Executive Summary, Research Readiness Level Assessment, and Technology Transfer

Assessment of Winter Maintenance Performance Objectives Using Maintenance Decision Support System

Research Objectives

The proposed project seeks to provide strategic guidance to NDOT in the development of its own suite of performance metrics by conducting an inventory of available weather, mobility, and maintenance data that may be used to create various performance indicators. The project intends to produce sample metrics with the available data and make recommendations on best options and/or additional data needs NDOT may wish to pursue.

Research Benefits

An assessment of winter maintenance performance objectives will allow NDOT to better understand its resource allocations during winter storms while combating challenges such as staffing shortages. Additionally, performance metrics can be an internal tool to enhance planning/scheduling activities and/or an external-facing tool to showcase how NDOT is servicing the public. Performance tracking may also assist with decisions on longer term NDOT investments such as physical equipment, maintenance assets, and service products. Overall, performance measures can provide an objective, independent baseline of NDOT winter maintenance activities and allow NDOT to identify subsequent actions to promote greater efficiency and effectiveness of its operations.

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Background

NDOT has made significant investments in winter maintenance operations including the procurement of a Maintenance Decision Support System, acquisition of dedicated weather operational expertise, and the development and refinement of a winter severity index. These resources have improved NDOT's internal operations, coordination with its partners, and its statewide level of service; however, specific quantification of performance is necessary to maintain and improve NDOT service to its customers. Historically, NDOT has used traffic mobility data to assess performance along the Interstate 80 corridor in terms of speed recovery after a winter storm. This metric has limitations in specifically quantifying NDOT's winter maintenance operations performance such as its responsiveness to the actions of adjacent state road closures (e.g., Wyoming) and the influence of commercial vehicle congestion when the road initially reopens. Other states have considered metrics such as friction measurements, leveraging camera images to identify time to bare pavement, road condition reports, and more. The proposed project seeks to provide strategic guidance to NDOT in the development of its own suite of performance metrics by conducting an inventory of available weather, mobility, and maintenance data that may be used to create various performance indicators. The project intends to produce sample metrics with the available data and make recommendations on best options and/or additional data needs NDOT may wish to pursue.

Conclusion

It is important for transportation agencies to assess their winter maintenance operations performance to identify areas for improvement and/or resource investment to maintain optimal levels of service, mobility, and safety. This study explores nine winter snowstorms in Nebraska during the 2023-2024 winter season across 20 road segments, 12 of which were along the Interstate-80 corridor. Datasets explored include meteorological information, traffic mobility insights, winter maintenance operations activities, and road conditions before, during, and after the periods of accumulating snowfall. Statistical analyses explored correlations and quantitative relationships among these datasets, while visual dashboards were developed to promote more qualitative considerations of factors that most influenced winter maintenance operations performance. Across these datasets, time, or duration, was found to be the most meaningful performance metric. The utility of time as a performance metric applied across all considered datasets to include factors such as the duration of snowfall or blowing snow conditions, the duration of speed reductions, road closures, or road condition degradation, and the duration of winter maintenance operation activities such as plowing or chemical applications. Traffic mobility insights, most notably speed disruptions which included speed reductions and road closures, were found to be the most important singular performance metric. Despite this importance, it is imperative to highlight that speed disruptions can result from external factors such as vehicular crashes and congestion associated with adjacent state road closures. All assessed metrics had strengths and limitations which warrant further scrutiny and caution regarding their use as a sole performance metric. The most important conclusion of this study is that a holistic consideration across multiple metrics offers the greatest benefit in the assessment of winter maintenance operations. The best lens is the broadest assessment which allows for consideration of both individual metrics as well as the relationships among various metrics in both time and space.

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NDOT Recommendations Based Off Research Project – 2026 – RRL4

This research concluded that traffic mobility, specifically speed disruptions and road closures, is the most important performance metric. Disruption duration was also found be an important supporting performance metric. NDOT's implementation strategy will focus on the following components:

• Dashboard Development: Develop a performance dashboard that communicates mobility metrics to practitioners, district personnel, and executive leadership in a clear and actionable format.

• Sensor Integration: To obtain real-time or near real-time condition data, NDOT should prioritize investment in physical sensors (including friction, grip, surface condition, and visibility sensors) rather than additional research studies. These data sources will support improved operational decision making.

• Variable Speed Limits (VSL): Ongoing VSL work on the I-80 corridor provides a related pilot opportunity. Sensors deployed for VSL will help verify whether speed reductions correlate reliably with deteriorating pavement or weather conditions. NDOT will be using temporary speed sensors under FY26(059), Selection, Integration, and Effectiveness Study of Input Data for Nebraska Variable Speed Signs on I-80, which will help inform next steps for this research and guide long-term implementation.

- *As provided by Tom Renninger and Mike Mattison, Lead TAC Members*

Research Readiness Level (RRL) Assessment

RRL 4

Level 4: Implementation with Follow Up

Revisit project status in 3 years.

Technology Transfer

Webinars/Presentations

- Kauzlarich, T. S., A. Farhan, C. L. Walker, M. Anderson, A. Khattak, and L. Chen, 2025: Leveraging Weather and Transportation Data in Support of Winter Maintenance Operations Performance. Available online at: https://ams.confex.com/ams/105ANNUAL/meetingapp.cgi/Paper/456118
- Kauzlarich, T. S., C. L. Walker, M. Anderson, A. Farhan, A. Khattak, and L. Chen, 2026: Developing a Framework to Assess Winter Maintenance Operations Performance. Available online at: https://ams.confex.com/ams/106ANNUAL/meetingapp.cgi/Paper/473897

This brief summarizes Project SPR-FY24(029)
"Assessment of Winter Maintenance Performance Objectives Using Maintenance Decision Support System"
Nebraska Department of Transportation Research Program