



# *Project Summary*

*Texas Department of Transportation*

## 0-6167: Assessment of Need and Feasibility of Truck-Mounted Changeable Message Signs (CMS) for Scheduled and Unscheduled Operations

### *Background*

Scheduled and unscheduled operations (e.g. pothole patching, snow/ice removal, incident management) where work is only present at any one location for a very short time are particularly challenging to highway agencies tasked with ensuring safe and efficient travel approaching and passing these operations. The temporary traffic control (TTC) required for most long-term work operations is relatively extensive. Many of the established devices to be used for such purposes, most specifically portable changeable message signs (PCMS), are not practical for application to mobile or very short duration activities as the deployment of such equipment would take as long or longer than the operation itself.

Truck-mounted changeable message signs (TMCMS) appear to offer significant opportunities to improve both motorist and worker safety at scheduled and unscheduled operations where traditional TTC support has been limited. Since current CMS message design guidance addresses traditional character signs and does not provide specific guidance on appropriate messages for scheduled and unscheduled operations, researchers had to determine which types of operations and roadway conditions TMCMS may be best suited for. Furthermore, researchers needed to determine which messages or symbols should be displayed for the given work zone operation and roadway condition to maximize motorist and worker safety.

### *What the Researchers Did*

A nationwide survey was conducted with researchers and practitioners including supervisors of maintenance personnel and emergency management coordinators to help identify existing issues for various work activities that are done as scheduled and unscheduled operations, what issues or hazards work crews are encountering with regard to the motoring public, and situations where a TMCMS could provide significant benefits.

Next, researchers created a list of possible scenarios where the use of TMCMS may be effective in providing information to the motoring public and developed message and application alternatives to address those scenarios.

A human factors laboratory study was conducted to evaluate motorist comprehension and preference of the information alternatives at several locations in Texas. The study consisted of five different types of human factors methodologies, which included comprehension analysis, response time analysis, fixed time recall analysis, wet paint lane line identification analysis and preference analysis.

### *Research Performed by:*

Texas A&M University - Kingsville (TAMUK)

Texas Transportation Institute (TTI),  
The Texas A&M University System

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Researchers included a combination of both symbol and text messages in this study for various scenarios, which included symbol versus text message to convey an accident condition, symbol versus text message to convey a road work condition, symbol versus text message to convey lane blocked information, lane closure action statements and wet paint lane lines identification analysis.

Field studies were performed to evaluate the most promising message and application alternatives at real work zone operations in Texas. Researchers employed a passive observation methodology following a TxDOT crew that was using TMCMS and documented motorist behaviors (braking, lane changes, erratic maneuvers) when different information alternatives were displayed. Camcorders were placed on two different data collection vehicles positioned at the shadow vehicle and along the convoy to record videos of passing motorist behaviors. Researchers also documented vehicle speeds as motorists approached and moved around the convoy.

## What They Found

Researchers developed guidelines to address the issues of design and application for the use of TMCMS during scheduled and unscheduled operations based on the results of both the human factors laboratory studies and the field evaluation of the information alternatives and with the input from the project monitoring committee. Research identified percent correct interpretation of each alternative display and application, and the average/variation in interpretation and preference across subjects. Researchers determined many key points regarding motorist interpretation of TMCMS messages. The following bullets summarize these points:

- The accident symbol was well understood and showed a benefit in motorists' ability to recall the situation in very limited viewing time situations.
- A roadwork symbol that is a variation on the traditional working man sign will be well understood by motorists. Researchers recommend using the working man figure without the symbol outline as this had the best reaction time by study participants.
- Lane blocked symbols similar to the traditional TxDOT sign for this application was found to work well in communicating with drivers.
- In defining wet paint lines during striping operations researchers recommend the following phrase usage:
  - Two-lane, two-way facility: WHITE LINE WET or WET EDGELINE,
  - Two-lane, two-way facility: YELLOW LINE WET or WET CNTRLINE,
  - Multi-lane facility: WHITE LINE WET (for lane dividing lines/right shoulder line) or WET EDGELINE (for right shoulder line only), and
  - Multi-lane facility: YELLOW LINE WET (for median/directional dividing line).
- When using an action statement at a lane closure, researchers recommend that either STAY IN XX LANE or USE XX LANE would be appropriate.

## What This Means

This study of TMCMS served to address questions concerning what information should be displayed, the format in which information should be presented to the driver, the types of applications that TMCMS are best suited for, and other issues associated with the use of TMCMS.

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