

# Motorist Information Needs and Changeable Message Signs for Adverse Winter Travel

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The information needs of motorists during adverse winter travel conditions were evaluated. Commuters traveling on Interstate 80 between Laramie and Cheyenne, Wyoming, and Interstate truck drivers were the primary sources of field data. During poor winter travel conditions, motorists were asked to evaluate wind, visibility, and pavement conditions and to assign a severity rating between 1 (ideal conditions) and 6 (road closed). The survey participants also indicated their desired road and travel information for changeable message signs. The results indicated that motorists have generally consistent adverse winter travel information needs. Pavement condition was the primary information desired. Visibility was the secondary needed information; however, when pavement condition was poor, visibility information became more important. The local commuters most often sought road and travel information from the winter travel advisory phone. The primary source for Interstate truckers was the citizens band radio. The changeable message sign was indicated as an important source by almost 70 percent of the local commuters and 40 percent of the Interstate truckers surveyed.

On December 11, 1990, 12 motorists were killed and 50 others seriously injured during a 99-vehicle pileup due to heavy fog on rural Interstate 75 in Tennessee. As a result, the National Transportation Safety Board heard testimony claiming that highway agencies do not do enough to warn the public about the hazards of driving in adverse weather conditions and singled out changeable message signs (CMSs) as a countermeasure for further study (1, p. 32).

The purposes of this study were to evaluate motorist information needs during adverse winter travel conditions and determine how to best meet information needs using CMSs. Local commuters, Interstate truck drivers, and other motorists traveling on Interstate 80 in southeast Wyoming were surveyed during the winters of 1990–1991 and 1991–1992.

The specific objectives of this research were as follows:

1. To identify information needs and consistencies within user groups for particular adverse winter travel conditions,
2. To determine the priority of winter travel information needs, and
3. To develop CMSs to be displayed for different adverse weather travel conditions.

## STUDY AREA

The area studied in this project was a 66-km (41-mi) section of Interstate 80 between Laramie, elevation 2185 m (7,165 ft), and Cheyenne, lowest elevation 1849 m (6,062 ft), in southeast Wyoming. The study area is prone to high winds, poor pavement conditions, and limited visibility during the winter. The summit, elevation 2635 m (8,640 ft), is a point 7 mi east of Laramie. The terrain is mostly flat with open plains near Cheyenne and becomes more hilly and rolling approaching the summit to the west, where the terrain turns mountainous. A steep downgrade of 5 to 7 percent occurs from the summit to Laramie. The extreme differences in elevation and terrain often cause hazardous driving conditions to occur only on isolated sections. Motorists' desired information in terms of worst condition or overall condition and consistency of the information requested was of interest in this project.

The CMSs evaluated are drum-type signs with three lines of copy; they are located on the outskirts of Laramie and Cheyenne. Each drum or line has six possible messages with a capacity of 24 characters. The last line consists of two six-sided drums set end to end that have the capacity to hold an 18- and a 6-character message, respectively. Each drum can be rotated separately to display the appropriate message.

The individuals surveyed were asked to evaluate the road and travel conditions within the study area during poor winter conditions and give indications as to what road and travel information would help them make travel decisions. To aid in surveying the motorist, road and travel conditions were classified as discussed in the following section.

## CLASSIFICATION AND ANALYSIS METHODOLOGY

Different levels of time, wind, visibility, and pavement were chosen to describe the road and travel conditions (see Table 1). A dependent variable reflected the severity rating of the road and travel conditions. For this dependent variable, a linear rating scale was established, where 1 was an ideal driving condition and 6 was a condition in which the motorist believed that the road should be closed. The road users were asked to rate the severity of the road and travel conditions on the rating scale and then identify the level of each independent variable that best described the road and travel conditions encountered. Severity rating was then modeled as a

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TABLE 1 Road and Travel Conditions

Time	Wind	Visibility	Pavement	
day	calm, breezy	clear	dry	snowpacked
night	strong, gusty	limited very limited	wet slushy	slick/spots icy

function of time, wind, visibility, and pavement and their interactions.

For each trip made during adverse travel conditions, the motorists were also asked to list their desired winter travel information needs with respect to the CMS. Other data were gathered to profile the population characteristics, vehicle type, and information sources being used to determine road and travel conditions.

### DATA COLLECTION PROCEDURE

Field data were collected using travel diaries and interview forms. The travel diary respondents were commuters between Laramie and Cheyenne. A total of 235 diaries were sent to volunteers during spring 1991, and an additional 270 diaries were sent out during fall 1991. A citizens band (CB) radio interview process was used to reach noncommuters. A total of 337 interviews were conducted, consisting primarily of Interstate truckers.

Three supplemental surveys were sent to diary users during the course of the study. The first survey was designed to identify the messages of primary benefit to the motorist. The second survey evaluated the use of a six-point road rating system considering both the degree of adversity and length of condition. The final survey evaluated combinations of three-line messages for different adverse winter travel conditions.

### STUDY RESULTS

For analysis purposes, the field population was separated into consistent groups by vehicle type and origin using vehicle license plates. Two analysis groups were defined as follows:

- Locals: passenger vehicles with local Wyoming license plates (County 2 or 5 and noncommercial diary users), and
- Trucks: all commercial freight vehicles.

The local drivers primarily used at-home information sources (phone, 80 percent; radio, 61 percent; and TV, 50 percent) to receive road and travel information (see Table 2). CMSs

TABLE 2 Information Sources Used by Local and Truck Groups

Source of Information	Percent	
	Locals	Trucks
Road and travel phone	80	23
CMS	69	40
Radio	61	63
Television	50	21
CB Radio / Other drivers	24	72
Others	< 30	< 40

were identified as an information source by 69 percent of the local drivers. Despite receiving information about adverse travel conditions, 63 percent of the local drivers indicated that they would travel if the road were open, regardless of the conditions. This indicates that local drivers are using the information sources not to decide whether to travel but as a gauge of the severity of the conditions expected when traveling or as a guideline for route selection.

The truck drivers indicated that they receive their road and travel information primarily from the CB radio. Through communication with other drivers using the CB radio network, truck drivers are able to gather information at various points along their routes. This system and the regular broadcast radio account for most of their information sources. Forty percent of the truck drivers also indicated their use of the CMS as a source of road and travel information.

Information desired by the motorist revealed consistencies in the type of information needed for particular adverse travel conditions. Related key words were consistently requested on particular dates investigated during poor winter conditions. Descriptions of the wind conditions were consistent throughout the dates investigated, with requests for wind warnings ("Strong/high wind") and wind speeds ("Wind gusts to xx mph"). Specific words used consistently for describing visibility conditions were "snowfall," "fog," and "blowing snow." The message reduced visibility was recommended for mixed visibility conditions. For pavement conditions, consistent requests were made for terms such as "icy," "slick in spots," and "snowpacked." The key words "icy" and "snowpacked" often occurred together to describe the same condition, but "icy" was used more often.

The local drivers indicated that pavement conditions are the principal influence on the perception of the severity of adverse travel conditions. Visibility conditions were found to be the secondary influence. The results of the supplemental surveys established a set of messages designed for the CMSs in the study area (Table 3). On the basis of the road users' desired information priority, the first line of the CMS was reserved for pavement information. The second line was reserved for visibility and wind information. The message "Reduced visibility" was added to identify conditions not described by "Heavy fog ahead" and "Blowing snow." The road rating information on the third line was derived from the adjectives obtained in the second supplemental survey. The appropriate road rating selection may be determined by using the Severity Rating condition matrix (see Table 4), where 3 = poor, 4 = very poor, and 5 = severe. The condition matrix in Table 4 summarizes the severity ratings derived from a regression model containing the independent variables of wind, visibility, and pavement. The message "Advise no light trailers" was intended to be displayed with a strong wind warning and was therefore listed on the first line. Messages that were not specific to weather advisory were included in the displays.

**TABLE 3 Candidate CMS Messages**

Drum Number	Position	Message
1	0	Blank
	1	Icy Road Ahead
	2	Slippery in Spots
	3	Drifting Snow
	4	Advise No Light Trailers
2	5	I-80 Closed
	0	Blank
	1	Reduced Visibility
	2	Blowing Snow
	3	Heavy Fog Ahead
3	4	Wind Gusts To
	5	Fasten Seatbelts
	0	Blank
	1	40 KPH <sup>a</sup>
	2	56 KPH
4	3	64 KPH
	4	72 KPH
	5	86 KPH
	0	Blank
	1	Conditions: Poor
	2	Conditions: Very Poor
	3	Conditions: Severe
	4	Chain Law in Effect
	5	Return to Laramie or Return to Cheyenne

<sup>a</sup> 1 km = 0.62 mi

The message "Return to Cheyenne" or "Return to Laramie" was intended to be displayed with the "I-80 closed" message and was placed on the third line of the display. The message "Chain law in effect" was also included on the third line to be displayed when chains were required for travel on the Interstate.

Respondents indicated that if a combination of snow and fog was present, then the message "Reduced visibility" is more appropriate than "Heavy fog ahead." When respondents were presented with a combination of heavy snowfall and blowing and drifting snow, the message "Blowing snow ahead" was preferred 2 to 1 over "Reduced visibility." When slushy road conditions occurred, 85 percent requested "slippery in spots" to describe this condition.

**CONCLUSIONS**

The specific conclusions from the major findings are

1. The CMS is an important source of adverse winter travel information for rural Interstate motorists.
2. Pavement condition was the primary factor affecting the perception of the severity of adverse travel conditions for both local commuters and truck drivers. Visibility conditions were secondary and of greater importance as pavement condition became more adverse.
3. A three-point rating scale will meet motorist winter travel information needs when adverse conditions exist: poor, very poor, and severe.

**TABLE 4 Severity Rating Matrix**

Wind	Pavement	Visibility		
		Clear (0)	Limited (1)	Very Limited (2)
Calm (0)	Dry/Wet (0)	2 <sup>c</sup>	2	4
	Slick in Spots/Slushy (1)	3	3	4
	Snowpacked/Icy (2)	4	4	4
Strong(1)	Dry/Wet (0)	2	3	4
	Slick in Spots/Slushy (1)	3	3	4
	Snowpacked/Icy (2)	4	4	5

<sup>b</sup> RATING = 1.7 + 0.9P + 0.6V + 0.2V<sup>2</sup> + 0.2W - 0.3 (V\*P); R<sup>2</sup> = 0.565

<sup>c</sup> 2 = Good, 3 = Poor, 4 = Very Poor, 5 = Severe

4. Local motorist ratings of adverse conditions reflected the length of condition. As the length of adverse conditions decreased, condition adjectives requested decreased from severe to very poor to poor.

5. Local commuters primarily obtained adverse road and travel information from at-home sources.

6. Interstate truck drivers primarily used the CB radio for adverse road and travel information and supplemented this by using broadcast radio and CMS information.

7. Local commuters desired to travel regardless of road and travel conditions.

## RECOMMENDATIONS

The majority of local user information concerning adverse winter travel conditions was received primarily through the road and travel phone number, the radio, and the television. These at-home sources have the potential to give highly detailed road and travel information that may deter the motorist from traveling in adverse winter conditions. If more reliable winter travel information could be provided to the motorist through these media, then perhaps fewer motorists would risk traveling and consequently lessen the chance of an adverse weather-related accident.

The CB radio network was the primary source used by the truck drivers. Investigation of a similar noninteractive system for passenger vehicles on a linear radio network would be of benefit. Monitoring CB radio for gathering road and travel information at various locations along a section of highway has potential. Assessing the reliability and accuracy of this information, as well as its applicability to other information sources, is recommended for further study.

Although local motorists prefer to receive road and travel information from at-home sources and truck drivers prefer information from CB radios, the CMS has the potential to be a very effective means of communication to the driver. Further efforts should be made to evaluate the effect of weather advisory CMSs on the reduction of weather-related accidents and the ability of a weather advisory CMS to invoke a positive response to adverse travel conditions from a driver who is unfamiliar with the surrounding area.

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