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Performance Measures in Snow and Ice Control: Linking Operational Objectives and Performance Measures NCHRP Report 889

The NCHRP report highlighted seven operational objective categories, reviewed in a previous one-pager. The report went on to identify seven performance measures that could support the operational objectives. These performance measures support a wide variety of agencies capabilities, types and functions.

Percent time road segment meets agency-defined level of service.

This measure assesses whether the service-level thresholds, which define the acceptable road conditions during an event, set by an agency were met. Whatever thresholds are decided upon an agency should be capable of monitoring them during a storm. Objective measures of service quality, such as the amount of accumulation or measured grip factors are recommended.

Percent of segments meeting time to regain or recover to acceptable criteria at the end of event.

A key objective of winter maintenance operations is to reach acceptable pavement conditions so that an agency can assess the performance of winter storm management and response for an event. This performance measure assesses the amount of time that passes from the end of a winter event until an acceptable surface condition once again exists. There will be variation in the degree of acceptability due to the type of roadway. Agency defined criteria include acceptable condition of roadway, performance target, roadway segment prioritization, and storm severity.

Percent of Trips within Accepted Difference between measured travel time and additional expected time for snow and ice events on selected routes.

This performance measure looks at the difference between measured TTI during a storm and the prespecified additional TTI for key trips defined by an agency. Consistency in travel time is an important measure of service quality and mobility for travelers since there is a real value in understating how congestion and service behave throughout the operation of a transportation system. A time travel index is the ratio of the peak-period travel time to the free-flow travel time, with averages across urban areas, road sections, and period being weighted by VMT.

Five-year rolling average of Number of fatalities and injuries during a winter season.

This performance measure indicates the number of fatal and serious injury crashes related to the winter season or winter weather events. The measure allows for seasonal evaluations and can be an important input to both maintenance and incident management planning.

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Customer satisfaction ratings for snow and Ice response.

This performance measure analyses the satisfaction of transportation system users by tracking traveler feedback at a regional or statewide level. Traveler satisfaction data can be gathered through surveys, focus groups or other approaches. The use of smartphones in this regard could make the gathering of such information easier. Traveler satisfaction is likely to decrease during a severe event so severity should be considered in the evaluating performance.

Cost of Snow and Ice control to meet established performance criteria for a given winter severity.

This performance measure is a highly visible parameter of local and state expenditures. Developing a monetized approach that captures the complexity that exists in most agencies is a challenge. Agencies might have limited ability to control costs since factors determining the cost of materials might be outside their jurisdiction and control. Fuel prices fluctuate for reasons unrelated to winter maintenance activities, also personnel have multiple duties, not just those related to snow and ice, and this makes assessing personnel costs a challenge. Winter maintenance cost information can be viewed as the output of combining usage indicators of labor, equipment, materials, and other resources with respective cost information. This measure, then, tracks the true cost of winter operations per storm and season.

Agency within acceptable difference between expected and actual use of salt and other materials in a season.

This performance measure assesses the amount of material an agency uses in a given winter season for highway maintenance. To use material usage as a performance measure multiple factors have to be included to achieve consistency from storm to storm or season to season. These factors include storm/season severity; varying levels of service; proactive approaches such as treated salt, anti-icing, and pre-wetting; computerized dispensing equipment; maintenance decision support systems; calibration of equipment; and yearly weather patterns. These factors should be considered when normalizing the usage of salt and other materials. It is also important to model expected amount of salt and material usage based on winter severity and objectives of the response. This performance measure then is an acceptable difference (plus or minus 10% for example) between the expected and actual material usage.

Objective	Identified Performance Measure
Maintain level of service during event	Percent of time road segments meet agency-defined LOS thresholds during winter storms
Meet recovery criteria set by agency	Percent of segments meeting time to regain or recover to acceptable criteria or agency-defined segments after the end of event
Meet reliability targets for specific routes	Percent of trips within accepted difference between measured travel time index and additional expected travel time index for snow and ice event on selected routes
Support safe operations of the roadway	Five-year rolling average of number of fatalities and injuries during a winter season
Meet customer satisfaction ratings	Customer satisfaction ratings for snow and ice response
Support efficient use of resources to meet operational objectives	Cost of snow and ice control to meet established performance criteria for a given winter severity
Support environmental stewardship goals	Agency within acceptable difference between expected and actual use of salt and other materials in a season

Relationship between operational objectives and performance measures

