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DEPARTMENT OF TRANSPORTATION

OFFICE OF RESEARCH & INNOVATION

TECHNICAL SUMMARY

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$75,270

DMS can be used to inform drivers of adverse road conditions when conditions are not visible.

Effect of Real-Time Winter Road Condition Messages on Driver Behavior

During winter weather events, dynamic message signs that display real-time road condition information can result in reduced driving speeds and safer following distances. Researchers identified important factors for MnDOT's consideration when deciding how, when and where to use safety messaging during winter storms.

What Was the Need?

To help make roads as safe as possible in winter, MnDOT uses dynamic message signs (DMS) to display weather advisories to drivers. Roadside pavement sensors can provide real-time road condition data for these warning messages, alerting drivers to conditions ahead.

With over 300 DMS currently available in Minnesota and sensors installed in roadways across the state, increased use of weather messaging has the potential to provide a highly cost-effective impact on crash rates and mobility.

MnDOT needed to better understand the effectiveness of these messages to determine whether drivers actually pay attention to the signs—slowing down and leaving more distance between the cars in front of them.

What Was Our Goal?

MnDOT engaged researchers to measure how DMS with weather-related messages affect driver behavior on a particular instrumented stretch of highway. As part of this effort, researchers needed to determine how best to measure and quantify changes in driver behavior.

What Did We Do?

Researchers first reviewed literature focused on the influences of driver behavior, metrics and data sources used to evaluate DMS effectiveness, and specific data analysis and interpretation methods. This review led researchers to choose speed changes and following distances to measure changes in driving behavior.

They then designed and collected data along a portion of U.S. Highway 12. Deployed along the corridor were roadside pavement friction sensors that detected any adverse conditions. The road condition data then informed cautionary warnings on DMS. Traffic sensors located before and after the DMS recorded driver speeds and other variables to note any changes in driver behavior after passing the displayed warnings.

The DMS–traffic sensor configurations measured both eastbound and westbound traffic. In the eastbound direction, the DMS was located outside Delano, Minnesota, and traffic continued into a rural area where the friction and traffic sensors were placed. In the westbound direction, the DMS was in Maple Plain. Drivers went through multiple intersections and experienced lane configuration changes before reaching the rural area and the traffic sensor.

Finally, researchers analyzed data from the experiment for 14 weather events during the 2020-2021 winter season. They used corresponding baseline periods for each weather event—in which road conditions were normal—to compare driving behavior in the same locations and general time periods.

What Did We Learn?

In many cases, alerting drivers to icy or snowy roads resulted in drivers slowing down. Average speeds decreased 3.5 mph in the eastbound direction. There were also some increases in driver

continued

"This study showed DMS can prompt drivers to slow down. The results will be very valuable for MnDOT districts in deciding whether and where to place DMS during winter weather events."

—Garrett Schreiner,
Freeway Operations Engineer, MnDOT Regional Transportation Management Center

"The eastbound results were really promising for decreasing speeds during winter weather, and all the results will allow MnDOT to be strategic and cost-effective in placing DMS to provide driver warnings."

—Skylar Knickerbocker,
Co-Director, Real-Time Analytics in Transportation Laboratory, Iowa State University

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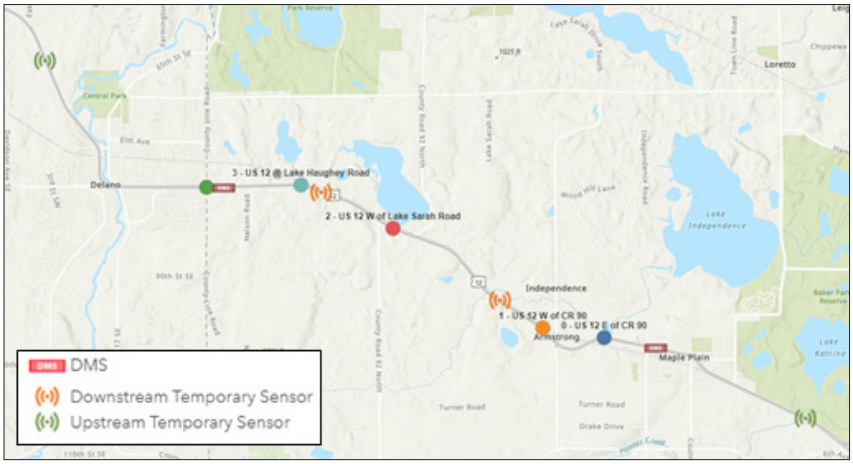

DMS and corresponding sensors were located in eastbound and westbound lanes along U.S. Highway 12.

following distances after passing the warnings, but those benefits were less pronounced than the speed decreases.

The decreases in speeds were greater during milder storm events with less participation. Researchers surmised that during strong winter storms with heavy snow or ice, adverse road conditions were more obvious and drivers already travel at slower speeds. DMS road condition warnings when conditions are adverse but not visually apparent can lead to more informed and prepared drivers.

The westbound traffic results were more mixed. While researchers recorded some decreases in driving speeds after the DMS, these observations were not consistent or significant. They identified multiple variables to explain the difference in results between eastbound and westbound traffic. For example, the DMS for the westbound traffic was in Maple Plain, whereas the DMS for the eastbound direction was outside Delano. After westbound drivers saw the safety messages, they still had urban traffic to navigate before entering the rural area where the traffic sensor was located.

These study results, including the mixed westbound results, provided valuable information for MnDOT to consider when using DMS for winter road condition warnings across the state:

- Road conditions in different maintenance districts may vary under adverse conditions due to different plowing schedules or techniques.
- Placing DMS in an urban area to message for impacts in a rural area may not be effective for various reasons.
- Road condition warnings on DMS may be most effective when adverse conditions are not visible.
- Traffic volumes may have an impact on driving speeds.

What's Next?

These study results raise some questions about the variables that impact driver behavior during winter weather such as differences between urban and rural areas and severity of storm events. While MnDOT may further examine these issues, the agency will use these study results now to inform how, when and where to display winter road condition messages on the existing DMS networks throughout the state.

This Technical Summary pertains to Report 2021-25, "Evaluation of Road Weather Messages on DMS Based on Roadside Pavement Sensors," published October 2021. The full report can be accessed at mndot.gov/research/reports/2021/202125.pdf.