

RESEARCH SPOTLIGHT

Project Information

REPORT NAME: Quantifying Effectiveness and Impacts of Digital Message Signs on Traffic Flow

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Benefits of dynamic message signs on driver behavior and traffic flow

A dynamic message sign (DMS) can be an effective tool to keep drivers informed of road conditions and traffic flowing smoothly. With finite resources, the Michigan Department of Transportation (MDOT) needs to invest in message sign uses that result in the greatest benefits. A multi-faceted research study identified effective DMS practices and messaging refinements for the agency to consider, providing a clear strategy for maximizing the benefit of DMS deployments.

PROBLEM

For more than four decades, MDOT has used digital signs with changeable messages to alert drivers to inclement weather, crashes and other incidents. Today, more than 200 DMSs are managed by the agency's traffic operations centers. In addition to safety campaigns, keeping drivers informed with real-time messages related to congestion, road condition and travel times can be an effective way to manage traffic and enhance safety.

Given the myriad possible DMS applications but with limited resources available, MDOT has to be strategic in when, where, why, and how DMSs are deployed and messages are displayed. The agency needed to understand the usefulness and cost-effectiveness of DMS technologies and practices to guide investment and maximize traffic flow improvements.



The majority of MDOT's DMSs are deployed in urban areas where there is more congestion and variable travel times. Other DMS applications, such as weather warnings, are useful across the state.

RESEARCH

With the goal of assessing the effectiveness of different DMS types, purposes and deployments in Michigan, researchers undertook a multifaceted approach to explore driver perceptions, traffic data and observations, simulations, and economic analyses.

“This research gave us quantified benefits of having portable or fixed dynamic messaging capability in specific places for certain purposes, allowing MDOT to take a more holistic approach to managing these tools.”

Eliseo Gutierrez
Project Manager

After reviewing past DMS studies in Michigan and literature pertinent to other states’ practices and guidelines, researchers surveyed road users in the state for feedback on their preferences and perspectives on DMS applications. They also examined drivers’ understanding of and compliance with the signs’ messages.

Collecting data from sources including MDOT traffic counters, road weather monitoring, traffic sensors, and video cameras, a series of field case studies evaluated the signs’ impacts on driver behavior, including:

- Whether drivers’ speeds vary in response to weather-related messages.
- Whether drivers divert from their original routes based on DMS displaying alternative route travel times.
- Whether portable DMSs at construction sites improved traffic flow.

Researchers then performed cost-benefit analyses on these three practices.

Additionally, case studies helped assess the feasibility of automating weather-related messages and addressed the accuracy of displayed travel times. Researchers also conducted a virtual-reality laboratory experiment in which participants used driving simulators to demonstrate comprehension and the effectiveness of MDOT’s practice of presenting alternating messages on the same screen (known as “message phasing”).

RESULTS

Researchers found that many of MDOT’s existing DMS practices are cost-effective, encourage safer driving and improve traffic flow. Weather-related messages effectively slow drivers traveling over the speed limit while portable signs with messages placed in work zones can help drivers merge earlier and keep traffic flowing more evenly. When traffic was slowed due to congestion or an incident, displaying alternative routes on DMSs improved traffic flow. Also, as displaying accurate travel times is essential for maintaining drivers’ trust, researchers compared posted times with the time actually required to travel the specified distance. The effort showed DMS-displayed travel times are generally accurate, though higher traffic volumes and other factors can affect actual travel times in urban areas.

In analyzing the economics of these applications, the research showed certain benefits, such as travel time savings and potential reductions in speed-related crashes, outweighed the costs of deploying and operating the equipment.

Researchers also identified ways MDOT could increase DMS effectiveness.

Message clarity: Surveyed Michigan road users indicated they are more likely to comply with messages that are brief, easy to understand and specific. In addition to text color (yellow text on a black background was found to be most visible) and having enough signs that drivers notice them, the wording of the message matters as well. When a message includes a location, such as for an incident or a congested stretch of road, street name suffixes (such as St. or Rd.) should be used. Also, the distance to the incident and travel times for a suggested alternative route should be included.

Message phasing: The virtual-reality laboratory experiment illustrated a connection between message phase time and drivers’ comprehension of the message. The ability to read the alternating messages on a DMS when phasing was used was the most significant issue identified by drivers. Driving speed, message display time and message length were factors affecting understanding.

IMPLEMENTATION

The research project results will be useful in considering any updates to MDOT’s DMS guidelines and will inform the agency’s Transportation Operations Centers in altering current practices. The cost-benefit analyses will help prioritize deployment of message signs for work zones, inclement weather and alternative routing.

In addition, a case study examining the pairing of environmental sensor stations with DMSs will inform MDOT’s [research in progress](#) on automated DMS warnings on icy bridges, as well as related future studies. DMS technology advances, including full-color displays, may prompt further study as well.

Research Administration

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