CLEAR ROADS
research for winter highway maintenance

RESEARCH BRIEF

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ESTIMATING THE VALUE OF SNOW AND ICE OPERATIONS

RESULTS SUMMARY

A new cost–benefit tool will estimate the value of winter maintenance operations to support agency decision-making.

PROJECT DETAILS

Project Title: Quantifying the Economic Value of Snow and Ice Operations Success

Project Number: CR23-02

Project Cost: $98,062

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Need for Research

State and municipal agencies invest significant funds in new equipment, emerging technologies and innovative practices to improve winter maintenance operations. Calculating the economic net benefits from these investments supports and justifies purchasing decisions and operational strategies. It also provides valuable information for planning annual budgets.

Winter maintenance strategies and purchasing decisions also benefit from fiscal analyses that estimate the expected value of these assets and practices. This project examined current methods to identify appropriate data inputs and calculated outputs that were then used to develop a user-friendly cost–benefit tool for transportation agencies.

Objectives and Methodology

This project developed a methodology and tool to help agencies quantify the net benefits of winter maintenance activities, including management strategies and investments in innovative technologies and practices. The project started with a literature review to better understand current practices for conducting cost–benefit analyses in winter maintenance operations. As part of the review, investigators identified pertinent information needed to calculate costs and the resulting benefits.

Next, a survey of transportation agencies further identified required data needs for the tool and highlighted current agency practices. Using the information gathered from the literature review and survey, investigators developed the methodology and use case examples to help illustrate the methods. Then they developed an automated Visual Basic for Applications tool that allows agencies to test various scenarios for budget ranges and show the value of their operations.

Results

The primary inputs considered when calculating cost–benefit ratio, cost per lane mile and estimated budget are:

- **Weather data,** defined by severity based on weather characteristics and expected winter maintenance needed. Total hours of winter events is the

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A cost–benefit analysis can estimate the net benefits of proposed operational strategies and equipment or technology investments for budget planning.

most relevant data measurement needed. Users can alternatively use their Accumulated Winter Season Severity Index (AWSSI) score, which agencies can enter along with their state and average hourly rate for winter maintenance workers.

- **Network and operation data,** which includes a network area description and annual average daily traffic data categorized by volume, percent heavy vehicles, speed, lane miles and centerline miles.
- **Annual costs for winter maintenance.** Direct costs include labor (agency and contracted), fuel and deicing material. Agencies can also estimate annual direct costs with the AWSSI. Indirect costs include capital equipment and maintenance, software and data subscriptions, training, infrastructure and environmental maintenance, storage, environmental costs and discount rate.
- **Weather-related crash counts.** Agencies can add baseline weather-related crash counts per year by severity. The tool applies a similar methodology used in Strategic Highway Research Program's (SHRP's) *Development of Anti-Icing Technology* (SHRP-H-385) to estimate crash reduction because the agencies are treating the roads.
- **Speed reduction and vehicle delay cost.** Agencies can estimate a mobility benefit from treating the roadways. Speed reduction is estimated based on weather received if they were not to treat the roads. Then the vehicle delay can be compared and an overall benefit–cost can be calculated.

Other associated costs not fully covered within these categories can be added to ensure the cost–benefit tool produces the most accurate cost information.

The calculated benefit outputs include safety, such as crash and injury avoidance, and vehicle delay costs savings. Users must determine the impacts/benefits of treated versus untreated roads in terms of exposure to ice (for safety) and speed reduction (vehicle delay). The crash costs for the safety crash reduction were obtained from the Federal Highway Administration's *Highway Safety Benefit–Cost Analysis Guide*. These costs consider medical expenses, vehicle insurance, legal implications and inflation. For vehicle delay costs savings, user delay is estimated based on average travel speed from various sources such as field observations, traffic sensors and probe data. In the project's example, the vehicle delay cost is $20 per hour for passenger vehicles and $40 per hour for commercial vehicles, but these can be adjusted by the user.

Benefits and Future Research

This tool can provide specific estimates for numerous scenarios and highlight the value of effective management activities that could guide budget appropriations. Further, it enables agencies to analyze cost–benefit values for scenarios unique to their operations with their own detailed input information. For example, it could support personnel or equipment investments or provide justification for guaranteed work commitments with contractors for specific geographic circumstances.

The cost–benefit tool is available for agency use. Investigators have developed a user guide and video to provide guidance for using it.

"This cost–benefit tool can be used by practitioners of winter roadway maintenance to model different operational scenarios and determine which strategies may maximize economic benefit."

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