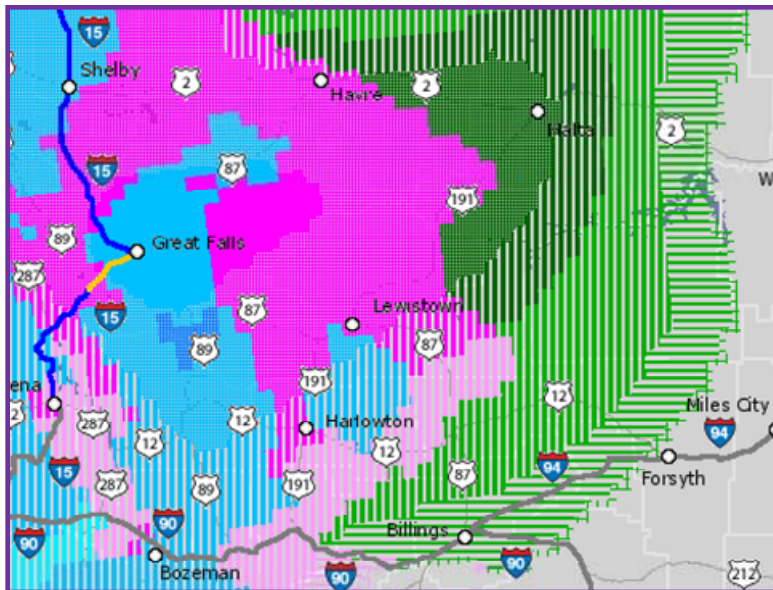# *Clarus* Multi-State Regional Demonstrations

Evaluation of Use Case #5: Enhanced Road Weather Content for Traveler Advisories

www.its.dot.gov/index.htm

Final Report — May 11, 2011
FHWA-JPO-11-120

Source for Cover Image: Meridian Experimental Website Screen Shot

Produced by Federal Highway Administration Road Weather Management Program
ITS Joint Program Office
Research and Innovative Technology Administration
U.S. Department of Transportation

1. Report No. **FHWA-JPO-11-120**	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle *Clarus* Multi-State Regional Demonstrations, Evaluation of Use Case #5: Enhanced Road Weather Content for Traveler Advisories		5. Report Date 5/11/2011
		6. Performing Organization Code
7. Author(s) Chris Cluett (Battelle) and Deepak Gopalakrishna (Battelle)		8. Performing Organization Report No.
9. Performing Organization Name And Address Battelle Seattle Research Center 1100 Dexter Avenue North, Suite 400 Seattle, WA 98109-3598		10. Work Unit No. (TRAIS)
		11. Contract or Grant No. DTFH61-06-D-00007, Task No. BA07-055
12. Sponsoring Agency Name and Address United States Department of Transportation Federal Highway Administration, Office of Operations 1200 New Jersey Ave., SE Washington, DC 20590		13. Type of Report and Period Covered Evaluation, October 2008 – May 2011
		14. Sponsoring Agency Code HOIT

15. Supplementary Notes

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16. Abstract

This evaluation report presents an assessment of the benefits of a new road condition forecast tool that offers road weather information to travelers. The tool has been developed by Meridian Environmental Technology, Inc. and has been demonstrated in selected northern tier states as part of the *Clarus* Multi-State Regional Demonstration Program under the auspices of the Road Weather Management Program (RWMP) of the Federal Highway Administration (FHWA). The use of this tool was independently evaluated under contract to the RWMP. This report identifies the hypotheses that were tested, the data collected and analyzed, and the findings from the evaluation.

17. Key Words Road Weather Management, Traveler Advisories, Road Weather Condition Forecasts; Evaluation; Focus Groups; Web Survey; *Clarus* Demonstration	18. Distribution Statement No restrictions. This document is available to the public.		
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 64	22. Price

Form DOT F 1700.7 (8-72)   **Reproduction of completed page authorized**

Preface/ Acknowledgements

The Road Weather Management Program (RWMP) within the Federal Highway Administration (FHWA), under the auspices of the *Clarus* Initiative, has sponsored a multi-state demonstration of *Clarus*-enhanced experimental tools that offer state Departments of Transportation (DOTs) new ways to mitigate the effects of adverse weather events on the operation of their transportation systems. The RWMP sponsored independent evaluations of each of these "use case" demonstrations, and this report focuses on the results of one of those demonstrations; namely, enhanced road weather systems and information for traveler advisories. Findings from this evaluation, as presented in this report, are encouraging regarding the potential benefits of a tool that offers DOTs, for the first time, enhanced road condition forecast information.

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List of Acronyms

CARS ....Condition Acquisition and Reporting System

CVO ....Commercial Vehicle Operations

DMS .... Dynamic Message Sign

DOT .... Department of Transportation

ESS ....Environmental Sensor Station

FHWA..Federal Highway Administration

HAR .... Highway Advisory Radio

ITD .... Idaho Transportation Department

MDSS..Maintenance Decision Support System

MDT ....Montana Department of Transportation

NDDOT ....North Dakota Department of Transportation

NOAA........................National Oceanic and Atmospheric Administration

NWS ....National Weather Service

RWIS..Road Weather Information System

RWMP..Road Weather Management Program

SDDOT ....South Dakota Department of Transportation

Executive Summary

The *Clarus* Multi-State Regional Demonstration Program leverages the quality-checked data available through the national network of Environmental Sensing Stations called the *Clarus* System to test and provide road weather management applications for state and local agencies. This document describes the approach and findings from an independent evaluation of the use and benefits of Use Case #5 - Enhanced Road Weather for Traveler Advisories, a tool developed and tested under the *Clarus* Multi-State Regional Demonstration Program. This tool provides enhanced road weather and pavement condition forecast information for interstates on both the state DOT's website and through the state's *Clarus*-enabled 511 system. The independent evaluation of this use case tool examined how users in Idaho, Montana, North Dakota and South Dakota could use the tool and how travelers responded to the availability of this new information, in terms of its potential value and benefits in planning and carrying out their trips.

Evaluation Approach

The approach to evaluating this use case began with the development of an Evaluation Strategy that identified the expected benefits of the tool use and developed a set of testable hypotheses. A more detailed Evaluation Plan was prepared to guide the data collection and analysis, and this was refined as more information about the demonstration and opportunities to collect data became available. South Dakota was selected as the site to conduct two focus groups (commercial and general travelers), and Idaho, Montana and North Dakota agreed to post on their traveler information websites a link to the tool demonstrated on Meridian Environmental Technology's experimental website, which also contained a traveler survey. This approach offered extensive participation among these northern tier states.

The three main objectives of this evaluation were as follows:

- Understand how the use of the road condition forecast tool offered benefits to the state DOT and to end users of the enhanced traveler information;

- Understand the value added by the tool and the information products it offered, beyond information already available to travelers in these states.

- Document the lessons learned from the evaluation to help guide further development and deployment of the forecast tool beyond this demonstration.

Seven hypotheses were specified for testing in the evaluation, two of which were related to the satisfaction of the state DOTs with the tool and the remaining five related to traveler satisfaction. The hypotheses were tested by analyzing focus group discussions with a small number of commercial travelers (held in Sioux Falls, SD) and general travelers (held in Pierre, SD) and feedback from a sample of website users (in Idaho, Montana and North Dakota) who reviewed the new tool on-line and completed a survey with questions that probed their perceptions of potential benefits of the tool, the likelihood they would use this information in their travel planning, and the usefulness of the tool in preparing for hazardous conditions and making their trip decisions. A set of questions was also asked of six state DOT stakeholders in this demonstration to help assess their perceptions of the concept and readiness of the new tool.

Evaluation Findings

The results from the focus groups, web surveys and questions for the state DOT users are presented in detail in this report. While overall support for this new road weather forecasting capability was positive and widespread across the different user groups, there were many suggestions offered for making this tool work effectively for both different user groups and different geographic locations. Results of the tests of the hypotheses are shown in Table ES-1:

Table ES-1. Identified Level of Support for the Hypotheses

Hypotheses	Evidence	Level of Support
1. DOTs will perceive the tool to constitute a useful, high quality enhancement to their current traveler information.	▪ "If the tool could be incorporated into our current road condition map information, it would provide more value." ▪ "This product has potential. The largest benefit would be from the public actually canceling travel plans when conditions are forecasted to deteriorate. Getting to the point of having the public's trust would be a tremendous undertaking." ▪ "I believe this is the direction our DOT will eventually move toward – more focus on predicted impacts to roadway conditions." ▪ "Winter weather is our state's #1 travel concern; being able to predict adverse road conditions would be very valuable." ▪ DOT officials scored "perceived need for the concept" an average of 7.7 on scale of 0-10.	High support
2. DOTs will be interested in making further investments in the tool past the demonstration phase to integrate the new information with their current traveler information (website and 511).	▪ "It will take some innovative work to integrate the tool with our current traveler information website." ▪ "The cost of providing this is not high, given that we already do road condition forecasts through the Maintenance Decision Support System (MDSS)." ▪ "Public and agency acceptance would be high."	High support
3. End users will perceive that the new tool offers valuable information to support their trip planning and decision making.	▪ 78% of web users want their DOT to integrate the new info on the state's website, and 83% say it would be a good addition.	High support
4. End users will express a willingness and desire to use the new information when it becomes available to them.	▪ Users scored "need for the tool" 8.5 on scale of 0-10. ▪ Users scored "trust in the tool" 7.1. ▪ 39% said they wanted secondary routes covered in addition to the interstates. ▪ Focus group participants say this would become another tool in their toolbox.	Moderate to high support
5. Long distance and cross-state travelers will value the new information provided consistently across state boundaries.	▪ 93% of users say providing this new info across states is useful. ▪ 100% of CVO respondents said very or somewhat useful.	Almost universal support

Hypotheses	Evidence	Level of Support
6. End users will perceive that the new forecast information will enhance the safety and mobility of their travel.	▪ 86% say the new info will help them avoid hazardous routes. ▪ Users scored "potential to improve safety" 8.6 on scale of 0-10.	High support
7. The use of the new information will result in decisions to adjust travel plans and behaviors in response to forecasts of pavement conditions.	▪ 60% of first time visitors to new website said they used the info to plan trip. ▪ Between 75% and 79% said the website is useful for making trip adjustments (timing, route, postponement). ▪ Frequent users of the new tool made proactive behavior change decisions based on the new information. ▪ Focus group participants say they use weather information, and would use this tool, to identify alternate routes in bad conditions.	Moderate to high support

Conclusions

This demonstration of a road weather forecasting capability can be viewed as reasonably successful. The experimental tool was perceived by states and travelers as needed and of great potential value, though suggestions were offered for refinements that could improve further its utility and benefit. State DOTs that may be considering offering this capability should benefit from the findings and suggestions offered in this report.

1 Introduction and Background

The *Clarus* Multi-State Regional Demonstration Program leverages the quality-checked data available through the national network of Environmental Sensing Stations (ESS) called the *Clarus* System to test and provide road weather management applications for state and local agencies. Five use cases were developed as part of the demonstration:

- Use Case #1 – Enhanced Road Weather Forecasting
- Use Case #2 – Seasonal Weight Restriction Decision Support
- Use Case #3 – Non-Winter Maintenance Decision Support System
- Use Case #4 – Multi-State Control Strategy Tool
- Use Case #5 – Enhanced Road Weather Traveler Advisories

The use case development was led by two deployment teams. Each team was comprised of a private-sector system developer and several state agencies where the use case has been tested. Two independent evaluations also were conducted. The first evaluation assessed the improvements in road weather forecasting in Use Case #1 from a meteorological perspective. The second set of four evaluations assessed the value of the remaining four use cases to the state Departments of Transportation (DOTs) during 2010 and early 2011. The evaluation of the four use cases (#2 to #5) sought to understand the systems' impacts and benefits experienced by the state agencies and end users, including transportation managers, related agencies, and travelers.

This document describes the approach and findings from an independent evaluation of the use and benefits of *Use Case #5 - Enhanced Road Weather for Traveler Advisories*, a tool developed and tested under the *Clarus* Multi-State Regional Demonstration Program.

2 Description of the Use Case

Most state DOTs offer travelers information about travel conditions that are helpful for planning and conducting trips and improving mobility and overall travel safety. Traveler information may include, for example, the location and severity of congestion, travel times, camera images of traffic conditions on selected road segments, construction schedules and activities, or accidents and delays.

Information on atmospheric weather conditions that may impact travel is also provided. Travelers can typically access this information pre-trip on their state DOT's website, or en-route from their car radio, Highway Advisory Radio (HAR), Dynamic Message Signs (DMS), or "511" telephone access. Some states also provide road condition information compiled from Road Weather Information System (RWIS) Environmental Sensor Stations (ESS) and field reports from maintenance personnel. These systems provide travelers with the latest reported road conditions. However, forecast road advisories continue to be a challenge for state DOTs given the lack of reliable, location-specific forecast weather information. Atmospheric information may sometimes lack the relevancy and usefulness of road weather information from a travel perspective, though forecasts are readily available and widely used (for example, hourly forecasts on weather.com). Observed road condition data offer travelers information pertinent to their travel, such as pavement conditions, ice formation, and snow accumulation but suffer from latency issues related to delays in communicating the information, a lack of consistent sensor coverage, and data sources that vary in quality.

This use case demonstrates a new dimension to the road weather information that could be made available to travelers. The tool provides road weather and pavement condition forecast information for both the state DOT's website and their *Clarus*-enabled 511 system. For this demonstration, the information is restricted to the interstates, but the tool can be expanded in the future to cover secondary roads. By providing current and forecasted road conditions, the use case aims to decrease the latency and improve the usefulness of road condition information systems.

Meridian Environmental Technology, Inc. (Meridian) developed the experimental road weather forecasting tool to disseminate *Clarus*-enabled forecasts and is providing, for testing purposes, the prototype "beta" system demonstration in five states, including Montana, North Dakota, South Dakota, Idaho and Minnesota. While the use case web interface can be used by various traveler information providers, for the purposes of the demonstration, the enhanced 511 (telephone-based) capability is only available in three of these states for which Meridian is the traveler information service provider. The road weather information includes forecasts up to a day ahead (12 hours) based on a decision tree that seeks to avoid conflicts with other information provided by the states and takes account of atmospheric conditions close to the surface, information from RWIS ESS in the *Clarus* database regarding pavement surface conditions, state agency road condition reports, and *Clarus*-enhanced weather and road condition analyses and forecasts to provide enhanced traveler advisories. Meridian's High Level Requirements document for this use case describes the system as follows: "The Enhanced Road Weather Content for Transportation Information Service takes observed and forecasted information and produces route-specific road weather, road conditions, and advisory messages that are relevant and useful to the traveler community."[1]

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[1] Meridian Environmental Technology, Inc. 2009. *Clarus Multi-State Regional Demonstration: High level Requirements – Use Case 5.* Prepared for U.S. Department of Transportation, Federal Highway Administration. (April 30).

During the demonstration period Meridian provided on its website a visual representation of the forecasted road condition information, and also made that information available on the 511 phone system. This is currently a limited use experimental website application that requires a password to access. Each state has had access to this website during the demonstration phase so that they could experiment with the new tool and gain a better understanding of its potential uses for their state. A visitor to the website would find a composite map of the five demonstration states showing the interstate system that is enabled to display the new information. A user could zoom in to any one of the states. Figure 1 illustrates how the road condition forecast information was provided with an example from South Dakota.
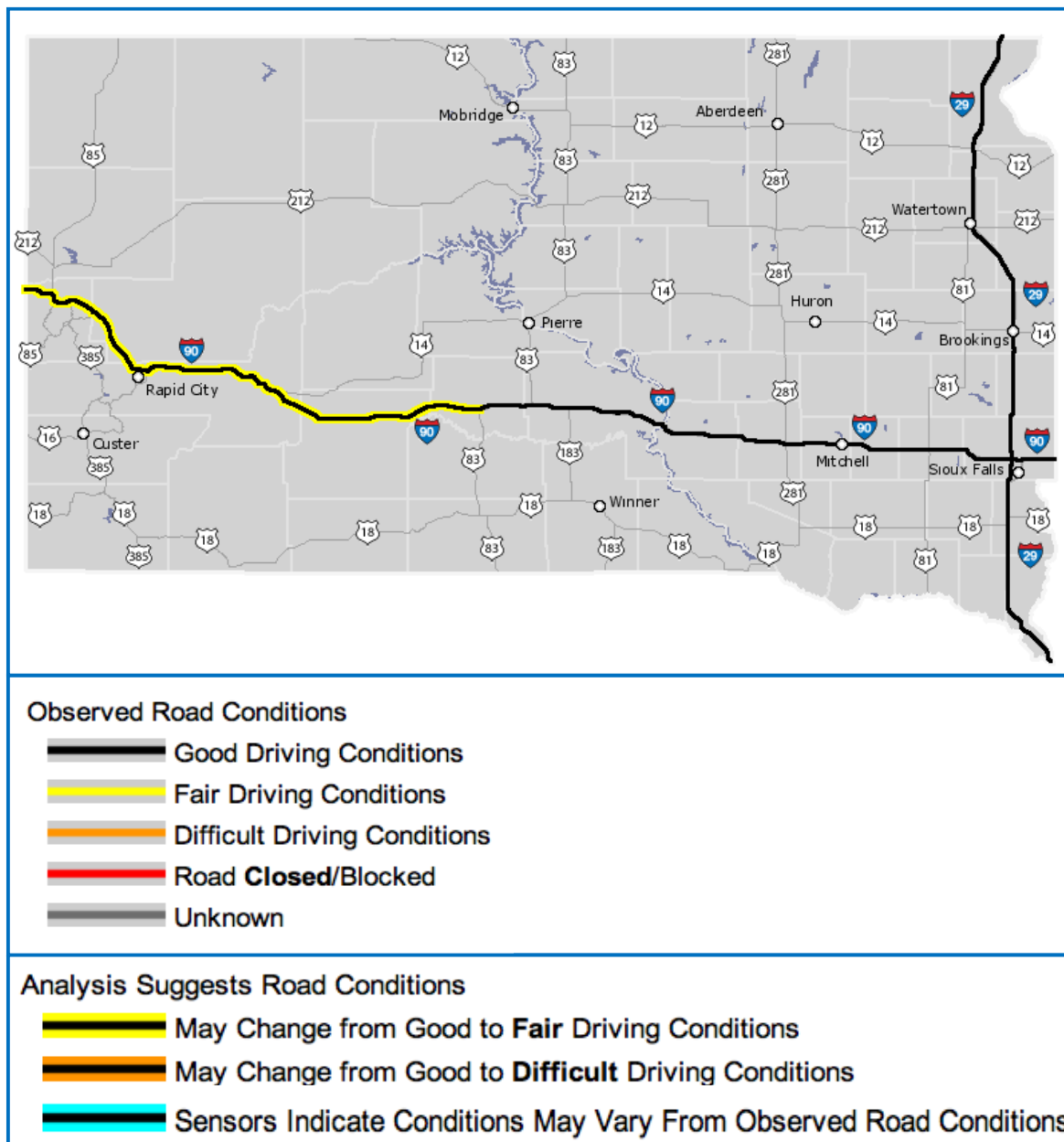
Source: Meridian's Experimental Website

Figure 1. Map of South Dakota Showing Forecast Road Conditions

A continuous, repeating loop forecast provided a precipitation and road condition forecast for a past weather event to demonstrate the capability of the system. A snap-shot from this loop shown on the website is presented in Figure 2. The loop depicts the path of a rain and snow weather system as it moves across this five state region. What is unique about the tool is its depiction of the changing road conditions as the system passes through. A user of the website can observe how the various segments of the interstate are forecast to change over a 12 hour period from dry to damp to wet to snow covered, for example, based on the forecasted weather conditions and current road condition information.
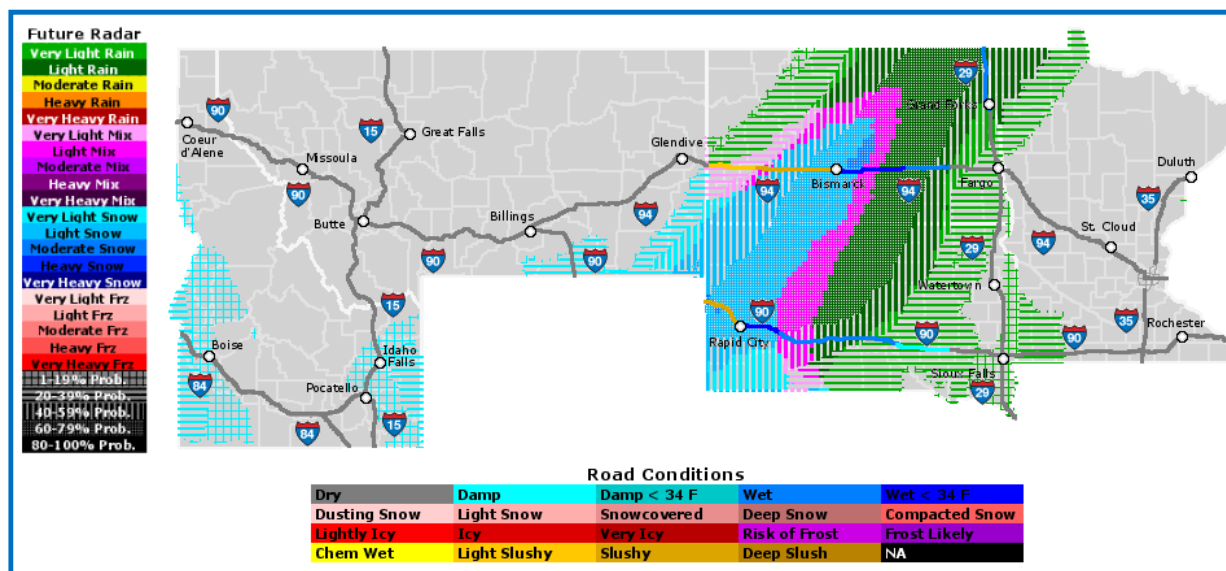
Source: Meridian's Experimental Website

Figure 2. Precipitation and Road Condition Forecast for April 2, 2010

A lack of uniformity exists across states with regard to how traveler information is presented on each state DOT's website. In the case of South Dakota, for example, their Safe Travel USA web site (http://www.safetravelusa.com/sd/) uses icons somewhat similar to the *Clarus* demonstration, based on colored solid and dashed lines, to indicate road condition information. In order to adopt this new tool as currently configured, the South Dakota DOT, with substantial support from Meridian, would have to significantly merge and modify their website information in order to effectively communicate the variety of road weather condition and forecast information represented by these two different approaches. Because of these challenges, and in order to provide the DOTs with time to assess the new use case road condition forecast tool before making any kind of commitment to it, the states examined the new capabilities independently, and some of the DOTs provided limited access for travelers to visit the experimental website for test and evaluation purposes.

The independent evaluation of this use case tool examined how users in Idaho, Montana, North Dakota and South Dakota could use the tool and how travelers responded to the availability of this new information, in terms of its potential value and benefits based on limited use experience in planning and carrying out their trips.

3 Evaluation Approach

The focus of each of the four use case evaluations was on how end users might actually use the new tools and the benefits they expect to derive from that usage. The approach to evaluating each use case began with the development of an overall Evaluation Strategy. The strategy sought to identify the expected benefits of the tool use and develop a set of testable hypotheses that would guide the data collection and analysis. The strategies were prepared based on documentation from the demonstration teams and discussions with the states about how they thought they might use and benefit from the new tools. As the tools were refined and presented to the states through initial training sessions, both the states' and the evaluator's understanding of the tools evolved further, and in several cases the attributes and capabilities of the tool were modified. As a result of this dynamic process, the evaluation approach as projected in the Evaluation Strategy was refined accordingly in the development of the Evaluation Plan. Even as the demonstration and evaluation periods were coming to an end, an opportunity arose to expand the demonstration and as a result, both the demonstration and evaluation periods were extended through early 2011. This resulted in further modifications to the Evaluation Plan to take advantage of the opportunity to collect and examine new data.

3.1 Evaluation Setting

As noted earlier, five states were included in the program to demonstrate and test this use case method for disseminating road-weather information. The identified lead person for each state DOT was contacted to determine the level of interest and suitability for participating in the independent evaluation. The objective was to select one state for the evaluation while considering that one or more of these states might also participate in the evaluation of Use Case #2, the road restriction decision support tool. South Dakota was initially selected for Use Case #5 based on their interest in considering this tool for enhancing their current traffic information website and 511 systems, both of which are supported by Meridian. South Dakota was particularly interested in exploring ways to enhance their current traveler information to include information on possible future road conditions as they are impacted by adverse weather. While North Dakota and Montana had agreed to participate in the evaluation of Use Case #2, they, along with Idaho, decided later in the evaluation period to participate in a web-based traveler survey opportunity that arose as a result of the decision to extend the demonstration period. Idaho and Minnesota utilize the Condition Acquisition and Reporting System (CARS) for traveler information, and there was concern about the time and costs that might be incurred to integrate this new road-weather information source within the CARS system. As a result of these considerations, South Dakota was selected for the initial focus group evaluation of Use Case #5, and Idaho, Montana and North Dakota agreed to post on their traveler information websites a link to Meridian's experimental website, which contained a traveler survey. This approach offered extensive participation among these northern tier states for the use case.

3.2 Evaluation Design

The evaluation of the Use Case #5 tool was based primarily on user perceptions of expected use and benefit, rather than on "revealed preferences" based on observations of uses and subsequent effects on driving

decisions that could be attributed to the new road condition forecast information from the tool. The end users included both the four state DOTs in each of the demonstrations states and a sample of commercial truck operators and members of the traveling public. A limited number of commercial and general travelers in South Dakota participated in focus groups where they were shown the new tool and asked for their opinions. In addition to the focus groups, a link to a survey was posted on the traveler information websites in Idaho, Montana and North Dakota, and interested visitors to those websites had an opportunity to view the experimental web tool and share their reactions by responding to the survey questions. Finally, for those web survey respondents who agreed to answer some follow-up questions, the evaluation examined how those individuals subsequently used the information from the experimental site in their travel planning and trip execution.

3.2.1 Objectives and Hypotheses

Evaluation Objectives: There were three main objectives of this independent evaluation of the Use Case #5 demonstration.

- Understand how the use of the road condition forecast tool offered benefits to the state DOT and to end users of the enhanced traveler information;
- Understand the value added by the tool and the information products it offered, beyond information already available to travelers in these states.
- Document the lessons learned from the evaluation to help guide further development and deployment of the forecast tool beyond this demonstration.

Evaluation Hypotheses: As specified in the Evaluation Strategy and considering the timeframe of this demonstration, this use case tool was expected to yield measurable benefits primarily in one of six potential goal areas, namely, customer satisfaction. Because there are two main customers for the information offered by the tool, for the purposes of the evaluation, customer satisfaction was divided into agency satisfaction and traveler satisfaction. Measurable benefits were not expected in the short-term in the remaining goal areas of safety, mobility, efficiency, productivity, or energy and environment, though after full deployment and time to become familiar with the new information and gain experience using it, users could certainly expect to have benefits in these other goal areas. Table 1 lists the hypotheses that were tested in each of the customer satisfaction goal areas.

These hypotheses represent a modification of those initially specified in the Evaluation Strategy, before the tool was fully developed and deployed in the demonstration. As the states learned through the demonstration team's training sessions and faced with the realities of the limited timeframe for this demonstration, this tool would not be ready to make fully available to the public and integrated with the state DOT's existing traveler information sources. Thus, the ability to evaluate the actual use of the tool by end users was limited, including the limited opportunity to evaluate user trust and confidence in the new information or the actual affect of the use of the tool on traveler behavior (such as trip modifications based on forecast road weather conditions). Therefore, hypotheses that are testable under the actual conditions of this demonstration relate primarily to user perceptions and expectations for the uses and benefits of the tool. In addition, a follow-on survey asked a small group of respondents how they may have altered their travel based on information from the tool on forecasted pavement conditions.

Table 1. Evaluation Goal Areas and Hypotheses

Goal Areas	Hypotheses
Customer Satisfaction (Agency Users: State DOTs)	▪ DOTs will perceive the tool to constitute a useful, high quality enhancement to their current traveler information. ▪ DOTs will be interested in making further investments in the tool past the demonstration phase to integrate the new information with their current traveler information (website and 511).
Customer Satisfaction (General Travelers and Commercial Operators)	▪ End users will perceive that the new tool offers valuable information to support their trip planning and decision making. ▪ End users will express a willingness and desire to use the new information when it becomes available to them. ▪ Long distance and cross-state travelers will value the new information provided consistently across state boundaries. ▪ End users will perceive that the new forecast information will enhance the safety and mobility of their travel. ▪ The use of the new information will result in decisions to adjust travel plans and behaviors in response to forecasts of pavement conditions.

Hypothesis Testing Approach: The nature of this demonstration constrained the opportunity to conduct a more complete evaluation of the tool that would only have been possible if the traveler information that is the central output of the tool were made widely available to travelers to help support their trip planning and decision making. The seven hypotheses noted in Table 1 were mostly aimed at eliciting stated preferences for the potential usefulness and value of the road condition forecast information. Feedback from a sample of travelers was also made available through the extension of the demonstration. Information from this evaluation is available to the demonstration team and the DOTs to help guide their decision on whether to seek to fully deploy the tool and how best to integrate the information into their current traveler information systems. Feedback from the web survey respondents was expected to be suggestive of whether the new pavement condition forecasts were making a difference in actual trip planning and driving behavior, though this was restricted to a small sample of self-selected respondents who were not statistically representative of these states' driving populations.

The hypotheses were tested by analyzing focus group discussions with a small number of commercial and general travelers and feedback from the sample of website users who reviewed the new site tool and completed a survey. The participants in the focus groups were shown the new road condition forecast information on the demonstration website and listened to examples of audio segments that could be broadcast on the 511 telephone system. A moderated discussion sought participants' reactions and opinions regarding the new information and how they thought they could make use of the information in the planning and execution of their trips. The discussion also addressed desired features and content along with suggestions for the effective presentation of the information on both the website and 511.

The survey was linked through the three states' traveler information website pages and Meridian's website, on which survey questions resided. After completing the short survey, these respondents were offered a chance to leave their contact information for a follow-up email survey to further understand how often they revisited the beta site and whether and how they used the new information in their travel planning and decisions.

3.2.2 Data Collection

Focus Groups: Data were collected through the two focus groups, one with a mix of commercial truck company representatives and another with a mix of general travelers. Recruitment into these focus groups is described below:

> *Commercial Operators:* Commercial Vehicle Operators (CVOs) are active users of traveler information throughout their operations. A focus group was held in Sioux Falls on June 7, 2010 with a mix of representatives of companies that are active users of the I-90 and I-29 interstate routes that pass through Sioux Falls. Participants included truck drivers, and company dispatchers and safety officers who are users of traveler information to plan, coordinate, and guide their shipments. Support was provided by the South Dakota Trucking Association to identify candidate companies for participation in this focus group.

> *General Travelers:* SDDOT assisted with recruitment of state employees to attend an afternoon focus group held June 8, 2010 in Pierre, SD. A mix of participants was sought with travel experience that included commuting, recreational travel, and short and long distance trips. Selection criteria included frequent travel on I-90 and/or I-29, since these are the two interstate routes for which the new road condition forecast information was being provided in South Dakota. In addition, participants were selected who were regular users of either the Safe Travel USA traveler information website and/or the 511 traveler information telephone system. Also desired was variation among participants in their trip distances, such as short commutes and longer recreational or business trips.

Each focus group session lasted approximately an hour and a half. Depending on the timing of the sessions, drinks, snacks and/or dinner was provided as appreciation and as an incentive for participation. Each group session was held in a conveniently located meeting space. A formal focus group facility was not required, and the intent was to keep the sessions informal but well structured and directed to the topic. Participants were asked for their permission to have the discussions tape recorded in order to facilitate accurate note taking, and both groups agreed. Confidentiality of the discussions and all materials related to the focus groups was emphasized. First name tent cards were prepared to facilitate the informal and personalized conversations. Equipment was made available to be able to project the new *Clarus*-enhanced road condition web-based forecast information and play 511 audio clips in the meeting room. Also, participant recruitment screening scripts were prepared to guide identifying qualified participants and assure a well-rounded group of participants for each focus group session.

A complete protocol was prepared to guide each discussion session (Appendix A). This protocol was used by the facilitators to introduce the objectives of the focus groups and included a set of questions designed to engage the participants in sharing their travel experiences and their history of using traveler information. Each group discussed the new website and the 511 system, providing an opportunity for them to share their reactions to the new information and talk about how they thought they would use the information in their trip planning, en-route travel decision making, and, for the commercial participants, how they would use the information to improve truck trip scheduling and guidance for their drivers on the road. Of particular interest to SDDOT was feedback from these groups on how the new pavement condition forecast information could effectively be integrated into SDDOT's current website and 511 information formats.

Web Surveys: A decision was made late in 2010 to extend the period of the study and evaluation through the spring of 2011 to provide additional opportunity to evaluate user response to the new tool. Idaho DOT (ITD), Montana DOT (MDT) and North Dakota DOT (NDDOT) posted links on their traveler information websites to the experimental pavement condition forecast site, and these links allowed travelers visiting those sites to

voluntarily access the new information and express their opinions about the site through their responses to survey questions. The survey was active for approximately a month in each state, primarily during the month of February 2011 and a few additional days before and after February. The respondents are self-selected and therefore do not constitute a random sample of all users of each DOT's website information. Nevertheless, their opinions provide useful information about the perceived utility of this use case for travelers.

The survey questions that were linked to each DOT site are attached (Appendix B). The website linking strategies used by each of these three DOTs is shown in the following figures (MDT Figure 3, ITD Figure 4, and NDDOT Figure 5).

MDT linked their road conditions, commercial motor carriers and bicycles and pedestrians pages to MDT's interim page introducing the new beta site and then to the new site on which another link took the visitor to the survey. MDT's link said "Multi-State Forecasting (BETA), Help evaluate a new service." ITD linked their Highway Info, 511 Info Links, and Winter Driving pages to Meridian's BETA Site introductory page that then led the visitor to the beta site and the survey. ITD's link said "Multi-State Winter Driving Forecast – BETA." NDDOT linked their 511 page directly to Meridian's BETA site with a link that said "Multi-State Forecasting (BETA) Survey."
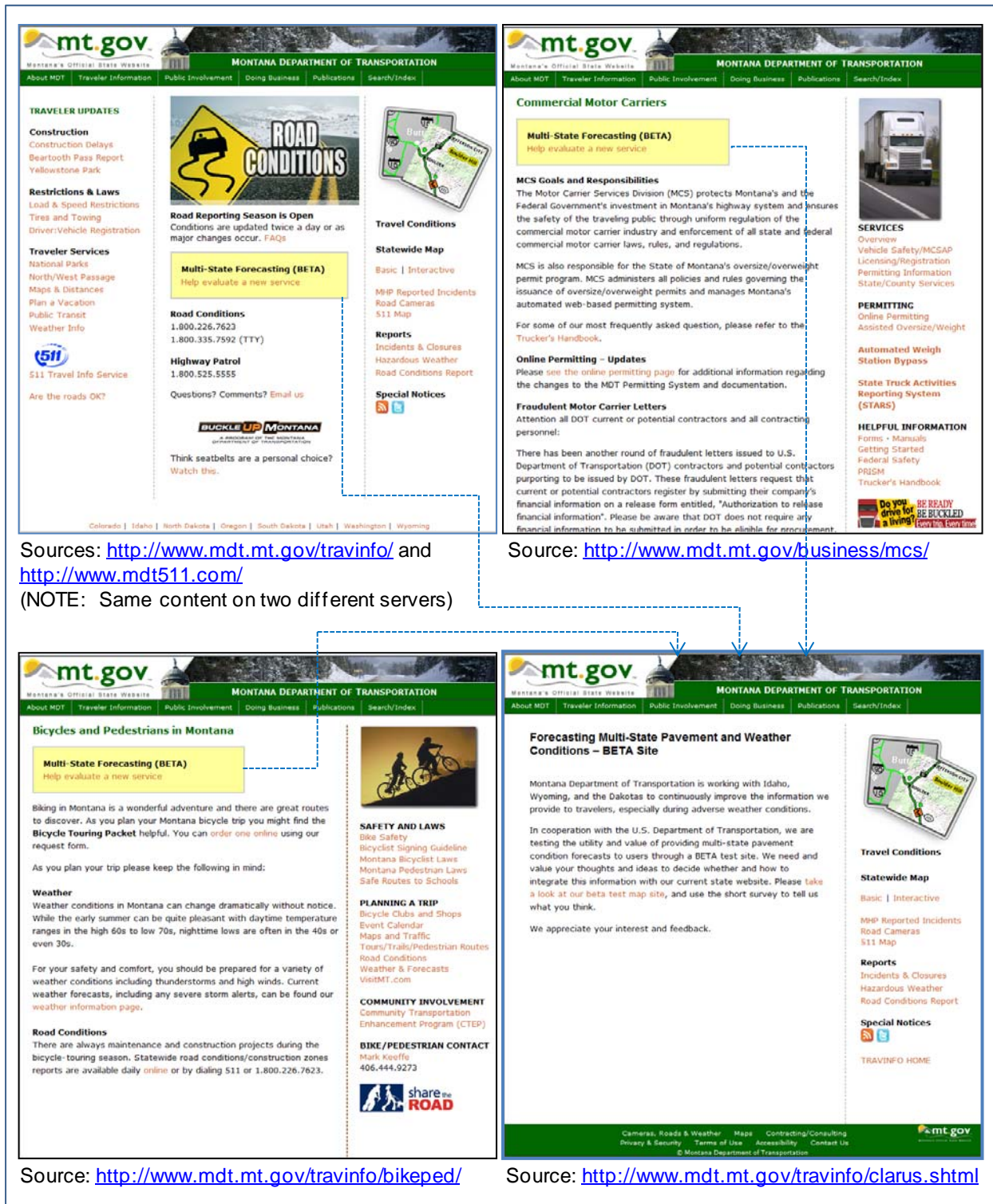
Sources: http://www.mdt.mt.gov/travinfo/ and http://www.mdt511.com/
(NOTE: Same content on two different servers)

Source: http://www.mdt.mt.gov/business/mcs/

Source: http://www.mdt.mt.gov/travinfo/bikeped/

Source: http://www.mdt.mt.gov/travinfo/clarus.shtml

Figure 3. Montana DOT Website Links to *Clarus* Pavement Condition Forecast Beta Site

http://hb.511.idaho.gov/main.jsf

http://511.idaho.gov/default.asp

http://lb.511.idaho.gov/idlb/

http://lb.511.idaho.gov/idlb/links.jsf?view=state&text=m

http://lb.511.idaho.gov/idlb/truckreports_routeselect.jsf

http://uc5.clarus.meridian-enviro.com/intro/
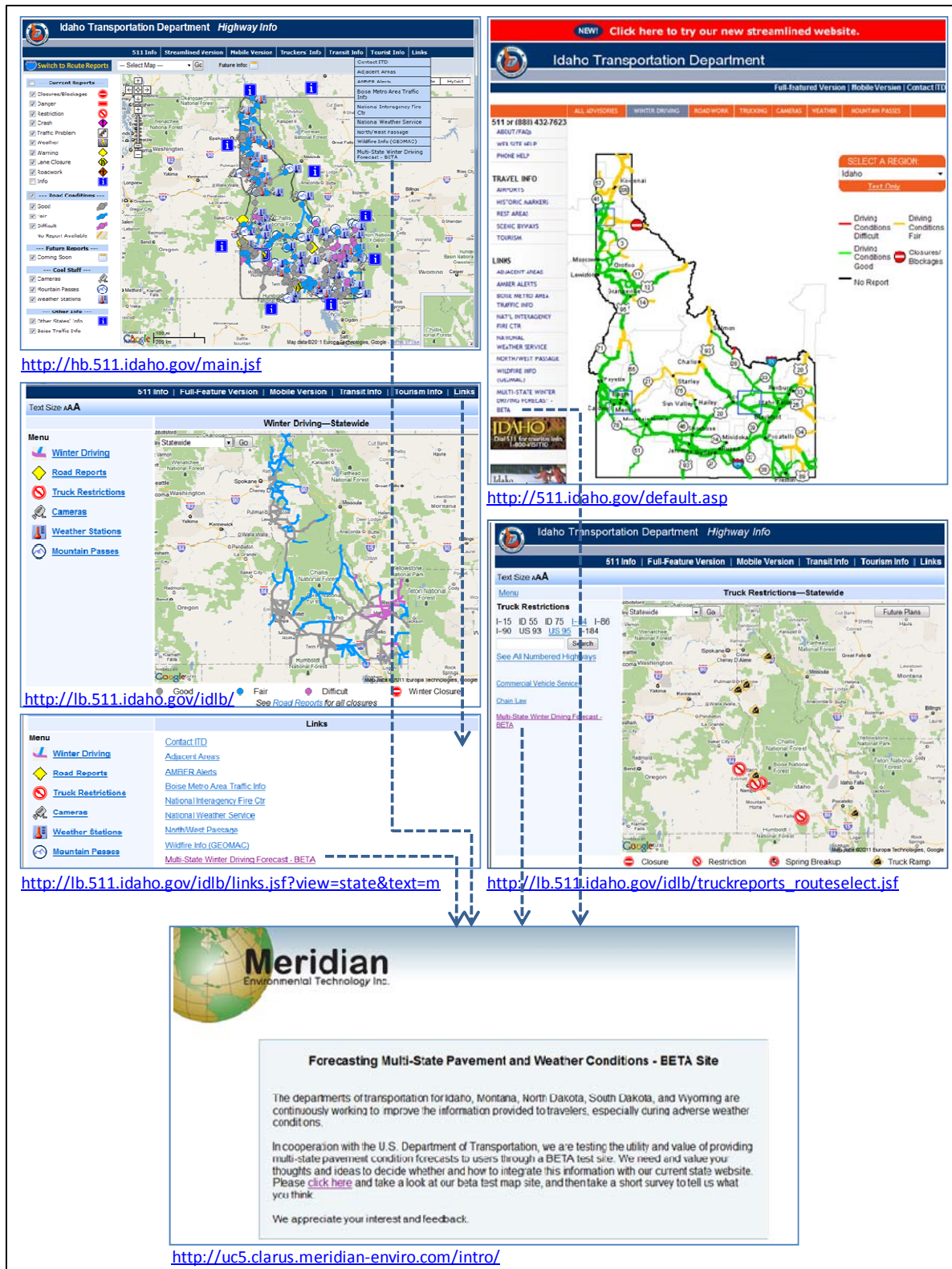
Figure 4. Idaho DOT Website Links to *Clarus* Pavement Condition Forecast Beta Site

Source: http://www.dot.nd.gov/divisions/maintenance/511.htm

Source: http://uc5.clarus.meridian-enviro.com/

Figure 5. North Dakota Website Links to
***Clarus* Pavement Condition Forecast Beta Site**

4 Evaluation Findings

Data from the focus groups conducted in the early summer of 2010 in South Dakota and from the responses to the web survey questionnaires received in February 2011 were organized and analyzed to test the hypotheses to the extent possible and assess the perceived value and benefits of the Use Case #5 tool that was demonstrated.

4.1 Focus Groups

An described above, two separate focus group sessions were held, one with general travelers and the other with commercial operators. The results are discussed in this section.

4.1.1 General Traveler Focus Group

A focus group was held with six general travelers in Pierre, SD, along with a representative of SDDOT, the Meridian team, and two from the evaluation team who served as facilitators. The proceedings of the hour and a half session were recorded, with permission of the participants, to facilitate taking accurate notes of the discussions, after which the tapes were erased. The discussion protocol that guided these discussions is shown in Appendix A. At the start, the participants were informed that the discussion would focus on a new, experimental pavement condition forecast system and that no decision had been made whether or not to implement the system in the future.

Highlights from this discussion are summarized as follows:

General Traveler Information Comments

- Participants discussed tools they currently use for planning their trips, such as camera images and 511 information on road construction, but shared concerns that cameras are sometimes not working or get obscured by snow in the winter. A key need is to know whether roads are closed due to weather. Some say, if the road is open, they will go regardless of the weather.

- Participants want to know when the information is updated so they can better judge its reliability, but they don't get that from the website. One participant commented, "I don't see any standardization on information sources. Some counties don't update at all."

- Web and 511 users want to identify alternate routing possibilities when weather is impacting roads and interstates.

- Travelers consult a variety of weather information sources, including DOT web and 511, TV reports, and other on-line weather information. It was noted that weather.com offers radar images and 3 hour forecasts. Users also recognize they can't get all the information they want or need from any single source, so that is why they consult multiple sources. They expressed a desire for a "one-stop shop" approach.

- Participants said that they have to make trip changes when a key road is closed, but often have to travel even when conditions are bad. Sometimes those trips are long distance, covering more than one state. Area-wide, multi-state information is valuable. One participant commented, "Many families in our area have 4-wheel drive vehicles. We are a tough group."

- A participant commented that once out on the road, little could be done about the weather encountered along the way.

Comments on the New Website

- Participants expressed concerns that the website information gets too cluttered, and a need existed to simplify the information, especially on the maps. Also, website managers need to recognize that various graphics may appear differently on different computer monitors, and different states use different legends to represent the same information.

- Participants said they would value more animations or radar loops of weather systems to help get a better sense of how weather was unfolding in their areas of planned travel.

- Participants favored tailoring the information to fit on small mobile devices, such as cell phones. Right now, some key information can't be used effectively on these devices.

- Users said they prefer names of places instead of mile markers, as travelers more readily relate to places they recognize. One participant said, "We are landmark drivers."

- The participants expressed interest in having the new site show local roads (e.g., county and city roads) in addition to the interstates.

- Participants said they value the pavement condition forecasts but they found some of the graphic road condition symbols confusing. They suggested separating current from forecast conditions and providing clearer guidance for how to interpret the information.

- A participant said he prefers real-time radar loops to convey what weather system is affecting his route and where it is likely headed. He prefers pictures to text. He said, "I would rather rely on true radar than modeled guesses and know what's going on."

- The participants also preferred visual images, indicating that travelers preferred the radar loop (trend) forecasts. They liked the idea of layering information on the website, with a user being given the ability to select what they do and do not want to see.

Comments on the new 511 Phone Application

- Participants said they use the 511 phone system to verify road closures. They indicated that they listen to parts pertaining to the highway on which they are traveling only. They do not like to have to listen to extraneous information and want to be able to "jump" directly to the information of interest to them.

Comments in Summary

- The group felt it important to clarify that the atmospheric radar images are measuring conditions 10 meters or more above the pavement surface, while the pavement condition forecasts are looking right at the pavement.

- Participants felt the accuracy of forecasts more than 6 hours was suspect. They liked the idea of offering warnings of likely road weather conditions but cautioned that some travelers might interpret this as certainty and be upset if they find something different. One commented, "You have got to create trustworthy information first so people will pick up on it. If the information is close most of the time, then people will trust it more and use it more." They suggested having some way to point out to a user that a piece of information was particularly significant, such as using a flashing road segment symbol.

- The group wanted to know whether more pavement sensors were going to be installed to improve the coverage and reliability of the new pavement condition forecast system.

- Users want demonstrated real-time accurate weather information. They thought camera images are particularly useful for drivers experienced with the area and that short, clear text messages might be better for less experienced drivers; just say, "The road is icy."

4.1.2 Commercial Operator Focus Group

A focus group was also held with six representatives of various commercial vehicle operators (CVOs) that operate on the two interstates in South Dakota. Two representatives of SDDOT participated, along with a representative from the Meridian demonstration team and two members of the evaluation team. As with the other focus group, this discussion lasted an hour and a half and was recorded to supplement the note taking.

Highlights from this discussion are summarized as follows:

- CVOs routinely consult National Oceanic and Atmospheric Administration (NOAA), National Weather Service (NWS), satellite radio, and SDDOT's Safe Travel USA website for weather information, especially during winter months. Many CVOs provide their drivers with current condition information and let the drivers make the final trip decisions. Drivers want to be able to access this information immediately prior to a trip on a mobile device or en-route via an in-vehicle device.

- To support shipment planning, commercial fleet operators need weather information 12 to 24 hours in advance of an anticipated departure time. Weather information is shared among dispatchers and drivers, and decisions to change trip plans are often arrived at jointly.

- Uniformity of information across states is particularly important to commercial fleet operators that operate across state boundaries. Currently, CVOs have to access weather information from different sources that vary state by state. As with the general traveler focus group, CVO participants preferred names of places over milepost markers as the way to designate locations for the road weather information.

- CVOs want to know not only when a road will close but also when it is scheduled to reopen once the weather event has passed.

- Commercial operators would like the ability to toggle through simplified, layered information on a website, rather than trying to blend the usually available traveler information and the new pavement condition information all together on one dense web page. The information presented on the experimental page seemed overly confusing to some of them – too many little bits of information, icons, colors, etc. They want a straightforward way to know where and when a road will be hazardous. Also, the participants cautioned against conveying information that is too subjective, such as "good, fair, poor," and therefore open to different interpretations.

- Participants indicated that they were interested in using this new website (if implemented) but would not initially rely solely upon it until shown to be reasonably accurate. Many of the participants indicated that "This is another tool in the toolbox." The participants indicated they would continue to consult their sources of information, such as Weather Channel and camera images. Drivers were likely to prefer the 511 phone system over the website while they were on the road; although some drivers have wireless communications that could support laptop usage. The participants emphasized the importance of having real-time updates as conditions evolved.

- The CVO operators indicated that standard professional driving practice includes checking for potential adverse weather conditions along a route ahead of a scheduled departure. Most CVOs expect their drivers to make judgments based on common sense.

4.2 Web Surveys

As described earlier, the beta test site for this use case was made available through links with the DOTs in Montana, Idaho and North Dakota. Visitors to those state DOT's traveler information web pages could elect to click on a link that would take them to Meridian's beta site and from there to the survey. The total number of respondents across the three states was 216. MDT's web link resulted in 181 responses received between 1/24/11 and 3/3/11. ITD's link resulted in 30 responses received between 2/1/11 and 3/3/11, and NDDOT's link resulted in 5 responses received between 2/11/11 and 2/23/11.[2] The responses are presented in detail, with frequency and percentage distributions, along with bar graphs, in Appendix C. This section discusses these quantitative results, along with qualitative responses to an open ended question asking respondents for any comments or suggestions they may want to provide, and then focusing on a subset of the respondents who expressed willingness to be contacted with follow-up questions on their uses of the beta site information on pavement condition forecasts.

4.2.1 Quantitative Results

Of the 216 respondents, 40 (18 percent) were commercial operators, and 176 (82 percent) were non-commercial (i.e., general) travelers. The quantitative survey results will be discussed in the aggregate across all respondents, both commercial and general, and important differences in responses will be noted.

The majority (58 percent) of both the commercial operators and general travelers indicated that they were frequent users of traveler information, saying they consulted such information ten or more times in the past 30 days. Twenty-five percent of commercial operators and thirteen percent of passenger vehicle drivers indicated that they used road weather information to make changes in their travel in the past 30 days.

Table 2 shows the responses to four attitude questions on different aspects of the new forecast information. The detailed data are contained in the tables shown in Appendix C.

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[2] It is assumed that much of the variation in response rates across these three DOTs can be explained by the differences in where the links were placed, how prominently they were displayed, and how the links were formatted and worded. The DOTs varied substantially in how much flexibility and leeway within state guidelines they had in making these choices. Comparisons across states were not considered important for the purposes of this evaluation, however, and the total number of responses was adequate for assessing traveler perceptions of the tool's value.

Table 2. Web Site User Attitudes towards Forecast Tool

Agreement/Disagreement with Statement	Agree	Neutral or No Opinion	Disagree
The new pavement condition forecasts are a good addition to the regular web site information.	83%	11%	6%
I would like our DOT to integrate this new forecast information permanently into the DOT's web site.	78%	13%	9%
I am using the new pavement condition forecasts in deciding when and how to travel.	60%	28%	13%
I expect to change my trip plan (timing or routes) based on the forecast information obtained on this visit to the experimental web site.	48%	34%	18%

A high proportion of the respondents (83 percent) believe that the new forecasts offered by this use case tool constitute "a good addition to the regular web site information," and very few disagree with that (6 percent). Over three-quarters of the respondents would like this new information to be offered on their DOT's web site (78 percent). Fewer, but still a majority, said they are using this information in helping them make travel decisions, but many (28 percent) expressed no opinion on this question. Slightly less than half (48%) said they expected to change their trip plans based on the information obtained on this visit to the web site. Given that travelers were asked these questions on their first viewing of this new web site, this split of opinion is understandable. Furthermore, prior studies[3] of the uses of traveler information have shown that travelers value information without necessarily making any changes in their travel plans. Such information offers the benefits of greater travel preparedness and reduced uncertainty and stress of travel.

Nine questions in the survey focused on user perceptions of the usefulness of the new pavement condition forecast tool. Table 3 shows the aggregated results of the responses to those questions, with the lowest value (75 percent) being quite high. Again, Appendix C provides the detailed frequency distributions on these questions. In Table 3, "somewhat useful" and "very useful" are combined, as are "not very useful" and "not at all useful," for presentation and discussion purposes.

Virtually all the respondents felt that having this road weather information provided across several states was useful. All (100 percent) of the CVO respondents said this was useful, and the CVO respondents were much more likely than automobile travelers to say they were planning a cross-state trip in conjunction with their visit to the beta web site (58 percent versus 39 percent). Having access to both current and forecast pavement conditions is useful to most of these respondents (87 percent and 84 percent respectively), with no apparent difference in opinion on this between commercial operators and non-commercial travelers.

[3] Lappin, J. and Bottom, J. 2001. *Understanding and Predicting Traveler Response to Information: A Literature Review.* Report prepared for the US Department of Transportation, Federal Highway Administration. Volpe National Transportation Systems Center. (December).

Table 3. Web Site User Perceptions of Usefulness of Forecast Tool

How useful do you find this new website as a source for:	Useful	Neutral or No Opinion	Not Useful
Providing information across several adjacent states?	93%	4%	3%
Providing current pavement conditions?	87%	2%	10%
Helping me improve my preparedness for a driving trip?	86%	7%	7%
Helping me avoid hazardous routes?	86%	8%	6%
Providing forecast pavement conditions?	84%	8%	8%
Helping me decide whether or not to postpone or cancel a trip?	79%	15%	6%
Helping me decide between different possible routes?	77%	12%	11%
Providing a repeating loop image of conditions?	77%	21%	3%
Helping me decide when to start my trip?	75%	18%	7%

Regarding the beta site information's usefulness for helping with travel plans, at least three-quarters of all the respondents said this was a useful aspect of the tool. The respondents expressed the most uncertainty regarding the usefulness of the tool for providing a repeating loop image of conditions. In the open-ended comments some respondents said this was hard to find or use on the beta web site.

4.2.2 Qualitative Results

The web survey asked respondents to "Please provide any comments or suggestions you would like regarding this new weather and pavement condition forecast web site." Sixty-one percent of the automobile traveler respondents and 55 percent of the commercial respondents provided comments. These have been grouped into response categories to facilitate communicating the main points made by these survey respondents. The comments serve to supplement and help expand upon the responses to the other survey questions.[4] Table 4 and 5 organize the comments offered by the general travelers and commercial vehicle operators who responded to the survey, respectively.

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[4] Some visitors to Meridian's experimental beta site also offered comments directly to Meridian. We have reviewed those, and all of those comments are reflected in the comments provided on the survey, as shown in this report.

Table 4. Comments and Suggestions Provided by General Travelers

About 39% wanted information on secondary routes covered.

- "Secondary highways offer shorter routes."
- "Just shows interstates and most of us don't use them."
- "For this to actually be useful, all primary roads, and maybe even secondaries, would have to be monitored. I would never check a road report for an interstate."
- "The interstate is usually better maintained than the secondary roads, but if you have no access to them this site is worthless. You need to include all the roads."
- "Not really helpful for us who live in rural areas."
- "Disappointing that it only forecasts the interstates."
- "Most of our travel does not happen on an interstate route."
- "Interstates are great, but you have to get there first."

About 23% wanted more states covered.

- "Add more adjacent states (WY, WA, UT, etc.)."
- "Wish it were coast-to-coast!"

About 34% offered various suggestions for improving the site.

- "When you click on the individual state you lose the 'road condition' definitions."
- "It's amazing how fast your site downloads! I have dial-up Internet."
- "Loads way too slow. I have DSL and it took 38 seconds to load up."
- "Would it be possible to add live camera sites to your system?" (3)
- "Would like the same map key across all the states' websites."
- "The legend of road conditions does not 'match' the map. … Remove the gray border within the legend." (2)
- "Simplify it as much as possible."
- "The looping forecast conditions map is really well done."
- "I am not familiar with locations described by mile markers. Other land marks would be of benefit." (2)
- "Would be nice to know where mountain passes are."
- "The legend is not that clear, not very easy to understand." (2)
- "A key to the map would be useful."
- "Mouse over didn't work with IE8 or Opera."
- "To be really useful it would need to provide road condition forecast for the next 2-3 days. Forecasting just 12 hours or so is not very useful for longer trips."
- "'Average' web users will have difficulty getting through all the detail in the new site – simplify it; reduce text; more graphics."
- "I seriously question the usefulness of the 'forecasts' for road conditions. What really helps the most is real time data, not reading of tea leaves."
- "My only difficulty was in determining where each road segment begins and ends. New users have no indication of where to click for each individual section, and might reasonably assume that conditions are the same along an entire same-colored segment."
- "It would be ok to make the map bigger, …if on the main page each state was the size of the zoomed in page or bigger. 1024x768 is antiquated... The map could use the hand to drag the map around... Cell phone users could scroll around. The weather maps could be zoomed in on the region. For the surface weather analysis map it would be nice to see more of Canada and the Pacific. They could be looped as well."
- "Please change the road condition color key. DOTs and MUTCD have been trying to condition people for years that green is go, yellow is caution, red is stop, or hazard. At the least your fair and poor colors are too close in color and should be changed."

- "You need to look at the use of your colors." "I do not like the colors used for road conditions."
- "It would be helpful if the pavement condition reports indicated the time that the report was issued so the usefulness could be assessed. The choosing alternate routes function does not seem very usable given the spacing of the interstate system. Changing to another interstate would necessitate a big increase in travel distance and time."
- "Types of road conditions not specific enough. I want to know - blowing drifting snow, black ice, etc."
- "As a meteorologist and imagining how difficult it must be to forecast road conditions, I think you should keep the forecast portion very general."
- "The small size utilized for road condition categories is difficult to read. May need to enlarge these items. Need more definition as to the changing conditions. Hard to interpret what they mean."
- "It may just be the demo/beta nature of the site - but in looking at the stretch of I-90 between Bozeman & Billings, Mont - it's currently orange, coded 'difficult driving conditions' and upon clicking it says it's for dry surface with winds gusting to 19mph. If that's 'difficult' then you're going to need a couple more grades of road condition between 'difficult' and 'road closed'. The wind is *always* gusting to 19mph in Livingston, Mont."
- "Have good, fair, difficult examples when you mouse on and click the descriptions."
- "The primary benefit is for preparation and planning. The trip itself generally needs to occur anyway and would not have that much flexibility. Similar information and planning comes from weather forecasts. Integrating forecasts with the pavement forecast could be very useful."
- "Did not see the link for the "repeating loop image" forecasting conditions. Didn't know it was there."
- "I like the ability to click on portions of the interstate/roadway and see a narrative of the road conditions. As a person who is color blind, the maps that contain many different color roadways to describe the road conditions can be a very difficult for me, since many of the colors used appear the same to me and often I cannot differentiate between the various conditions. Thanks."
- "Turn this into an iPhone app."

About 19% offered general comments, mostly positive.

- "I like it!" (2) "I really like this concept." "This is a good concept."
- "Easy to use."
- "A good tool to have."
- "Please continue this effort."
- "Whoever was the web designer for this site – GREAT job! Everything works as it should and gives the information required."
- "What is available now is really cool. Pavement conditions … give me a change to decide how long [my commute] will take."
- "Its current most valuable asset is including info across several adjacent states."
- "The new map layout has a lot of potential." "This multi state map is a great tool. Glad to see it." "Very useful map with road conditions."
- "I like to use the travel map to check on road conditions for guests at my hotel that are heading out. It's really useful during the winter to determine if roads are closed, or hazardous."
- "Nice to be able to access multiple states to see conditions." (2)
- "I think this is an AWESOME concept that just needs some fine tuning."
- "This site is a curiosity, that's all."
- "Road cameras are more helpful than the forecasts, as you can see what you are going to be driving on."
- "I have been a snow plow driver. I know how conditions can change in a matter of minutes and know how important it is to update existing conditions. Keep up the good work."
- "What does Fair Driving Conditions and Difficult Driving Conditions mean? Different drivers will interpret these terms differently. Define those down further or better."
- "Will take time to build confidence in the forecasts."

Table 5. Comments and Suggestions Provided by Commercial Operators

Consolidated Comments by CVOs
▪ "Appreciate and utilize as much accurate info as we can get when our routes are across these states, Our company sets our routes but we have some say in the timing. Ultimately if conditions appear too hazardous we have the option of shutting down. This could be very useful. We currently utilize 511, web route reports, weather channel, NOAA, and Weather Bug to anticipate travel conditions."
▪ "The MTDOT websites show Severe Driving conditions around Forsyth, MT on I-94 and north on MT-24. This site does not show the restricted driving conditions. It is very important that this information is shown so oversize loads can determine whether they can go or if they are prohibited from going on these roads. The map does not show the Severe Driving conditions that prohibit permitted loads from travelling on I-94; therefore, a driver or dispatcher does not have accurate information needed to plan a route. This site indicates a large load can travel when in fact they are prohibited from being on this section of the roads. I need to have accurate information to give to truck driver's. Today your site was inadequate in this instance. I do like the idea and general layout but I cannot trust or recommend this site because of this missing information. I hope you will take this suggestion seriously and make whatever changes are needed so this site can be used by truck drivers and dispatchers. That is the only problem I have seen on this site. I feel more detailed information is required on the large map because many people will not click on each state to get the correct information. Thank you."
▪ "One site for several states saves a lot of time and will allow critical information access when internet connection is slow or spotty."
▪ "We have over 12,000 trucks in our fleet and this information is critical to the safety of our drivers and the on time delivery our customers require. I like the forecast data but use the current data most of all until I get comfortable with the forecast data. Some of the color codes are hard to distinguish. Too many people get hurt or killed during bad weather and this is a huge assist in making decisions based on fact. The multistate info is absolutely fantastic! All states do things differently and all state websites run differently. This is one click for many states."
▪ "A 3 day forecast with snow level would be helpful."
▪ "We use this map daily in dispatch – the easier to read the better!"
▪ "Regarding deciding upon different routes, conditions for Mn and US highways did not display. Good site - easy connection within several states but the road condition definitions should be to the side of the map and not so far below. The graphics are far below Illinois DOT and several states are now using a plug that integrates Google Maps with overlays, not only of road surface conditions but weather conditions - Doppler Radar and traffic cams. It's a good start, and perhaps your volume of traffic does not necessitate such options. Thank you for allowing my participation."
▪ "Include secondary roads." (7) "Add other states." (3) "Like the color coding."
▪ "Love this idea!! Thank you." "I greatly appreciate your service." "Awesome idea!!"

Summarizing across all the comments received, the reactions of most all of the respondents who took the time to comment were positive and constructive. There were many for whom the pavement condition forecasts that related only to the interstate roads was not particularly useful, and they wanted to see much wider coverage of secondary and more rural roads. Many also commented on how they would like to see more western states included in this coverage. They appreciated being able to visit a single website to get a multi-state view, and this interest was also shown in the quantitative survey results. Respondents offered a variety of specific suggestions about ways the information could be augmented or improved to be more useful and relevant to them. This feedback will be helpful when the prospects of incorporating the new experimental information into the individual state traveler information websites, or possibly even considering a new, multi-state road weather site, are explored further.

4.2.3 Follow-up Regarding Website Usage

4.2.3.1 Commercial Operators and General Travelers

Of the 176 general travelers in Idaho, Montana and North Dakota who visited the experimental pavement condition forecast website, 63 of them left their email contact information and said they would be willing to be contacted for follow-up. In addition, 16 of the 40 commercial operator respondents agreed to be contacted. The objective of following up with these respondents was primarily to understand whether they continued to visit the experimental website for road weather information and whether they used that information to make adjustments to their travel plans and trip decisions. In addition, the research team wanted to find out from these website users what their opinion was of the overall concept of this new tool and the extent to which they thought it was ready for wide-scale deployment. Seventeen of the 79 who expressed willingness to be contacted (22 percent) responded to a short set of questions that were emailed to them after the experimental website was closed. The questions are shown in Appendix D.

Figure 6 shows their aggregate responses to six questions about the overall concept of a web-based tool that provides pavement condition forecasts as a supplement to other road weather information currently available on these states' websites.

The average responses on the six questions, applying a scale for each question that ranged from "0" as the lowest rating (not at all suitable) to "10" as the highest rating on each attribute of the concept, are shown in Figure 6 as a dark blue line. To better show the degree of agreement or disagreement among the 17 respondents on each of the six items, a measure of variability around the average response is shown as the inter-quartile range.[5] The closer these two dotted lines are to the mean (average) for each question, the greater the degree of agreement among all respondents on the question. The highest average score for the concept was for its potential to improve safety (average score = 8.6; 11 respondents scored this "10"), and the lowest average score was for the anticipated acceptance of the concept (average score = 7.1). The greatest agreement among the respondents was on the question regarding the potential for the concept to improve safety.

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[5] The first quartile is the point on the score scale (0 to 10) below which 25 percent of the cases fall, and the third quartile is the point on the score scale below which 75 percent of the cases fall. Thus, the first and third quartiles contain half of all the response scores.
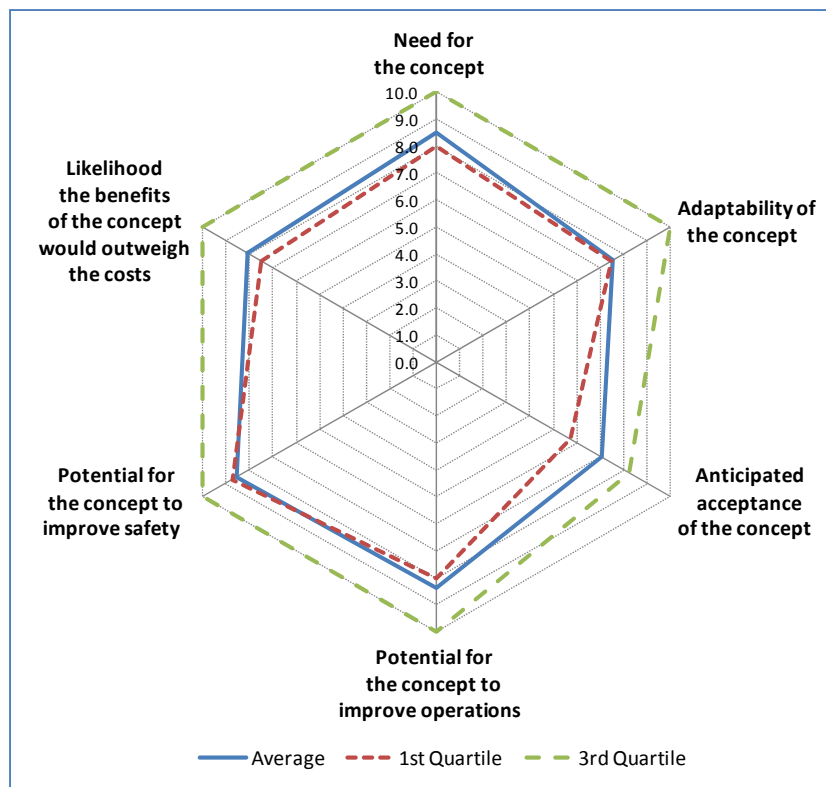
Figure 6. Assessment by Web Users of the Concept

These respondents were then asked to score their perception of the readiness of the tool for more widespread deployment and use, using the same scale. Figure 7 shows the results of this assessment.

Two dimensions received the highest average scores: the ease of setting up and configuring the tool for use and the ease of operating, interacting with, and navigating the tool. The lowest average scores were for perception of reliability and/or accuracy of the tool and trust in the tool and its performance and/or output. The level of agreement was very similar across all five dimensions of the readiness aspect, though there were several dimensions characterized by a large scoring difference among a few respondents. For example, for the question on trust, one respondent scored this readiness dimension a "0" and two scored it a "10." However, there is quite positive support on average for both the tool's readiness and for the concept. Overall, these responses indicate somewhat more positive endorsement for the concept of this tool than for its readiness for deployment.
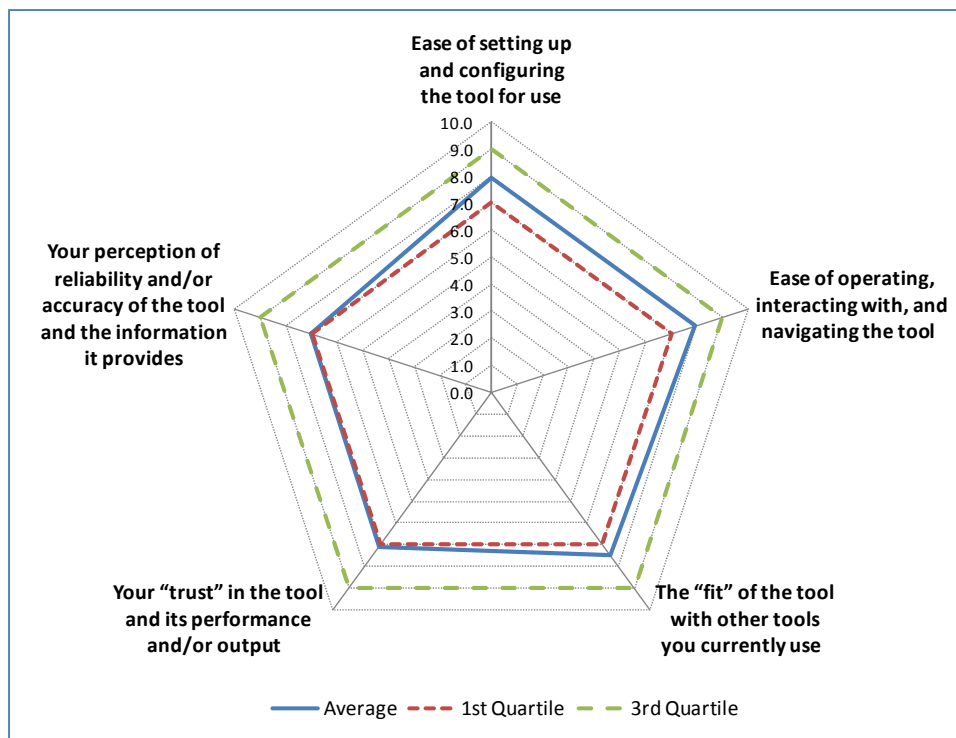
Figure 7. Assessment by Web Users of the Readiness of the Tool

In addition to these ratings on concept and readiness, the respondents were also asked whether they visited the experimental website again after their initial visit, and if so, how many additional visits did they make. Six out of the 17 individuals contacted did not visit the site again after responding to the initial survey; however, some of those who did go back said they consulted the site between 2 and 30 times, for an average of 7 times each. A few of those said they only returned a few times because they had no specific travel plans to schedule during this period, or the site didn't provide information on routes in which they were interested. Those who described their uses of the site offered the following comments:

- "I visited a dozen or so times. I also shared it with friends who were traveling. I didn't change plans but it provided more concise information in one web site."
- "Considerations were given to changing plans, but after checking the web it was apparent it was better to leave earlier than later."
- "No actual change but used the site to decide whether or not to go."
- "I cancelled a fishing trip due to icy road conditions."
- "I visited once a day for 4 days while traveling. On a winter cross-country trip, I used the information to avoid bad weather conditions and closed highways. I also was able to allow extra travel time when bad conditions were expected."
- "I typically use the information to see road and pass information prior to travel. At least twice have held up travel plans because of changing road conditions."

- "There were several times when we rerouted our drivers to I82 or I84 to avoid unsafe conditions in Montana and Idaho. We also used it to avoid the Dakotas if safer alternate routes were available. We have over 12,000 trucks and safety is a cornerstone to our success."

4.2.3.2   State DOT Officials

The state DOT officials in Montana, Idaho, North Dakota and South Dakota who supported the assessment of this use case tool also responded to a very similar set of questions about their perceptions of the suitability of the concept and readiness of the tool for wider deployment. Their responses, based on six respondents across the four states, are shown in the same graphic format in Figure 8 and Figure 9.

As shown in Figure 8 below, the score on each dimension of the concept, as assessed by the six state DOT officials, averaged between a low of 7.0 for "Adaptability of the concept" and "Likelihood the benefits of the concept would outweigh the costs," and a high of 7.7 for "Perceived need for the concept." The least agreement was on the question of whether the benefits would outweigh the costs, with scores ranging from "4" to "10."
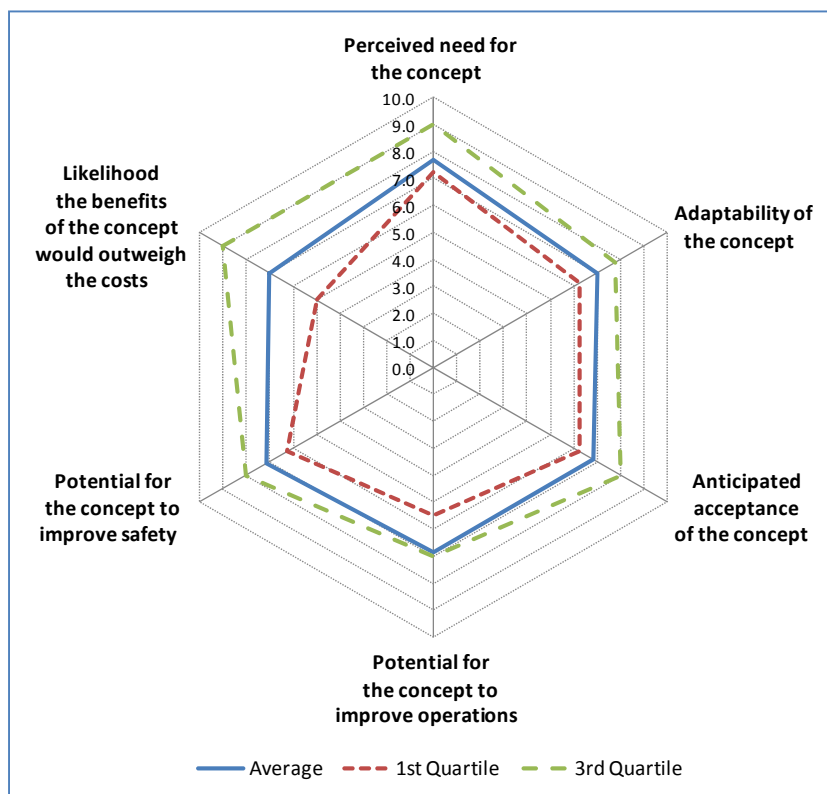

Figure 8. Assessment by State DOT Officials of the Concept

While the state DOT officials were generally quite supportive of the various aspects of the concept itself, they were less convinced that this tool is ready for deployment and use. As shown in Figure 9 below, the average scores ranged from 5.8 for "The 'fit' of the tool with other tools you currently use" to 8.0 for the "Ease of setting

up and configuring the tool for use." There appeared to be strong agreement among these respondents on each of these readiness dimensions.
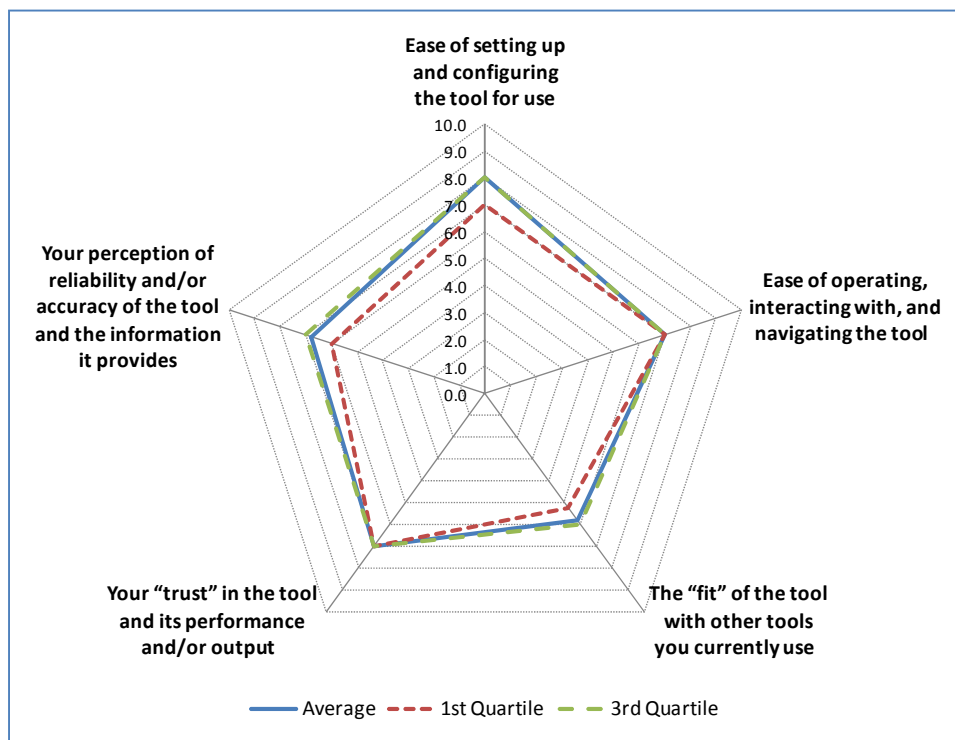

Figure 9. Assessment by State DOT Officials of the Readiness of the Tool

Generally speaking, the web users who responded to these concept and readiness questions were somewhat more favorably disposed toward this pavement condition forecast tool than were the DOT respondents. However, the differences are not great, and overall the responses across the board are fairly positive.

4.3 Hypotheses Test Results

The hypotheses presented at the outset were tested to the extent that the available data would allow. The data from the focus groups and surveys, along with comments received from the participating DOTs, were assessed in terms of the support they offered for each of the hypotheses. Results of these tests and the degree of support for each hypothesis are presented in Table 6.

Table 6. Identified Level of Support for the Hypotheses

Hypotheses	Evidence	Level of Support
1. DOTs will perceive the tool to constitute a useful, high quality enhancement to their current traveler information.	• "If the tool could be incorporated into our current road condition map information, it would provide more value." • "This product has potential. The largest benefit would be from the public actually canceling travel plans when conditions are forecasted to deteriorate. Getting to the point of having the public's trust would be a tremendous undertaking." • "I believe this is the direction our DOT will eventually move toward – more focus on predicted impacts to roadway conditions." • "Winter weather is our state's #1 travel concern; being able to predict adverse road conditions would be very valuable." • DOT officials scored "perceived need for the concept" an average of 7.7 on scale of 0-10.	High support
2. DOTs will be interested in making further investments in the tool past the demonstration phase to integrate the new information with their current traveler information (website and 511).	• "It will take some innovative work to integrate the tool with our current traveler information website." • "The cost of providing this is not high, given that we already do road condition forecasts through the Maintenance Decision Support System (MDSS)." • "Public and agency acceptance would be high."	High support
3. End users will perceive that the new tool offers valuable information to support their trip planning and decision making.	• 78% of web users want their DOT to integrate the new info on the state's website, and 83% say it would be a good addition.	High support
4. End users will express a willingness and desire to use the new information when it becomes available to them.	• Users scored "need for the tool" 8.5 on scale of 0-10. • Users scored "trust in the tool" 7.1. • 39% said they wanted secondary routes covered in addition to the interstates. • Focus group participants say this would become another tool in their toolbox	Moderate to high support
5. Long distance and cross-state travelers will value the new information provided consistently across state boundaries.	• 93% of users say providing this new info across states is useful. • 100% of CVO respondents said very or somewhat useful.	Almost universal support
6. End users will perceive that the new forecast information will enhance the safety and mobility of their travel.	• 86% say the new info will help them avoid hazardous routes. • Users scored "potential to improve safety" 8.6 on scale of 0-10.	High support

Hypotheses	Evidence	Level of Support
7. The use of the new information will result in decisions to adjust travel plans and behaviors in response to forecasts of pavement conditions.	60% of first time visitors to new website said they used the info to plan trip. - Between 75% and 79% said the website is useful for making trip adjustments (timing, route, postponement). - Frequent users of the new tool made proactive behavior change decisions based on the new information. - Focus group participants say they use weather information, and would use this tool, to identify alternate routes in bad conditions.	Moderate to high support

5 Lessons Learned and Conclusions

The evaluation of this use case demonstration offers lessons and conclusions that provide insights potentially useful both for future demonstrations of road weather tools and for DOTs that might seek to implement this pavement condition forecast tool on a long-term basis.

- ***Understand End-User Needs:*** A demonstration of a new road weather tool is likely to be better received and seen as more beneficial if it offers a new capability or piece of information that users want and previously haven't had. Forecasts of pavement conditions up to 12 hours ahead have not been included in the suite of weather information content typically available to state DOTs. The enthusiasm for this feature among the DOT users and travelers seen in this evaluation strongly suggest the potential value of this capability. A good approach for a demonstration like this is to start with the end users, find out ahead of time if the proposed new concept fills a real need, and work further with key stakeholders to specify the implementation pathway for the tool.

- **Communicating Complex Information without Overwhelming the User.** The multi-state pavement condition forecasting tool adds a new level of richness to the road condition data traditionally provided on state DOT websites. Transitioning the user from a consumer of current condition information to a user of forecasted road condition information presents a challenge. Careful design choices are required in the user interface to not only present what is known about the future but also provide the user with a clear description and differentiation of conditions now and in the near future. During the focus groups, the notion of layering of information was discussed as an important way to address the complexities of the user interface. This would allow users to easily select "layers" of information related to time-series "snapshots" of road conditions from now into the future, or to select various optional attributes of interest they would like to see, such as atmospheric and road conditions, congestion levels, camera images, etc.

- ***The Challenges of Integrating the Tool:*** The multi-state pavement condition forecasting tool evaluated for this demonstration presents challenges to successful integration with existing state traveler information systems, especially on websites. Even as a standalone test configuration, many users found the graphics, icons, and pavement condition descriptors complex and often confusing. State DOTs that desire to integrate this tool into their current weather information systems may need assistance. Some noted that the tool should be configured to provide "pavement improvement forecasts;" that is, travelers want to know not only when a road might experience hazardous conditions or closure due to bad weather, but also when those conditions are forecast to improve and roads are expected to return to a useable and safe condition. Notwithstanding these issues, the sense from the focus group discussions was that the new, multi-state forecast information presented graphically on a website was preferred over short audible messages on a 511 phone system.

- ***Advantages of Multi-State Approach:*** Users, and especially commercial operators, welcomed the idea of a multi-state information system as the one place they could go to plan a multi-state trip. Currently, travelers have to go to multiple DOT websites, each with different conventions and notations, to piece together the segments of their planned travel. The tool evaluated in this study included several northern states under one integrated website. The users appreciated that integration. One way to proceed forward would be for several states to agree on a common set of tools and display conventions so that users could move seamlessly from one state's website to another. Alternatively, a provider could offer to include many states under one traveler information software system that integrated both current and forecast road weather conditions. These kinds of cross-state integrated approaches are being actively discussed by the North/West Passage Transportation Pooled Fund group (8 northern tier states).

- ***Evaluate Again after Deployment:*** State DOTs are understandably hesitant to incorporate experimental information on their websites, open to the public, until they have fully tested the new systems and information and are satisfied with their reliability and level of accuracy. Given the very limited exposure of the pavement condition forecast information in this demonstration to the public, it was difficult to get beyond user perceptions and opinions. To thoroughly evaluate systems like this, they need to be fully deployed and used by the public to understand their long-run value and impact on the key transportation goals of mobility and safety.

- ***Expand Forecasts beyond the Interstate Highway System to Include more Local and Intra-state Roadways:*** Given that this was an experimental system, its various limitations were necessary and understandable. However, users were very clear about the importance of expanding coverage widely beyond the interstate system, as well as adding key additional states. Also, DOTs are likely to expect the tool's forecasts to also include when the roads are anticipated to return to level of service conditions. Eventually, it would be appropriate to seek to include all the U.S., though there are practical limitations presented by limited availability of installed pavement and other weather sensors and the significant costs that would be required, in addition to the complexity of institutional hurdles among states and jurisdictions.

In conclusion, the *Clarus* Use Case #5 enhanced road weather for traveler advisories tool can be viewed as a reasonably successful demonstration of a road weather forecasting capability that is perceived by states and travelers as needed and of great potential value. The technical concept and potential capabilities of this tool have been well demonstrated, and the challenge now is to make a benefit-cost case for deployment and address the institutional hurdles to a multistate approach to providing integrated, consistent, and reliable current and forecast road weather information to support transportation operations and meet traveler needs.

References

Lappin, J. and Bottom, J. 2001. *Understanding and Predicting Traveler Response to Information: A Literature Review.* Prepared for the U.S. Department of Transportation, Federal Highway Administration. Volpe National Transportation Systems Center. (December).

Meridian Environmental Technology, Inc. 2009. *Clarus Multi-State Regional Demonstration: High level Requirements – Use Case 5.* Prepared for the U.S. Department of Transportation, Federal Highway Administration. (April 30).

Appendix A

Demonstration of Potential Enhancements to
Weather and Road Condition Information

South Dakota Focus Groups for UC-5: Discussion Protocol

Introductions: Go around table. Write own first names on tent cards. Introduce observers. Scheduled for 1 ½ hrs. We will finish on time. Appreciate your taking the time to participate.

Discussion Topic: The US Department of Transportation is demonstrating several new technologies and has hired Battelle as an independent evaluator to understand how these technologies might be used by state DOTs and travelers. We will show you the new information format and content. We will be talking about this technology and your thoughts about it. No decision has been made to add these enhancements to South Dakota's website and 511 yet.

Objectives: We want to understand how travelers like you use the traveler information services provided by the South Dakota DOT and what you think about some proposed enhancements to these services. We will also discuss whether and how you think these changes in the kinds of information offered might cause you to modify your travel.

Discussion Format: Ask if recording is OK. All this discussion confidential and no individuals will be identified in reporting of results. Want everyone to have chance to speak. Looking for variety of honest opinions, both pro and con. Topics below will not necessarily be covered in order and other topics could be introduced to maintain the flow of ideas.

Warm Up Questions (15 minutes)

- How frequently do you travel either I-29 or I-90?
- Are you familiar with the Safe Travel USA Web Site? 511 phone service?
- Describe how you use this traveler information (circumstances; for weather, road conditions, construction, events, etc.)
- For what % times access information do you change your travel?
- How important is information about weather to your travel decisions?
- Do you use information both pre-trip and en-route? (cancel trip; postpone; change route)
- What is your preferred source of weather and traffic information? Web site, 511, both or other?
- Types of trips? Length of trips, e.g., cross-state trips (value of seamless information across states),

Website Feedback (15 minutes)

Show SDDOT web site in real time over Internet connection. Focus specifically on the major interstate routes: I-29 and I-90.

- What do you think of the quality of information? Probe on timeliness/accuracy.
- What features do you like? What features don't you like?
- Discuss value of information on current conditions versus future forecasts.
- What improvements would you like to see on the website?

511 Feedback (15 minutes)

Present audio of 511, and discuss how weather information is obtained on that service. Focus specifically on the major interstate routes: I-29 and I-90.

- Have you used the phone system before?
- How often do you access 511?
- What information do you use most on the 511 phone system?
- What do you think of the quality of information? Probe on timeliness/accuracy.
- What features do you like? What features don't you like?
- What are the improvements you would like to see on the phone system?

New Web Site and 511 Information Demonstration (35 minutes)

Show new web site (UC #5) using examples provided by Meridian.

Show clearly what new information is being tested. Describe the new tool. The new information adds forecasts of likely weather conditions on the road.

- Do you think this is a useful addition? (Probe into the parts of the package and usefulness; value of regional perspective; value of seeing changing conditions)
- What forecast timeframe is most useful to you?
- When do you think you will need this information?
- How might it affect your use of traveler information?
- Would you like to see the current web site updated to integrate this new information? If yes, how do you think the current web site should or could be modified to include this new information? [***Probe:*** Access information more often? Are you more likely to change travel on basis of the new information? How alter the color schemes to accommodate the new forecasts?]

Conclusion: Final comments, Summary, Thank You, Good Byes.

Appendix B

Web Survey Questions

Idaho, Montana and North Dakota

The Idaho, Montana, and North Dakota departments of transportation (ITD/MDT/NDDOT) are conducting research on an experimental web application that offers forecasts of weather and pavement conditions for up to 12 hours ahead. Your feedback will help shape the use and presentation of this kind of information in the future. We would like to ask you to answer a few questions to get your opinions on this new information. The survey is being conducted for ITD/MDT/NDDOT and the Federal Highway Administration by Battelle and Meridian Environmental Technologies, under contract to the US Department of Transportation.

Please complete this survey only once. We want to assure you that your survey responses will be kept strictly confidential, and we will not reveal, report, or release any names or personal information of survey participants.

Answering these questions should only take a short time. When finished with the survey, click "done" and you will be returned to the last page of this website you were on.

Thank you in advance for your interest and participation.

1. **Please indicate the State web site you were using to arrive here.**
   - ○ Idaho
   - ○ Montana
   - ○ North Dakota

2. **Please check the box that indicates approximately how many times you have consulted travel information <u>on your DOT's web site</u> over the past 30 days.**
   - ○ Just this one time in past 30 days
   - ○ 2-3 times in the past 30 days
   - ○ 4-5 times in the past 30 days
   - ○ 6-9 times in the past 30 days
   - ○ 10 or more times in the past 30 days

3. Please check the box that indicates approximately how many times you have used road weather information <u>from your DOT's web site</u> to change your planned travel in the past 30 days (e.g., change trip timing, route, vehicle type, or cancel trip)?

○   No changes in the past 30 days

○   1-3 times in the past 30 days

○   4-5 times in the past 30 days

○   6-9 times in the past 30 days

○   10 or more times in the past 30 days

4. Are you a commercial truck operator (including driver, dispatcher or safety officer)?

○   Yes

○   No

5. Please check the box that indicates the type of trip you are planning <u>with this visit to the new web site</u>.

○   Travel within state

○   Travel across state boundary

○   Not planning a trip now

○   Other (please specify:_____)

6. Please indicate your agreement or disagreement with the following statements. (Check one box for each item)

	Strongly Agree	Agree	Neutral/ No Opinion	Disagree	Strongly Disagree	Not Applicable
The new pavement condition forecasts are a good addition to the regular web site information.	○	○	○	○	○	○
I am using the new pavement condition forecasts n deciding when and how to travel.	○	○	○	○	○	○
I would like our DOT to integrate this new forecast information permanently into the DOT's web site.	○	○	○	○	○	○
I expect to change my trip plan (timing or routes) based on the forecast information obtained on this visit to the experimental web site.	○	○	○	○	○	○

7. How useful do you find this new web site as a source for the following kinds of information for this or a future trip? (Check one box for each item)

	Very Useful	Somewhat Useful	Neutral/ No Opinion	Not Very Useful	Not At All Useful	Don't Use
Providing current pavement conditions.	○	○	○	○	○	○
Providing forecast pavement conditions.	○	○	○	○	○	○
Providing information across several adjacent states.	○	○	○	○	○	○
Providing a repeating loop image of conditions.	○	○	○	○	○	○
Helping improve my preparedness for a driving trip.	○	○	○	○	○	○
Helping me decide between different possible routes.	○	○	○	○	○	○
Helping me decide when to start my trip.	○	○	○	○	○	○
Helping me decide whether or not to postpone or cancel a trip.	○	○	○	○	○	○
Helping me avoid hazardous routes.	○	○	○	○	○	○

8. Please provide any comments or suggestions you would like regarding this new weather and pavement condition forecast web site.

9. Thank you for agreeing to take this survey. Your responses will be very helpful in improving traveler information during adverse weather.

We would welcome a chance to follow up with you to understand how useful this information is in practice for you. If you would be willing to share additional feedback with us, please provide your contact information below. This is OPTIONAL, and the contact information will only be used to contact you for this study and will remain strictly confidential.
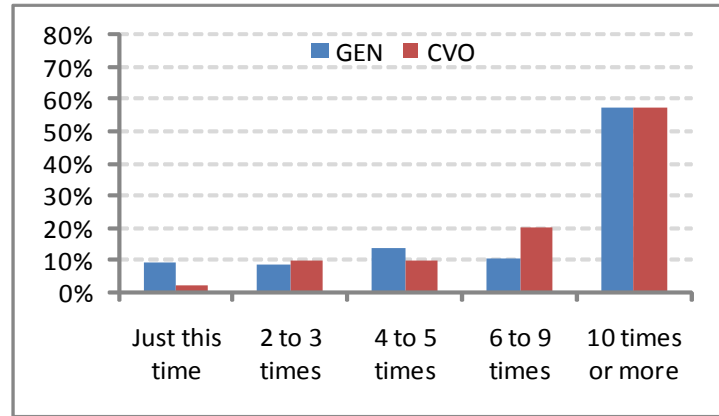
Name:
Email Address:
Phone Number: (Day?
Evening?)

Appendix C

**Frequency Distribution Results from Web Survey Questions**

Q1: Number of times you consulted traveler information in past 30 days.

	GEN	CVO	GEN %	CVO %
Just this time	16	1	9.1%	2.5%
2 to 3 times	15	4	8.6%	10.0%
4 to 5 times	24	4	13.7%	10.0%
6 to 9 times	19	8	10.9%	20.0%
10 times or more	101	23	57.7%	57.5%
N	175	40	100.0%	100.0%
Non-Response	1	0		

Q2: Number of times you used road weather information to change travel in past 30 days.

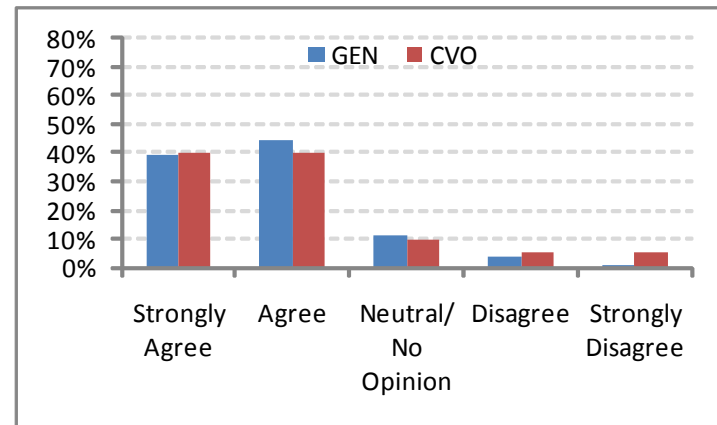|	GEN	CVO	GEN %	CVO %
No times	46	10	26.1%	25.0%
1 to 3 times	72	7	40.9%	17.5%
4 to 5 times	24	7	13.6%	17.5%
6 to 9 times	11	6	6.3%	15.0%
10 times or more	23	10	13.1%	25.0%
N	176	40	100.0%	100.0%
Non-Response	0	0		
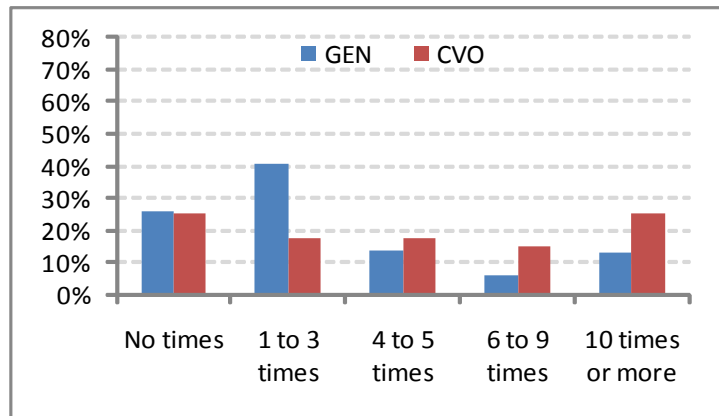
Q4: Please check the box that indicates the type of trip you are planning with this visit to the new web site.

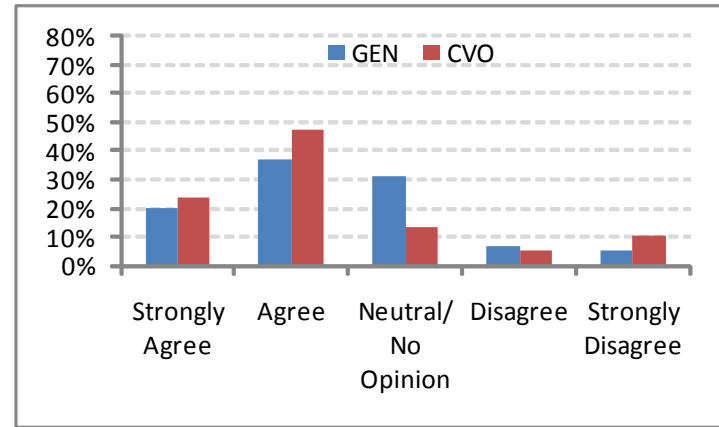|	GEN	CVO	GEN %	CVO %
Travel within state	52	11	29.5%	27.5%
Travel across state boundary	68	23	38.6%	57.5%
Not planning a trip now	46	4	26.1%	10.0%
Other (Please specify)	10	2	5.7%	5.0%
N	176	40	100.0%	100.0%
Non-Response	0	0		
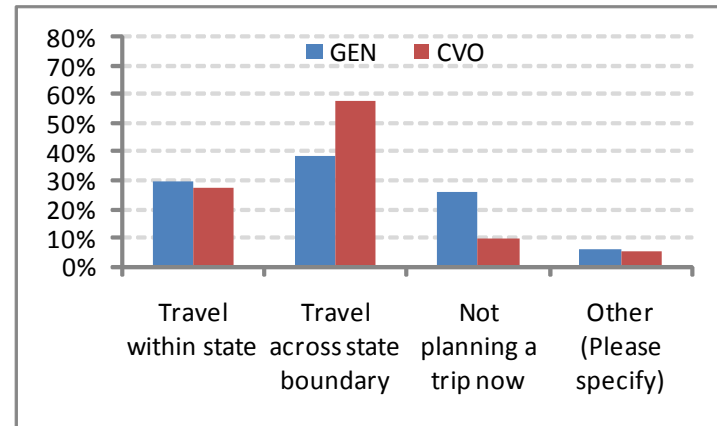
Q5: The new pavement condition forecasts are a good addition to the regular web site information.

	GEN	CVO	GEN %	CVO %
Strongly Agree	68	16	39.5%	40.0%
Agree	76	16	44.2%	40.0%
Neutral/ No Opinion	19	4	11.0%	10.0%
Disagree	7	2	4.1%	5.0%
Strongly Disagree	2	2	1.2%	5.0%
N	172	40	100.0%	100.0%
Not Applicable	2	0		
Non-Response	2	0		

Q6: I am using the new pavement condition forecasts in deciding when and how to travel.

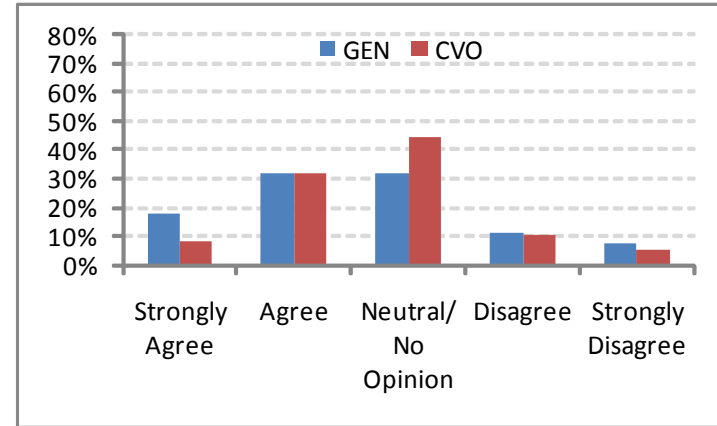|	GEN	CVO	GEN %	CVO %
Strongly Agree	33	9	20.4%	23.7%
Agree	60	18	37.0%	47.4%
Neutral/ No Opinion	50	5	30.9%	13.2%
Disagree	11	2	6.8%	5.3%
Strongly Disagree	8	4	4.9%	10.5%
N	162	38	100.0%	100.0%
Not Applicable	11	0		
Non-Response	3	2		

Q7: I would like our DOT to integrate this new forecast information permanently into the DOT's web site.

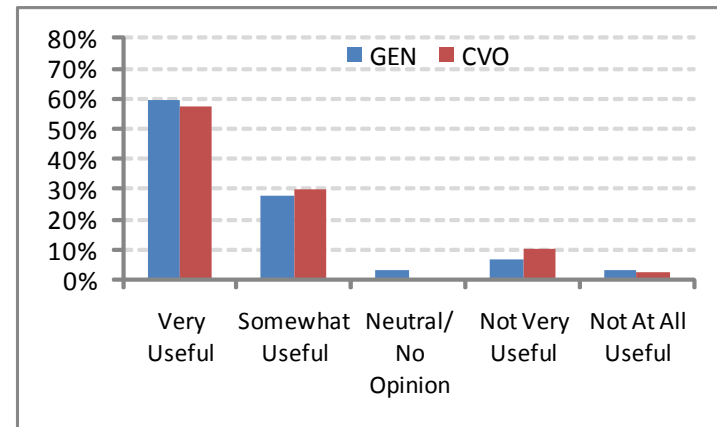|	GEN	CVO	GEN %	CVO %
Strongly Agree	76	18	44.7%	45.0%
Agree	58	12	34.1%	30.0%
Neutral/ No Opinion	22	6	12.9%	15.0%
Disagree	9	1	5.3%	2.5%
Strongly Disagree	5	3	2.9%	7.5%
N	170	40	100.0%	100.0%
Not Applicable	3	0		
Non-Response	3	0		
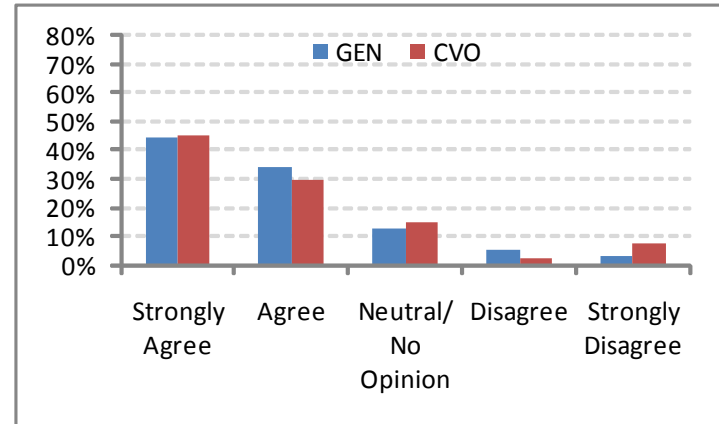
Q8: I expect to change my trip plan (timing or routes) based on the forecast information obtained on this visit to the experimental web site.

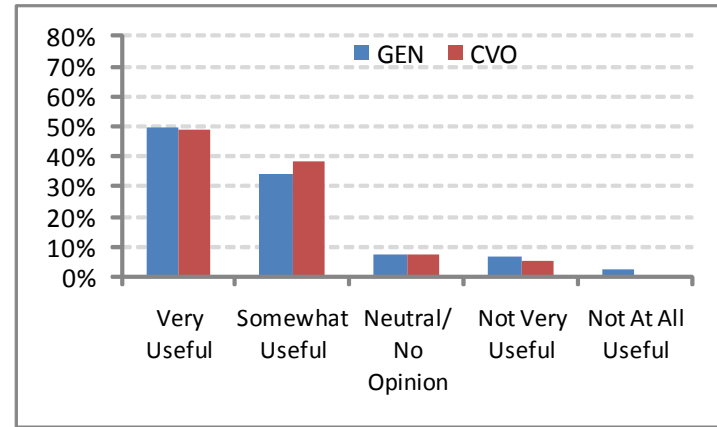|	GEN	CVO	GEN %	CVO %
Strongly Agree	28	3	18.2%	7.9%
Agree	49	12	31.8%	31.6%
Neutral/ No Opinion	49	17	31.8%	44.7%
Disagree	17	4	11.0%	10.5%
Strongly Disagree	11	2	7.1%	5.3%
N	154	38	100.0%	100.0%
Not Applicable	19	2		
Non-Response	3	0		

Q9: How useful do you find this new web site as a source for providing current pavement conditions?

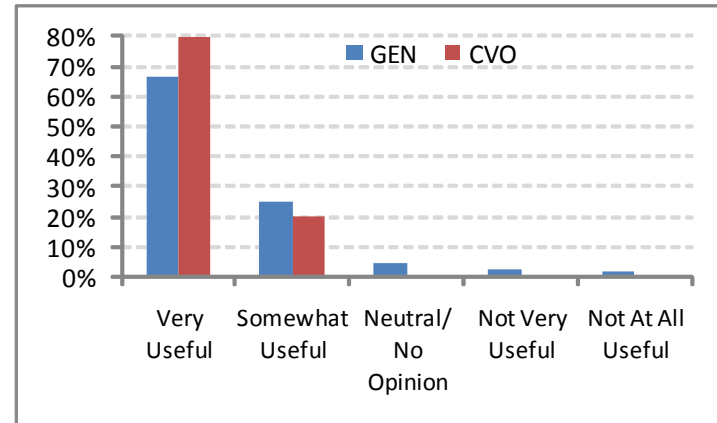|	GEN	CVO	GEN %	CVO %
Very Useful	103	23	59.5%	57.5%
Somewhat Useful	48	12	27.7%	30.0%
Neutral/ No Opinion	5	0	2.9%	0.0%
Not Very Useful	12	4	6.9%	10.0%
Not At All Useful	5	1	2.9%	2.5%
N	173	40	100.0%	100.0%
Don't Use	0	0		
Non-Response	3	0		

Q10: How useful do you find this new web site as a source for providing forecast pavement conditions?

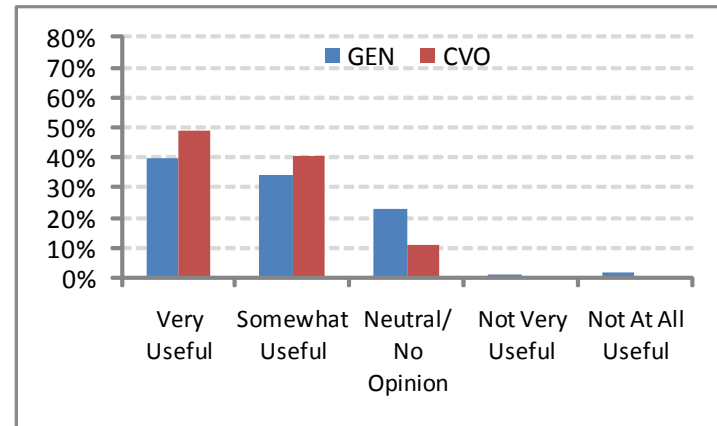|	GEN	CVO	GEN %	CVO %
Very Useful	84	19	49.4%	48.7%
Somewhat Useful	58	15	34.1%	38.5%
Neutral/ No Opinion	13	3	7.6%	7.7%
Not Very Useful	11	2	6.5%	5.1%
Not At All Useful	4	0	2.4%	0.0%
N	170	39	100.0%	100.0%
Don't Use		3	0	
Non-Response		3	1	

Q11: How useful do you find this new web site as a source for providing information across several adjacent states?

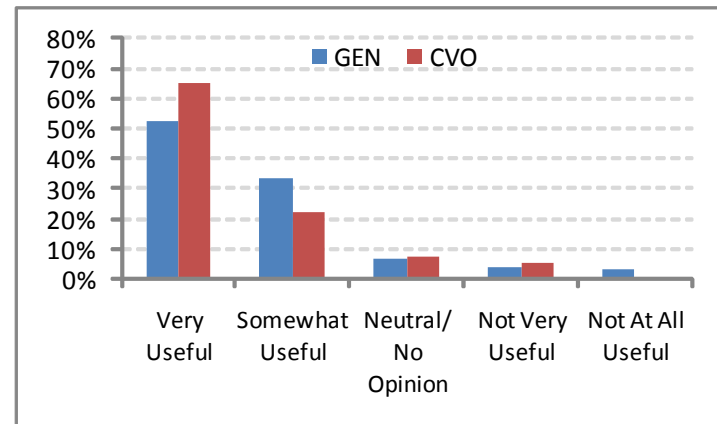|	GEN	CVO	GEN %	CVO %
Very Useful	113	32	66.5%	80.0%
Somewhat Useful	42	8	24.7%	20.0%
Neutral/ No Opinion	8	0	4.7%	0.0%
Not Very Useful	4	0	2.4%	0.0%
Not At All Useful	3	0	1.8%	0.0%
N	170	40	100.0%	100.0%
Don't Use		4	0	
Non-Response		2	0	

Q12: How useful do you find this new web site as a source for providing a repeating loop image of conditions?

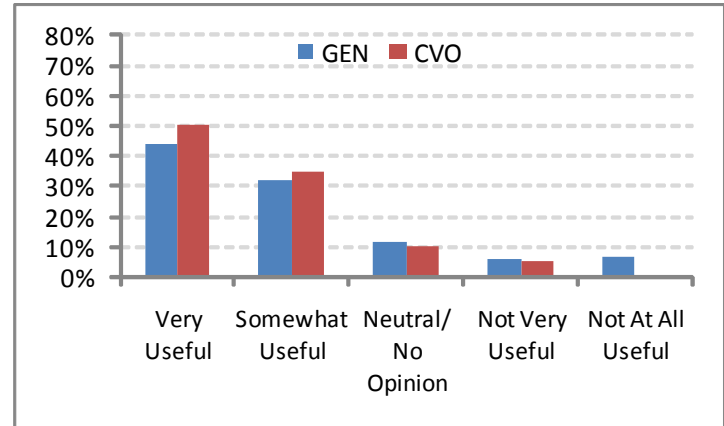|	GEN	CVO	GEN %	CVO %
Very Useful	64	18	39.8%	48.6%
Somewhat Useful	55	15	34.2%	40.5%
Neutral/ No Opinion	37	4	23.0%	10.8%
Not Very Useful	2	0	1.2%	0.0%
Not At All Useful	3	0	1.9%	0.0%
N	161	37	100.0%	100.0%
Don't Use	13	2		
Non-Response	2	1		

Q13: How useful do you find this new web site as a source for helping improve my preparedness for a driving trip?

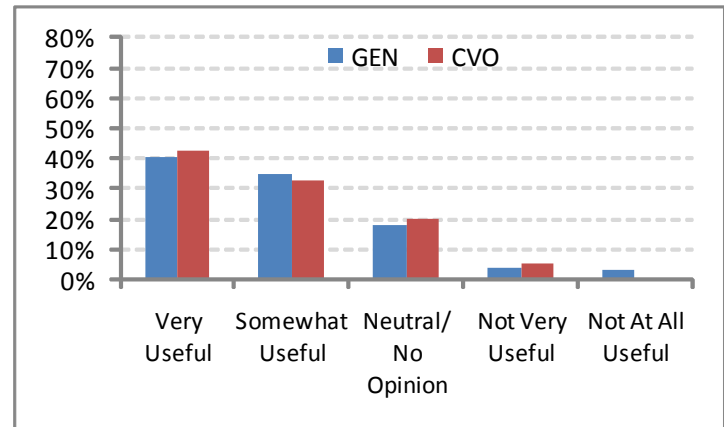|	GEN	CVO	GEN %	CVO %
Very Useful	89	26	52.4%	65.0%
Somewhat Useful	57	9	33.5%	22.5%
Neutral/ No Opinion	11	3	6.5%	7.5%
Not Very Useful	7	2	4.1%	5.0%
Not At All Useful	6	0	3.5%	0.0%
N	170	40	100.0%	100.0%
Don't Use	2	0		
Non-Response	4	0		

Q14: How useful do you find this new web site as a source for helping me decide between different possible routes?

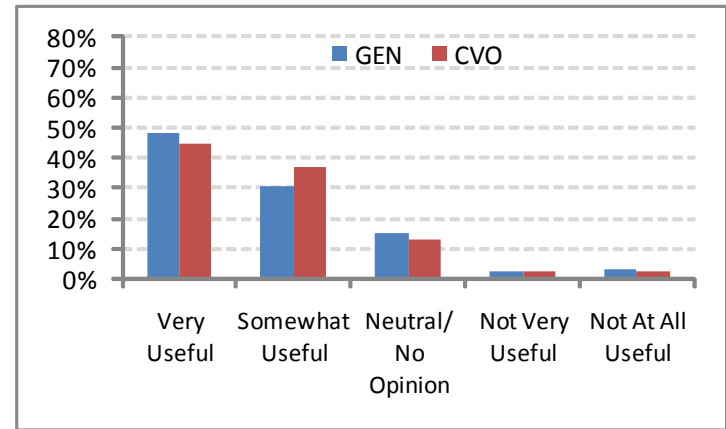|	GEN	CVO	GEN %	CVO %
Very Useful	73	20	43.7%	50.0%
Somewhat Useful	53	14	31.7%	35.0%
Neutral/ No Opinion	20	4	12.0%	10.0%
Not Very Useful	10	2	6.0%	5.0%
Not At All Useful	11	0	6.6%	0.0%
N	167	40	100.0%	100.0%
Don't Use		4	0	
Non-Response		5	0	

Q15: How useful do you find this new web site as a source for helping me decide when to start my trip?

|	GEN	CVO	GEN %	CVO %
Very Useful	68	17	40.5%	42.5%
Somewhat Useful	58	13	34.5%	32.5%
Neutral/ No Opinion	30	8	17.9%	20.0%
Not Very Useful	7	2	4.2%	5.0%
Not At All Useful	5	0	3.0%	0.0%
N	168	40	100.0%	100.0%
Don't Use		5	0	
Non-Response		3	0	

Q16: How useful do you find this new web site as a source for helping me decide whether or not to postpone or cancel a trip?

	GEN	CVO	GEN %	CVO %
Very Useful	82	17	48.2%	44.7%
Somewhat Useful	52	14	30.6%	36.8%
Neutral/ No Opinion	26	5	15.3%	13.2%
Not Very Useful	4	1	2.4%	2.6%
Not At All Useful	6	1	3.5%	2.6%
N	170	38	100.0%	100.0%
Don't Use	4	2		
Non-Response	2	0		

Q17: How useful do you find this new web site as a source for helping me avoid hazardous routes?

	GEN	CVO	GEN %	CVO %
Very Useful	93	23	54.1%	59.0%
Somewhat Useful	51	14	29.7%	35.9%
Neutral/ No Opinion	17	0	9.9%	0.0%
Not Very Useful	3	1	1.7%	2.6%
Not At All Useful	8	1	4.7%	2.6%
N	172	39	100.0%	100.0%
Don't Use	2	0		
Non-Response	2	1		
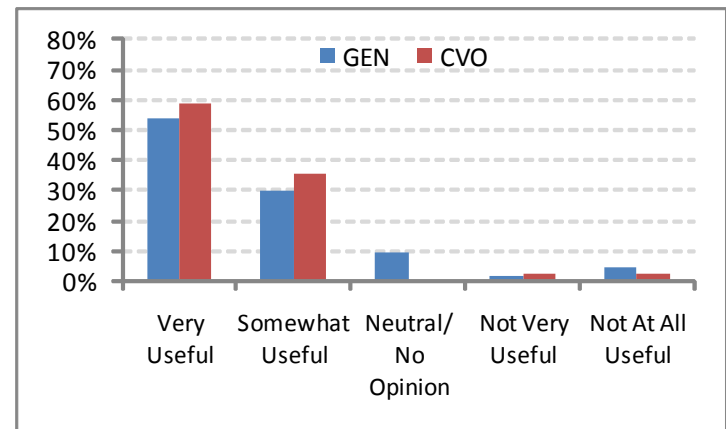
Appendix D

Follow-up Questions for Survey Respondents Who Agreed to be Contacted

To: _____

Thank you for taking the time to visit the *Clarus* experimental demonstration website and responding to our short survey this past month, and for sharing your contact information. This website is now shut down. The demonstration provided pavement condition forecasts, across several states, for up to 12 hours in the future for interstate routes and a weather forecast and pavement condition "loop" over the coming 12 hour period.

We received many helpful comments and suggestions from 216 respondents in Idaho, Montana and North Dakota. We hope you won't mind answering a few additional questions to help us consider further developments. Please just reply to this email message and add your answers below. As we said earlier, all responses will be treated as confidential and only aggregate statistics will be reported.

1. In addition to your initial visit to this demonstration website, how many times after that did you go back to the demonstration site to look at the updated information? _____

2. If you actually used the information on the demonstration site to change your travel plans, please briefly describe those travel changes. Your comments: _____

_____

_____

3. We would like to have your assessment of this **concept** (pavement condition forecasts available to travelers on their state's traveler information website). Please rank each of the below questions from 0 to 10, based on your opinion, where 0 is the lowest rating and 10 is the highest rating.

    3a. Need for the concept _____

    3b. Adaptability of the concept _____

    3c. Anticipated acceptance of the concept _____

    3d. Potential for the concept to improve operations _____

    3e. Potential for the concept to improve safety _____

    3f. Likelihood the benefits of the concept would outweigh the costs _____

4. We would also like to have your assessment of the **<u>readiness</u>** of this tool for deployment and use. Please rank each of the below questions from 0 to 10, based on your opinion, where 0 is the lowest rating and 10 is the highest rating.

    4a. Ease of setting up and configuring the tool for use   _____

    4b. Ease of operating, interacting with, and navigating the tool   _____

    4c. The "fit" of the tool with other tools you currently use   _____

    4d. Your "trust" in the tool and its performance and/or output   _____

    4e. Your perception of reliability and/or accuracy of the tool (and the information it provides)   _____

That's all. Thank you again for your participation in the assessment of this demonstration and for sharing your opinions and suggestions. Feel free to offer any additional feedback.

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FHWA-JPO-11-120

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