

## RESULTS SUMMARY

Investigators surveyed over 50 local, state and international transportation agencies on snow removal performance metrics in use and under consideration. Agencies are shifting from traditional input/output measurements to outcome-based metrics that better suit performance review and are more meaningful to the public.

## PROJECT DETAILS

**Project Title:** Snow Removal Performance Metrics

**Project Number:** CR14-05

**Project Cost:** \$74,640

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# OUTCOME-BASED PERFORMANCE MEASURES PROVIDE MEANINGFUL DATA

**S**now removal is one of the most visible activities transportation agencies perform in cold-weather states. Yet the ways in which agencies gauge the effectiveness of their efforts to clear roads remain individualistic and difficult to compare; one agency's clear-pavement standard may not match another's. Dramatic growth in data-gathering and data-processing options has expanded opportunities for assessing performance in the field and communicating outcomes to the public.

## Need for Research

Conventional measures of snow removal performance rely on inputs and outputs. Input-based metrics may include fuel usage, labor and machinery hours, and volumes of anti-icing material used. Output-based metrics include lane miles plowed per unit of time, lane miles deiced, and truck plowing speed.

However, such inputs and outputs offer little insight into the serviceability of roadways. As transportation agencies strive for greater transparency, providing data to the public on lane miles deiced may be less useful than sharing snow removal outcomes that directly affect driver experience. Research was needed to identify the performance measures that agencies find most effective.

## Objectives and Methodology

This project's goal was to catalog the range of winter maintenance performance measures that agencies use, especially newer outcome-based measures that may not have been captured in earlier research, and identify the most effective metrics. Researchers sought to assess the state of the practice in winter maintenance performance measurement, identifying promising metrics for further study. This study aimed to lay the groundwork for future research to identify metrics for evaluating performance and better ways of reporting that performance to the public.



Outcome-based performance metrics can measure the time required to regain a specific level of service or a specific pavement friction level.

The research team conducted a literature review and then sent surveys to 75 U.S. and international agencies and private firms. Investigators analyzed the survey responses, considering snow removal measures in terms of maintenance goals, metrics used, and methods of communicating performance to the public. Finally, they identified gaps in knowledge and recommended future research directions that could fill those gaps.

## Results

Of the 75 entities contacted, 51 returned completed surveys—35 state agencies, four local agencies, two private firms, two Canadian provinces, and eight European agencies or agency subcontractors.

For the survey respondents, the primary goal of snow removal was to promote safety by minimizing collisions and the incidence of vehicles leaving the roadway. However, safety is only an indirect measure of performance, because actual road conditions, driver behavior and other factors inform safety assessments. Mobility—keeping traffic flowing at normal or nearly normal speeds—was the respondents' next highest-rated maintenance goal.

The survey showed that outcome-based metrics have eclipsed traditional input- or output-based measures that focus on resources used. Over 70 percent of agencies reported using outcome-based level-of-service (LOS) goals for road conditions or usage, with performance usually measured in terms of time required to achieve established LOS criteria. Maintaining safe and passable roads throughout storms, providing bare pavement as quickly as possible, and achieving specific traffic volumes were the most widely used LOS goals. Metrics included “bare pavement time,” a measure of how long it takes to reach an observable level of uncovered pavement, and “speed recovery time,” a measure of how

long it takes driving speeds to return to normal following a storm.

Other results from the survey included:

- Twenty-seven percent of agencies reported that they were changing their metrics or adding new metrics.
- Metrics that measure road surface friction, which reflects vehicles' ability to maintain traction on the pavement surface, are gaining interest. Sensors embedded in roadways can produce timely, reliable friction data, but installing them may be cost-prohibitive. However, vehicle-mounted cameras and sensors have recently begun to show promise at measuring friction levels more cost-effectively.
- Many agencies employ a storm severity index to contextualize metrics. A severity index assigns a value to a storm based on precipitation amount, duration, intensity and other characteristics, which allows for agency-to-agency comparison of performance results according to storm severity.
- Agencies reported using sensors, on-plow hardware, software and other technologies to provide empirical data that are less subjective and more precise than manual observations.
- Agencies communicate directly with the public about performance through social media, websites, and dashboards, as well as through the news media. Social media and smartphones allow the public to provide real-time feedback on performance.

## Benefits and Further Research

This project provides insight into how agencies are using winter maintenance performance measures. Potential follow-up research topics include assessing the effectiveness of data-gathering techniques, identifying the outcome metrics that best reflect performance, and examining agencies' use of metrics to improve operations.

“This project collected a lot of good data that will be helpful to state DOTs as they look at their own performance metrics, especially how they can apply metrics to improve their winter operations.”

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