Driver Use of En Route Real-Time Travel Time Information

Project White Paper

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Task Order 28

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1. Project Objectives

This White Paper provides an abbreviated description of the methods, findings, and conclusions of the project "Driver Use of En Route Real-Time Travel Time Information." It also provides recommendations for further research and for fostering the implementation of the research findings. A more comprehensive description of the research methodologies and detailed findings may be found in the project Final Report (Lerner, Singer, & Robinson, 2009).

The purpose of this project was to conduct human factors research to establish a basis for the effective provision of en route real-time travel time information. The focus was on freeway-based changeable message sign (CMS) displays that provide travel times to destinations or related information (e.g., amount of delay, traffic congestion) to motorists. Travel time is a key piece of information that drivers wish to know. Communication and display technologies now make the provision of such information cost-effective. Consequently, many locations in the United States now provide real-time travel time displays on their freeway system. However, local practices in the format of display and the information content of the sign vary considerably from place to place. Two recent reviews of current practice show this (Dudek, 2008; Westat, 2007, an interim report under the present project, discussed further in Section 2.1). Foreign practice shows even greater diversity, including more use of diagrammatic signing and color coding. The goal of this project was to examine the range of alternative practices and their influences on driver decisions and attitudes, in order to provide preliminary suggestions for effective ways to provide en route real-time travel time information.

2. Overview of Research Methods

The project was comprised of three primary research activities. The first of these was a review of technical literature and current practice regarding the use of en route real-time travel time information. The second was a study of the self-reported behavior and information preferences of commuters in several cities in which en route real-time travel time displays are provided on freeways. The third was a laboratory study of driver comprehension and interpretation of display alternatives.

2.1 Review of technical literature and current practice

This task reviewed recent technical literature related to the provision of en route real-time travel time information and also sought information on current practices and rationale regarding the use and display of travel time information in the United States. The information was collected through keyword computer search, scans of key journals and reports, internet searches of local or regional transportation departments, expert contacts, and information requests submitted through various technical organizations, including the TMC Pooled Fund Study Participants, the Transportation Research Board (technical committees on User Information Systems, Intelligent Transportation Systems, Freeway Operations), the Institute of Transportation Engineers, and the American Association of State Highway and Transportation Officials (Standing Committee on Highways). The findings of research and practice were synthesized around a series of research or implementation questions (e.g., How should travel times be shown? How should travel time

destinations be defined? What factors influence whether drivers choose to divert? How can color be used on travel time displays?). The complete synthesis may be found in Westat, 2007).

2.2 Driver experience with en route real-time travel time displays

This study was conducted with samples of freeway commuters in three metro areas (Atlanta, Milwaukee, Seattle) that employ travel time signs but that have distinct practices from one another. In each city, the commuters in the sample drove a common corridor that included multiple CMS displays of travel time. The study had two components. First, the participants took part in focus groups to discuss their use of travel time signs, perceived benefits and limitations to usefulness of these signs, information needs, and comparison of alternative display formats (shown by the researchers). Subsequent to the focus groups, the participants completed trip logs for each morning and evening commute for a two week period. These logs described travel time influences on driver route choice, confidence in routing decisions, adequacy of information, other information needs, observed effects on traffic, and so forth. At total of 45 freeway commuters took part in the study.

2.3 Driver comprehension and interpretation of display alternatives

This laboratory study manipulated many aspects of travel time displays in order to assess the effects on how research participants understand and react to the signs. The 49 participants were all regular commuters along the I-270 corridor in Maryland (suburban Washington, DC), a route that currently contains no actual travel time displays. The participants were put in simulated trip scenarios (morning or evening commutes in moderate or heavy congestion) along their typical route. Travel time displays were presented on a computer screen and the participant clicked their computer mouse as soon as they felt they acquired the relevant sign information (or up to a 5-second maximum). The sign then disappeared and a series of rating questions were presented. The data collected included response time (information processing time), subjective difficulty of processing the information, decisions about diversion, and confidence in routing decisions. The experiment included 76 different displays, across which numerous display variables were systematically varied. For example, these factors included number of destinations, type of header, sign layout, destination designators, time ranges, time stamps, distance information, color coding, and diagrammatic elements, among others.

3. Summary of Research Findings and Conclusions

The findings of this project are extensive in their detail. With several different study methods, multiple dependent measures, and numerous travel time display factors, a full discussion of the findings is lengthy and complex. It is not readily capsulized. The project final report (Lerner et al., 2009) provides the full detail. For purposes of this White Paper, we highlight some of the selected key findings and then summarize conclusions as they related to suggested practice.

3.1 Selected Findings

The following selection of highlighted findings is drawn from the focus groups, driver logs, and laboratory experiment of this project.

- Drivers (regular commuters, in particular) like having travel time displays and consider them useful.
- Despite the positive attitudes toward travel time displays, it is difficult to find substantial effects of these displays on actual route decisions. Many participants in the focus groups felt that once they were on the freeway, they did not have viable options, except perhaps under extreme circumstances.
- Travel time displays help set driver expectations for the trip and are felt to reduce frustration.
- There was little indication in the focus groups or driver logs that travel time displays were causing problems of traffic slowing, risky driver actions, or driver distraction.
- People are unsure of how frequently travel times are updated, which contributes to perceived credibility. There was not consensus among focus group participants on the perceived accuracy of the times. There was some feeling that posted travel times were underestimates when congesting was increasing during peak periods.
- Travel time is clearly the preferred type of information, as opposed to average travel speeds or levels of congestion.
- Drivers do not report much difficulty in dealing with the information displays on travel time signs while driving. However, a number of signs tested in the laboratory study appeared to require excessive viewing time or cognitive effort. In general, this high demand came from the more complex diagrammatic signs, signs with more than three lines of text, signs with more that 6 information units, and signs with unusual or unfamiliar features.
- Although diagrammatic signs generally required more cognitive processing effort that text signs, simple diagrammatic signs, with linear depictions of the route ahead, were comparable to text signs in terms of the amount of viewing time required. Many, though not all, participants in the focus groups expressed favorable interest in diagrammatic signs, because they can show the location and extent of congestion, compare alternative paths, and detect congestion levels at a glance (through color coding).
- Certain types of alternative or supplemental information that have been used or suggested for travel time displays did not appear advantageous. These include distance to the destination, traffic speed, time estimate ranges, time stamps, time trend indicators, and color coding of text.
- Some layout formats were more effective than others. A travel time banner (TRAVEL TIME TO) as part of the display was not seen as useful in the focus groups and did not contribute to performance in the laboratory study.
- A greater reported willingness to divert from a planned route was associated with a statement to use an alternate route, particularly with the provision of alternate route information (specific roadway, travel time).

3.2 Conclusions and Recommendations for Travel Time Displays

Current U.S. practice in the design and use of en route real-time travel time displays varies from location to location. Practices are even more varied internationally. There is little existing guidance specifically related to travel time messages. Based on the research conducted in this project, suggestions for travel time displays can be made that deal with some of the human factors issues concerning motorist perception and behavior.

It is evident from the research that commuting drivers have a favorable opinion of real-time travel time information and agencies are serving the interests of these motorists by providing such information. However, it is also the case that current travel time displays have relatively limited effects on route diversion and that some displays may be visually demanding of drivers. Some potentially useful types of information are unfamiliar to drivers and make the display more difficult to interpret quickly.

Another consideration for roadway-based real time displays is consistency with other traffic information sources. These may include other media provided by the same roadway operators (e.g., website) as well as information from other providers, such as providers of in-vehicle travel information and radio or television traffic reports. There may be issues of consistency in the look-and-feel of the information displays, terminology used, data sources, timeliness, and so forth. These consistency issues may result in driver confusion or poor perceived reliability. The concern with consistency among information sources was beyond the scope of this project, which dealt specifically with roadway-based displays. However, as other information sources find more widespread use, this issue may require further consideration.

Recommendations for the design of en route real time travel time displays follow, based on the project findings. Because the extent of data on any particular feature is limited, the recommendations should be treated as preliminary. Also, these general recommendations may not be consistent with some local signing practices and so may have to be adapted. It may also be noted that in contrast to some foreign applications, travel time displays in the United States are typically provided via changeable message signs that are not specifically dedicated to travel time messages. Travel time information may be the default when other, higher-priority messages are not warranted (e.g., incidents, adverse weather, AMBER Alerts). This may preclude the use of fixed sign elements that simplify the sign and allow additional sorts or amounts of information. The recommendations below are based on normal U.S. practice and the available findings.

- Provide travel times to destinations, rather than travel speeds or descriptions of congestion. Indicate the time units (MIN).
- Left justify the destinations and right justify the travel times.
- Normally describe destinations as street names or towns, assuming the display is intended primarily for regular commuters. Exit numbers are not recommended.
- There does not appear to be benefit to including distance to destinations, time stamps, travel time trend indicators, or color coding of text. Since trend indicators and color coding are novel, there may be potential benefits if the public becomes familiar with these concepts, but in the absence of data on this, they are not recommended.
- Limit displays to three lines of text or no more than six information units.
- Simple fixed diagrammatic signs, with a linear depiction of the roadway and including a dynamic display of travel time, are acceptable. More complex map diagrams and/or diagrams with more than three destinations appear to be too difficult to readily interpret under driving conditions.
- Route diversion appears difficult to encourage with freeway-based travel time displays. Drivers frequently feel committed to their original decision or feel that there is no good alternative route at that point. There is some indication that travel time information may

have more influence on route diversion if it is provided prior to freeway entrance (on the surface street approach to the freeway). There is some limited U.S. use of arterially-located travel time displays but no formal assessment. Exploration of travel time displays on approaches to freeways is suggested, but specific recommendations for their use cannot be provided.

- To maximize route diversion in response to a freeway-based travel time display, the following display features should be considered:
    - Specifically recommend using an alternate route (USE ALT RTE)
    - Indicate a specific alternate route (VIA RT 355)
    - Indicate major delay or incident (MAJOR DELAY)
    - Provide an open-ended travel time estimate (30+ MIN)
    - Show travel times for both current and alternate route
- Convey to the public that travel times are updated frequently, but do not use the changeable message display for this purpose. Consider a fixed sign component (e.g., UPDATED EVERY 3 MINTUES) and/or public information.

4. Recommendations for Further Research and Testing Related to the Provision of Real-Time Travel Time Information

Although the research presented here addressed various design issues for real-time travel time displays, a number of issues remain open to further research and testing. Five potential research efforts are described in this section. These efforts will field validate or expand the findings and recommendations of the initial research and also broaden the context of use of en route real-time travel time displays into the broader issue of driver information and traffic system management.

The five research statements that follow are written as independent research efforts. They vary considerably in scope and required resources. Each research statement stands alone as a recommendation. In practice, it may be possible to consolidate multiple issues into a single study, should there be interest in pursuing a number of these.

4.1 Field assessment of driver behavior, diversion, and traffic flow

Problem Description: The initial research project systematically manipulated a number of travel time sign characteristics and examined the effects in a laboratory setting. The ultimate effects of various travel time displays on actual driver behavior and system performance are not certain. Promising alternatives should be systematically compared in an actual field evaluation. The effects of alternative displays should be considered at both the level of individual driver choice and confidence and at the level of traffic system performance and safety. The system level measures include such things as diversion rates, disruption of traffic (e.g., slowing to read signs, abrupt lane changing), and overall system efficiency.

Research Objective: The objective of the project is to quantify the effects of alternative real-time travel time displays on the behavior of actual motorists and traffic. Better-performing alternatives should be identified and recommendations for practice should be developed based on this.

Key Topics and Issues: Key topics include all of the major features of travel time displays, such as format, destination designation, amount of information, headers, and supplemental information (e.g. time intervals, distance, time stamps). One of the key issues to be dealt with in this research is the generality of the findings, since driver behavior in response to travel time displays will be related in part to the characteristics of the particular roadway network.

Anticipated Methodology: The project will require a controlled field study, with alternative display types implemented at different locations. To avoid confusing motorists, the designs should be implemented on a corridor or regional basis, not site by site, and comparisons will need to be made among different locales, not through a sequence of changes at a single locale. Two sorts of data should be collected. Data should be collected on traffic, including the sensitivity of route choices to sign messages, traffic speeds and congestion, distribution of traffic, and safety-related measures (e.g., slowing and bottlenecks at sign locations, frequency of abrupt lane changes, crash frequency). Data should also be collected from a sample of commuters, using some form of driver log, survey, focus group, or other self-report. This will document whether and how drivers make use of the information, what problems they may have with it, why they did or did not divert in response to information, etc.

Estimated Effort and Cost: The project is estimated to cost $500,000 over a period of 24 months. Cooperation from operating agencies will be required. This estimate does not include the cost of signage and communications equipment, which may or may not be in place or provided by the cooperating agencies.

Research Products: The project should identify and quantify the effects of preferred procedures for the use of en route real-time travel time displays on freeways. The findings will be used to derive recommendations for the design and use of travel time displays, including information content, display format, and sign location.

Potential Benefits: The project should promote more widespread and better use of en route real-time travel time displays, with resulting benefits in motorist decision making, congestion alleviation, and public response to the system.

4.2 Advance travel time displays at freeway entrance approaches

Problem Description: Consistent with some previous research, the initial project found that while motorists valued en route real-time travel time information, it was difficult to identify much actual influence of travel time displays on driver route choice and diversion. It appears that once committed to a freeway route, it is difficult to get motorists to divert. Current practice in providing travel time information generally makes use of existing CMS facilities on the freeway. The travel time information is typically provided when higher-priority messages do not over-ride them. The location of the travel time display is not necessarily optimal for supporting driver decisions and encouraging diversions from planned routes to make better use of system capacity. Travel time displays should have more influence on tripmaking if they are provided *prior* to the driver's point of commitment to a freeway route. Freeway entrances are often key choice points on a commute, where a driver commits to entering a freeway or remaining on a surface street route. Commuters express frustration at the absence of better decision information at this key

point. Examples of travel time displays on arterials in advance of a freeway entrance were found in the TMC Pooled Fund Study both in the U.S. and in foreign practice, but were not common. Although current practice on this is limited, existing implementations indicate that it is practical. There is no standard practice for such displays.

Research Objective: The objective of this project is to compare and quantify motorist response to real-time travel time displays at freeway approaches compared to displays located on the freeway itself. The project should define the benefits of travel time signs on arterial approaches to freeways and develop recommendations for the design and use of such displays.

Key Topics and Issues: The key topic is whether commuters and other roadway users make better routing decisions in response to real-time travel time information when that information is provided on the approach to the freeway. Key issues include what information to provide, what format to provide it in, and where to locate it.

Anticipated Methodology: The project should include an initial review of current practice and relevant research. The primary empirical effort should include laboratory or simulator research on display factors followed by a field evaluation of an implemented system. The field evaluation should include routing choices and diversions, roadway system performance, potential safety considerations, and a survey of local commuters who encounter the system. The project should also provide a cost-benefit analysis or other evaluative method to determine whether and when the observed benefits of providing arterial approach real-time displays warrant their use.

Estimated Cost and Duration: The project is estimated to cost $400,000 over a period of 24 months. Cooperation from an operating agency will be required.

Research Products: The research will determine the effectiveness of travel time displays as used on the arterial approach to freeways. It will provide recommendations for the design and use of such displays, including information content, display format, and sign location.

Potential Benefits: Assuming the research confirms that signing on the arterial approach has a greater effect on driver route decisions than does signing on the freeway itself, this project will foster practices that improve driver decision making and improve roadway system performance.

4.3 Modulating diversion rates based on traffic information messaging

Problem Description: Travel time displays are one example of the broader range of real-time traveler information that may be provided to motorists by CMS displays. The information provided to motorists may vary in its effectiveness in getting travelers to divert to alternate routes under conditions of congestion. Through the conduct of various projects involved with the provision of real-time information to drivers, we have repeatedly heard traffic engineers and other authorities raise the concern that they do not know how effective a message might be. They may not get an adequate response to influence roadway system performance or they conceivably might induce too many drivers to divert so that congestion problems migrate to other parts of the roadway network. Practitioners have expressed the desire to have some way to use real-time CMS displays as “valves” that could control diversion rates so that system performance can be

optimized. It is the case that message content can have substantial effects on diversion rates. One simulator study (Lerner, Llaneras, and Huey, 2000) found that while "basic" advanced traveler information increased diversion rates for drivers on a particular trip from 8% (with no real time information) to 42%, the provision of certain additional information more than doubled the diversion rate, to 88%. In practice, the absolute degree of diversion generated by real-time traveler information will be a function not only of the information provided, but also the characteristics of the roadway network, traffic characteristics, established commuter patterns, the predictability of congestion on alternative routes, and so forth. However, the prospect remains that for any network, manipulating travel time and other traveler information messages could be used to modulate diversion and the distribution of traffic in a controlled manner. The problem addressed in this project is to develop such a system of real-time CMS messages that can be used this way.

Research Objective: This project is a feasibility study to determine whether and how this approach can be used to effectively modulate diversion rates and the distribution of roadway network traffic in a predictable and controlled manner using real-time displays. It is a relatively high-risk/high-reward project. Practitioners have expressed an interest in this concept but there does not appear ever to have been a serious approach to addressing it. The project would define a set of displays that will produce different rates of diversion and then implement the system to determine whether it ultimately produces a range of predictable diversion rates.

Key Topics and Issues: The topic is broader than travel time information *per se,* although travel time displays will no doubt be a key component of the system. The topic more broadly is the relationship of real-time roadway information to driver decision making.

Anticipated Methodology: There are clearly two empirical phases to this topic. The first is to define a set of messages and display features that lead to widely different diversion rates, in a predictable way under various driving scenarios. This work can be done in a laboratory or driving simulator environment and probably would need to include a sequence of experiments and refinements. The second phase would then be to implement the system at one or more operational sites and determine what the actual effects are on diversion rates and the distribution of traffic on the network. Both of these phases are complex undertakings. The results of the empirical studies should then serve as a basis for modeling the effects of message manipulations on individual choice and traffic distribution.

Estimated Effort and Cost: The first phase of this research (laboratory/simlulator) is estimated at $750,000, over 24 months. The second phase is estimated at $750,000 over 18 months. Cooperation from operating agencies will be required in the second phase.

Research Products: This project will demonstrate the feasibility of using on-road real-time roadway information as a "valve" to systematically control the distribution of traffic among alternative routes. The set of messages and features used constitute a product that may be used by others in adopting this approach, although subsequent refinements may be warranted.

Potential Benefits: This project has the potential to provide a unique and powerful approach to controlling motorists' route choices dynamically in response to current conditions, in order to optimize the performance of the roadway network and mitigate congestion.

4.4 Potential effectiveness of diagrammatic and color coding features

Problem Description: Diagrammatic signs have the potential to convey considerable information to motorists beyond simple travel time. For example, they may show the location and extent of congestion points or provide direct comparison of alternative routes. Color coding, whether used in text or diagrammatic signs, can likewise convey information about travel speed or degree of congestion relative to normal conditions. Some enthusiasm was seen for these approaches in focus groups, though only if they were simple and intuitive. Likewise, the laboratory study observed difficulties with diagrammatic signs if they were not quite simple. The laboratory study manipulation of color or diagrammatic elements was limited, however, by the participants' general lack of familiarity with such signs. Color coding and diagrammatic features have been used in other countries, apparently with some success (though little documentation). It has also been suggested that color coding can make the display more salient when there is important information (e.g., red when there is serious congestion). This could be useful if everyday commuters tend to "tune out" on the sign. The features of diagrammatic elements and color are also common on web sites for traffic information, so they are usable by the public at least outside of the driving context. En route signing can take advantage of this parallel with associated traffic information sites. This project focuses on the development of simple and effective roadway-based displays that take advantage of color coding and/or diagrammatic features and determine whether (with some minimal degree of familiarity) they provide additional benefits over traditional text messages.

Research Objective: The objective of this research is to determine whether the potential advantages (in terms of information) of color and diagrammatic elements in travel time signs can be realized in readily comprehended displays. The project will provide prototype displays that meet motorist usability requirements.

Key Topics and Issues: Participants in the initial project were not able to benefit from the use color or diagrams in the examples in the set of travel time displays included in the experiment. It is not clear to what extent this was due to the novelty of the displays, or to less than optimal design, or to inherent limitations of such signs. This issue needs to be resolved if travel time signs are to take full advantage of new sign technology.

Anticipated Methodology: The project needs to determine whether there can be easily usable displays that provide additional information useful to motorists. This will require a sequence of developmental steps, such as the following: (1) review current examples and practice, domestic and foreign; (2) develop a range of design concepts using diagrammatic and color-coding elements in various ways; (3) conduct focus groups with roadway users to determine their interpretation, problems, changes; (4) select and refine the most promising concepts; (5) conduct comprehension testing; (6) conduct usability testing, given some familiarization with the displays. The usability testing may involve test tracks, driving simulation, or vision laboratories.

Estimated Effort and Cost: The project is estimated to cost $300,000 over a period of 18 months.

Research Products: The research will produce a set of prototype travel time displays using color and/or diagrammatic elements that are demonstrated to effective, usable, and desired by travelers. The project can also provide general guidance of "dos" and "don'ts" for the use of color and diagrammatic elements in CMS for travel time (and probably other) applications.

Potential Benefits: Assuming there are color-coded or diagrammatic displays that test well for comprehension, usability, and value of the information to motorists, traffic authorities will be able to provide more effective real-time travel time displays for motorists. These displays will be able to take advantage of the new generation of CMS technologies, including full-color, full-matrix graphic display. The provision of recommended displays will also help guard against inappropriate use of color and images by agencies who may want to take advantage of sign capabilities but lack guidance.

4.5 Dealing with traveler perceptions of travel time information accuracy, validity, timeliness, and prediction

Problem Description: There are issues with the actual and perceived usefulness of real-time travel time displays. Road users have questioned the accuracy of the information, its timeliness, and its ability to be predictive of traffic conditions X minutes in the future (when the driver may arrive at a sign destination). Some jurisdictions have dealt with this by putting a "time stamp" on the CMS display to show how recently the information was updated or by presenting travel times as intervals rather than single estimates (e.g., "4-6 minutes," rather than "5 minutes"). Neither the focus groups nor the laboratory study found these approaches to be particularly valuable. As to predictive times, this was not dealt with in the experiment except for the strategy of providing a "trend arrow" to indicate whether travel times were increasing or decreasing. The effectiveness of this concept was limited by the unfamiliarity of the participants with the display and its meaning. Thus there is a problem of providing travelers with information not only about current travel time, but about uncertainty and projected conditions.

Research Objective: The objective of this project is to determine whether there is an advantage to supplementing an en route travel time estimate with additional information that may improve its usefulness or perceived validity. Adding information to a travel time CMS display may have negative consequences in that this may increase the demand on the driver in processing the sign information or may require sign space that could be devoted to other information (e.g., adding a time stamp might preclude the inclusion of an additional destination). The goal of this research is to produce recommendations for the most effective set of information.

Key Topics and Issues: There are two key general topics related to this project. One concerns road user perceptions: do they see travel time information as accurate, timely, and useful? For example, most agencies update travel time frequently (every minute or two) but based on focus group findings, many drivers do not know this and suspect less frequent updates. The second topic concerns whether some form of projecting changes in travel time is feasible and is valuable to travelers. Issues related to this include the question of how to explain and present projected

estimates or trends and whether there may be implications for perceived validity of the travel time information.

Anticipated Methodology: The project should review strategies and practices for conveying timeliness, accuracy, time trend, and predicted times. This should not only include information presented within the CMS display, but also fixed sign panels and strategies independent of signing (e.g., public information). The project should then develop a range of alternative concepts. This process should include discussion groups or workshops with transportation professionals (e.g., traffic engineers, system operators, sign companies) as well as focus groups with drivers (and in particular, commuters). Promising concepts should then be tested in a laboratory environment. They evaluation should include comprehension, perceived validity, influence on routing decisions, and ability to process the information easily. The laboratory study should be followed by a broader survey of commuters in geographic areas with diverse travel time signing practices, to confirm that the message is widely comprehended and well-accepted. Based on the findings, prototype example displays should be designed and recommendations developed.

Estimated Effort and Cost: The project is estimated to cost $300,000 over a period of 18 months.

Research Products: The project will produce guidance on whether and how uncertainty and projected changes in travel time estimates may be provided on CMS.

Potential Benefits: Guidance produced in this project could improve public perception of real time travel time displays and greater driver responsiveness to the information provided.

5. Recommendations to Foster Implementation of the Findings

There are a number of initiatives that might facilitate the successful transfer of the project research findings and suggestions into transportation systems management. Recommendations include the following:

- Publicize through FHWA Divisions, Resource Centers, and related program activities
- Outreach through professional organizations, such as AASHTO, ITE, ITS America
- Presentation to the National Committee on Uniform Traffic Control Devices and/or the Federal Highway Administration's Office of Transportation Operations, for consideration as related to the *Manual on Uniform Traffic Control Devices*
- Conduct workshops or provide other sorts of training opportunities on the use of real-time travel time displays
- Work with manufacturers of CMS equipment to promote this application and the appropriate displays
- Disseminate the results of the project through presentations at meetings and/or the authorship of journal articles

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