



Project Summary Report 0-4023-S

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Project 0-4023: Automated Dynamic Message Sign  
Message Design and Display

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## Effective Message Design and Display for Dynamic Message Signs

Dynamic message signs (DMSs) are being deployed extensively in major metropolitan areas in Texas. Motorists expect the information displayed on DMSs to be consistent across the state. Therefore, it is important that the messages are formatted consistently among Texas Department of Transportation (TxDOT) districts (see Figure 1 for an example of an effective message). In this project, the researchers developed user-friendly guidelines for designing and displaying DMS messages for incidents, roadwork, AMBER alerts, floods, ozone alerts, major catastrophes, and other situations. A proof-of-concept software package was also developed to assist with designing messages.

### What We Did...

The research was conducted in two phases. Phase 1 involved



Figure 1. Example of Effective Message.

development of a DMS operations manual for DMS operators in Texas for incidents and roadwork, and a proof-of-concept software program to aid in the design of associated DMS messages.

The *Dynamic Message Sign Message Design and Display Manual* was written for use by TxDOT personnel who have responsibility for the operation of and/or message design for large permanent or portable DMSs. The manual is

designed to help both new and experienced users of DMSs at various levels of the agency including:

- entry-level personnel,
- personnel very experienced with traffic operations, and
- managers.

Phase 2 involved the conduct of focus group and human factors laboratory studies to assess other types of messages, update of the DMS operations manual, and update of the proof-



of-concept software package. The other types of messages included:

- AMBER alerts,
- major catastrophes,
- planned special events, and
- inclement weather and environmental conditions.

Once the human factors studies were completed, the researchers developed guidelines and then incorporated them into a revised edition of the *Dynamic Message Sign Message Design and Display Manual*. The proof-of-concept software was then updated. The new modules include a set of suggested policies and policy statements for consideration by TxDOT in developing a statewide policy on DMS operations.

### What We Found...

If all of the information desired by drivers during an incident, roadwork activity, or other roadway event were put on a DMS, it would far exceed the drivers' information processing capabilities. Therefore, as depicted in Figure 2, the message design process presented in the manual helps TxDOT sift through all of the desired information and "funnel" that which is most critical into the best DMS message for a particular set of conditions.

The focus group and human factors laboratory studies conducted in Phase 2 yielded a number of important results with implications for DMS message



Figure 2. Message Design Information Funnel.

design. Some of the key findings are as follows:

- More information is currently displayed on DMSs during AMBER alerts than motorists can read and recall. The messages are overwhelming when license plate and telephone numbers are displayed. Drivers prefer the terms KIDNAPPED CHILD or AMBER ALERT in contrast to ABDUCTED CHILD and MISSING CHILD.
- It is important to inform drivers when high water settles on or flows across the freeway even though drivers can still drive through the water. However, when the freeway is completely flooded, drivers want to know that the freeway is closed, the location of the closure, and what exit ramps to take to avoid the flooded freeway section.
- Only a small majority of drivers understand the word OZONE when used in a DMS message. Overall, none of the terms OZONE WARNING, OZONE ADVISORY, OZONE ALERT, or OZONE ACTION garnered a majority opinion with respect to the severity of the environmental situation. Approximately 90 percent of the participants stated that when any of these terms are displayed on a DMS, the message applies to today rather than tomorrow.
- With regard to terms that can be used to convey freeway locations of incidents, roadwork activity, or other roadway events, the term PAST [*cross street*] was



interpreted by 99 percent of the participants to mean that the incident is past the exit ramp leading to the cross street. Similarly, the term BEYOND [cross street] was interpreted by 95 percent of the participants to mean that the location of the incident was after the cross-street exit ramp. The term AT [cross street] was slightly less effective, interpreted by 85 percent of the participants as a location beyond the exit ramp.

- When presented with the term BEFORE [cross street], only 65 percent of the participants believed this message would mean that the incident was located prior to the exit ramp, thereby making it impossible to exit at the street referenced in the message. However, another 34 percent interpreted the message to mean that the incident was located between the exit ramp and the cross street, implying that those participants believed they could still use the exit ramp for the cross street referenced in the message.
- To indicate a section of freeway is closed, 86 percent of the participants interpreted the term pair FROM [cross street 1] TO [cross street 2] as beginning after the exit ramp for cross street 1 and 97 percent interpreted the message to mean the end of the closure as being prior to the entrance ramp of cross street 2. The results

imply that the participants interpreted the message to mean they could reenter the freeway immediately after cross street 2.

- The interpretation of the term pair BETWEEN [cross street 1] AND [cross street 2] was similar to the FROM/TO term set. In response to the term pair BEYOND [cross street 1] TO [cross street 2], 79 percent of the participants believed that the start of this closure was after cross street 1. Perhaps more importantly, 97 percent again believed that the message would mean that the closure began after the cross street 1

exit ramp. Regarding the location of the end of the closure, 90 percent of the participants stated the end as being prior to the cross street 2 entrance ramp.

### The Researchers Recommend.....

The *Dynamic Message Sign Message Design and Display Manual* prepared as part of this project should become TxDOT's standard for the design and display of DMS messages.

Recommendations from the results of the Phase 2 focus group and human factors laboratory studies are shown in Table 1.

Table 1. Phase 2 Recommendations.

Condition	Recommendations
AMBER Alert	<ul style="list-style-type: none"> <li>• Use term KIDNAPPED CHILD in message</li> <li>• Include vehicle description in message</li> <li>• Use short or easily remembered call letters (i.e., 911 or 1-FIND-A-CHILD) for telephone number</li> <li>• Use TUNE TO RADIO or TUNE TO XX radio station to provide more information to drivers</li> </ul>
High Water and Flood	<ul style="list-style-type: none"> <li>• Display message when standing water is on road, even if passable to vehicles</li> <li>• If road is flooded, use term CLOSED to alert drivers to exit roadway</li> <li>• Include exit information or other action in message; use street name instead of exit number if possible</li> <li>• If freeway name is included in message, display I-XX [direction]</li> </ul>
Ozone Alert	<ul style="list-style-type: none"> <li>• Specify TOMORROW if condition is predicted for next day</li> <li>• Include a driving behavior change in message</li> </ul>
Incident Location	<ul style="list-style-type: none"> <li>• Use PAST or BEYOND [cross street] instead of AT [cross street]</li> <li>• Use BEFORE [cross street] if location is prior to the cross-street exit ramp</li> <li>• Use either FROM [cross street 1] TO [cross street 2] or BETWEEN [cross street 1] AND [cross street 2] when the location is between [cross street 1] exit ramp and [cross street 2] entrance ramp</li> </ul>



## For More Details...

The results of interviews with personnel from five TxDOT traffic management centers as well as DMS message design decision flow charts, are included in Report 0-4023-1, *DMS Message Design and Display Procedures*. Software design requirement specifications for the stand-alone software package are documented in Report 4023-2, *Requirements Specification for DMS Message Optimization Software Tool (MOST)*. The results of the Phase 2 focus group and human factors laboratory studies are contained in Report 0-4023-4, *AMBER Alert, Disaster Response and Evacuation, Planned Special Events, Adverse Weather and Environmental Conditions, and Other Messages for Display on Dynamic Message Signs*. Efforts to develop guidelines for effective DMS message design and display are summarized in Report 0-4023-5, *Effective Message Design for Dynamic Message Signs*. Design guidelines for effective DMS messages are in Product 0-4023-P3, *Dynamic Message Sign Message Design and Display Manual*.

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