approach may not work for local agencies due to lack of data and resources.
- Treatment cost is not the only factor that affects the treatment selection process given potential performance, user satisfaction, procurement and contracts, and environmental sustainability concerns.

Implementation Readiness

This project developed a pavement treatment selection framework for local agencies that considers common practices and limitations. The treatment selection framework consists of decision-making matrices and decision-making trees for both asphalt and Portland cement concrete pavements.

Treatment selection framework

I	Collect distress data
	Identify number of existing distresses
	Determine distress severity and extent levels
	Collect roughness and friction data
II	Use the appropriate decision tree based on pavement type
	Determine the technically feasible treatment
IIIa	Determine the weights for each selection factor using AHP
	Collect cost, performance, user satisfaction, procurement, and environmental impacts data for each feasible treatment
IIIb	Calculate EUAC and ROI
	Estimate scores for other selection factors
	Calculate the overall score for each feasible treatment
	Determine the most suitable treatment

The framework uses a novel pavement condition classification process based on the severity and extent levels of existing pavement distresses. Three classes are defined for each pavement type. Each class indicates whether the pavement is heavily, moderately, or slightly deteriorated.

The framework provides decision trees to determine technically feasible treatments for different pavement condition classes. The decision-making logic considers roughness, friction, and distress distributions. The economic value of each technically feasible treatment is calculated using the equivalent uniform annual cost (EUAC) method and return on investment (ROI). Non-economic values can be determined using the analytic hierarchy process (AHP).

Based on the pavement treatment selection framework, an Excel-based spreadsheet tool that automates the treatment selection process was also developed, along with a standalone user guide for it. The Pavement Treatment Selection Tool (PTST) for Local Agencies requires users to input basic project information and distress data to generate a list of technically feasible treatments.

The PTST automatically calculates the EUAC and ROI values for each feasible treatment based on the discount rate entered by the user. Users can override default values of treatment costs and performance data using their local data and local agencies are encouraged to use their own performance data to accurately assess the cost effectiveness of each alternative.

The PTST also allows users to build future maintenance and rehabilitation scenarios. Each scenario can be evaluated for its long-term economic value, helping users to select the most economical alternative.

An optional non-economic scoring method that aims at selecting the most appropriate treatment when multiple treatments are available was also developed. The scoring method utilizes the AHP, which calculates the weights of different factors based on pairwise comparisons. The PTST allows up to three sets of user input per project for the pairwise comparisons of the selection factors.

Beyond treatment cost, other categories of factors used in the scoring system include treatment performance, user satisfaction, procurement and contracts, and environmental sustainability. Within these four categories, other factors that may have an impact on treatment selection include pavement structure improvement, treatment performance under traffic conditions, road closure or traffic disruption, impact on roughness, friction, or tire/pavement noise, contractor availability, material availability, and environmental impact.

Implementation Benefits

Maintenance and rehabilitation decisions can be technically justified by incorporating pavement condition data into the decision-making framework. The highest ROI value can be determined by analyzing the economic values of technically feasible treatments.

It is expected that the framework and tool will help local agencies improve their pavement asset management practices significantly and help their staff to make better economic and more defensible decisions on pavement treatment selection.

Future Work

The estimation of the unit cost of different treatments based on the historical data collected by the Iowa DOT was not feasible. The unit cost estimation for different treatments was not developed because the number of lanes for each project was not collected in the projects database. The length recorded in the database is the physical length of the project, without reflecting the number of lanes or pavement lane-miles.

In addition, the treatment projects database is not compatible with the Pavement Management Information System (PMIS) in terms of units of measurement or road system numbering methods.