

Commuters' Attitudes Toward Traffic Information Systems and Route Diversion

ELHAM SHIRAZI, STUART ANDERSON, AND JOHN STESNEY

This report describes the findings of the Los Angeles County Transportation Commission (LACTC) commuter information survey conducted by Commuter Transportation Services, Inc., in February 1987. Commuters in the Los Angeles area were surveyed by telephone to identify how various forms of traffic information are currently used and to assess their attitudes toward diverting from the freeway with improved traffic reporting. The survey collected information on commute characteristics, factors affecting route change, and commuters' attitudes toward improved traffic information. The survey evaluated three types of traffic information. These included continuous radio reporting, electronic freeway message signing, and a traffic information telephone number. The results of this study will assist LACTC before testing the "smart street network" concept along the Santa Monica freeway. Under this demonstration project, commuters will have access to direct real-time traffic information. The results of this study show that commuters in Los Angeles County want improved traffic information. Nearly four-fifths of the commuters surveyed throughout the county said that the current information was inadequate. Nearly 70 percent said that they would alter their commute if accurate traffic information were available. The survey also indicates that improved traffic information alternatives such as continuous radio traffic reporting and a traffic information telephone number could assist commuters in both route selection and route diversion.

In Los Angeles, growth in freeway use has resulted in excessive levels of traffic congestion. The development of improved traffic information systems can provide commuters with reliable traffic reporting on the status of traffic conditions and alternative routes to relieve congestion.

Traffic information systems allow the commuter to be aware of traffic conditions and thus enables them to plan their commute accordingly. One example of such a system is the use of freeway message signs, which have been found to be an effective means of informing commuters and rerouting them around congested areas (1). Another example is that of commercial radio reporting on traffic conditions, or real-time radio reporting (2).

The Los Angeles County Transportation Commission (LACTC), in conjunction with California Highway Patrol, City of Los Angeles Department of Transportation, the Los Angeles Police Department, and the California Department of Transportation, are jointly developing a "smart street network" in Los

Angeles. These agencies are envisioning a traffic management and information system that links ramp meters, detectors, and changeable message signs on freeways with centralized automated surveillance and signal control on major parallel streets. The centralized traffic information can be used to coordinate signal timing and to manage traffic congestion. Additionally, up-to-the-minute traffic information can be communicated directly to the commuter at home, via the personal computer or telephone, and on the road via an in-vehicle navigation system, commercial radio, roadside radio, and changeable message signs. To test this "smart street network" concept the participating agencies have developed a demonstration project on a selected portion along the Santa Monica freeway (I-10) west of downtown Los Angeles.

This study provides some insight into conditions under which drivers will divert from the freeway and the type of information that may motivate drivers to change from their normal travel route (such as real-time information, electronic message signs, and traffic information numbers). Previous studies have documented some of the effects of improved information systems on reducing commuter stress, traffic congestion, and improving the overall commute (3-6).

METHODOLOGY

The commuter information survey collected information on the following three topics:

- *Commute Characteristics.* Questions in this section assessed commuting time to and from work, commuting delay as a result of congestion, stopover delay, travel conditions, travel route, and route change.
- *Factors Affecting Route Change.* This section identified factors affecting route change, such as electronic freeway message signs and radio traffic reports.
- *Improved Traffic Information.* The final set of questions determined the effect of improved traffic information through media such as continuous traffic reporting and a telephone information number.

This survey includes 7 screener questions and 25 survey questions. The screener questions eliminated all but those commuters who were 18 years of age and older, and who traveled to and from work by freeways during peak hours. All survey questions were pretested and revised.

Approximately 10 interviewers contacted 400 commuters in Los Angeles County on weeknights and weekend days at their homes by telephone. The interviewers were trained to clarify questions but to avoid leading a response. In addition the interviewers were provided with a list of answers to questions about the study to use if asked by a potential respondent (i.e., "What is the purpose of this study?") The interviewers made up to three attempts at each number per night and "no answers" were followed up for 2 days. Most of the commuters responded to all the questions and offered additional information on the traffic situation in Los Angeles County.

Further areas for analysis could include duration of travel time, commute distance, demographics of respondents, and commuting mode. Additionally, it would have been useful to see if the portion of trip traveled on freeways affected the way respondents answered the questions and if commuters of specific freeways responded differently. This study was performed under contract to LACTC and had a limited budget.

Sampling

The sample for this study was drawn from a random list of computer-generated telephone numbers for the 213, 818, 714, and 805 area codes in Los Angeles County. To select a sample of Los Angeles County residents, Los Angeles County phone prefixes were used as a selection probability. A basic program generated random prefixes, which were then screened against valid Los Angeles prefixes. Random suffixes were then generated. A total of 2,000 telephone numbers were developed. A sample size of 400 was selected to permit a worst-case sampling error of ± 5 percent with 95 percent confidence. (Unless otherwise noted, all percentages given in this report are based on the total 400 sample size.)

Demographics

The survey requested information about the respondent's age and gender. This information was used to compare age and gender with factors relevant to the respondent's commute and his or her attitudes toward improved traffic information. The survey results show that the majority (67 percent) of the respondents are in the 21 to 40 yr age group. Only 5 percent of the respondents are in the 18 to 20 yr age group and the remaining 28 percent are above 40 years of age. The interviewers were required to indicate the gender of the respondents. Based on the responses, it was determined that 58 percent are male and 42 percent are female.

COMMUTE CHARACTERISTICS

The respondents' commute characteristics are discussed in the following sections.

Commuting Time

Commuters were asked to estimate their average travel time to and from work and the average delay they experience as a result of congestion. Interviewers were told to use the word "usually" (if asked) to describe the respondent's average commute time during the 5-day work period. Commuters travel an

average of 37.3 min to work and 41.9 min home from work. In comparison, a study conducted by Commuter Transportation Services, Inc., Carpool Evaluation 1987, found that Los Angeles County commuters (freeway and nonfreeway users) travel on the average 33.7 min to work and 39.6 min from work and have an average trip length of 16.8 mi. This survey, however, did not ask for trip length. The average reported delay due to congestion is 18 min. These results are given in Table 1.

TABLE 1 TRAVEL TIME AND DELAY

How much time does it usually take you to get to work?
How long does it take you to get home from work?
How much delay as a result of congestion do you experience?

Travel Time (min)	To Work		From Work		Average One-Way Delay (min)
	(count)	(%)	(count)	(%)	
Under 15	16	4	17	4	6.6
15-29	99	25	86	22	10.1
30-44	138	34	117	29	15.7
45-59	66	17	73	18	23.6
60-89	54	14	66	17	30.7
90+	12	3	26	7	47.5
Invalid response	15	3	15	3	
	400	100	400	100	
Average	37.3		41.9		18

Respondents were also asked whether they regularly make any stops on their way to or from work and if so, what they usually are. The results show that approximately 9 percent of the commuters make regular stops on their way to work, and 7 percent make stops on their way home. The most frequent regular stop made by commuters is for coffee or food on the way to work and stopping for groceries or other personal errands on the way home (3 percent and 4 percent, respectively). Commuters (both on their way to and from work) rank picking up or dropping off a carpooler or a friend as the second most frequent type of regular stopover (3 percent and 2 percent, respectively). All other reasons cited total only 4 percent, and these include dropping off and picking up children and performing work-related errands. Interviewers did not ask the respondents whether their stopover time was included in their estimate of travel times. If the survey is repeated, it will be necessary to ask respondents to account for stopover time in total trip time.

Travel Conditions

The respondents were asked to describe the traffic conditions they experience on the way to work. Three categories of responses were provided: flow freely, flow with some slowdowns, and always stop and go. Interviewers told respondents, in making a choice between these categories of traffic conditions, to consider more than a 50 percent portion of their trip. Three-quarters of the commuters experience some slowdown due to congestion during their commute. The responses are indicated in Table 2.

TABLE 2 TRAFFIC CONDITIONS

Please tell me which of the following best describes normal traffic conditions on your way to work. Does traffic

	Count	Percent
Flow freely?	83	21
Flow with some slowdowns?	191	48
Always stop and go?	113	28
Invalid response	13	3
Total	400	100

Commuting Route and Route Change

The survey participants were asked if they ever change to another route while on their way to work. Forty percent of the commuters say that they change to another freeway or street, and 31 percent said they do not (Table 3).

TABLE 3 ROUTE CHANGE

Do you ever change routes to another freeway or street while you are on your way to work?

	Count	Percent
Yes	161	40
No	124	31
Invalid response	115	29
Total	400	100

The respondents who alternate routes were asked how often they change to another route while on their way to work. Fourteen percent of the respondents change to an alternate route on the way to work very often or often. Approximately 25 percent change rarely or sometimes. The purpose of these questions was to provide LACTC with information on the existing propensity of commuters to change travel routes. The responses are given in Table 4.

TABLE 4 FREQUENCY OF ROUTE CHANGE

How often do you change to another route while you are on your way to work?

	Count	Percent
Very often	17	4
Often	39	10
Sometimes	62	15
Rarely	43	11
Never	0	0
Do not change route	124	31
Invalid response	115	29
Total	400	100

The responses in each category were then compared to the traffic conditions that the respondents experience on their way to work (refer to Table 2). Commuters who report stop and go traffic conditions are more likely than expected (chi-squared analysis) to report that they change to another route very often

or often. Commuters who report freely flowing traffic conditions are less likely than expected to change routes (a lower than expected actual number in "very often" and "often" categories and a higher than expected actual number in "rarely" or "never" categories).

Frequency of route change was compared to age, gender, travel time, and delay. The results show that variables of age, gender, travel time, and delay have no significant relationship to the frequency of route change.

FACTORS AFFECTING ROUTE CHANGE

Knowledge of Alternate Routes

The survey participants were asked if they know of any routes they could take to work other than the usual route traveled. Of the 400 participants, 71 percent said that they know of other routes they could take to work. The remaining 27 percent said that they know of no alternative route (Table 5). Therefore, 31 percent of the total respondents who know of an alternate route do not change their travel routes (refer to Table 3).

TABLE 5 KNOWLEDGE OF ALTERNATE ROUTES

Do you know about any routes you could take to work, other than the one you usually take?

	Count	Percent
Yes	284	71.0
No	106	26.5
Invalid response	10	2.5
Total	400	100.0

The respondents who know of an alternate route were analyzed by the categories of age, gender, travel time, and delay. The results indicate no significant relationship between knowledge of alternate routes and categories of age, gender, and delay. However, the results show a relationship between knowledge of alternate routes and travel time. People commuting for shorter periods of time (less than 45 min) were more likely to know of alternate routes to work than those with longer travel times (greater than 45 min). This relationship may be explained by the fact that shorter distance commuters often have more choices available to them in route selection than longer distance commuters who use freeways for their commute. These results are indicated in Table 6 by percentages.

Survey results indicate that of the 284 commuters who know of an alternate route to work, men are more likely to change travel routes than women. A total of 62 percent of all men who know of alternate routes change routes on the way to work and 38 percent of all women who know of alternate routes change routes.

Traffic Conditions and Route Changes

Survey participants were asked to identify traffic conditions that motivate them to change their normal travel route. The majority of commuters who change travel routes on occasion say they would alter their route if traffic was stopping often or was completely stop and go. The purpose of this question was

TABLE 6 ALTERNATE ROUTE AND TRAVEL TIME

Knowledge of Alternate Route	Travel Time to Work												Invalid Response		Total	
	Under 15		15-30		31-45		46-60		61-90		Over 90		(count)	(%)	(count)	(%)
Yes	14	3	81	20	95	24	48	12	34	9	3	1	9	2	284	71
No	2	1	15	4	42	10	18	5	19	5	9	2	1	—	106	27
Invalid response	0	—	3	1	1	1	0	—	1	—	0	—	5	1	10	2
Total	16	4	99	25	138	34	66	17	54	14	12	3	15	3	400	100

to provide LACTC with information on traffic conditions that may cause route diversion. Responses are indicated in Table 7.

Additional Factors Affecting Route Change

The 176 respondents who do change to another freeway or street on their way to work were read a list of factors affecting route change. As indicated in Table 8, the most frequently cited factor affecting route change is radio traffic reports, followed by personal experience, and having to arrive on time.

Each of the factors affecting route change was compared to age, gender, travel time, and delay. The results show no significant relationship between any of the variables.

TABLE 7 MOTIVATION FOR ROUTE CHANGE

Earlier, you described traffic conditions on your way to work. Would you change the route you usually take to work if you found out that traffic on your usual route that day was

	Count	Percent
Completely stop and go?	58	14
Stopping often?	30	8
Slowing down often and stopping sometimes?	45	12
Slowing down often?	11	2
Slowing down sometimes?	11	2
Do not change routes	224	56
Do not change because of delay	5	1
Invalid response	16	5
Total	400	100

TABLE 8 FACTORS AFFECTING ROUTE CHANGE

Do any of the following usually help you decide to change routes while you are on your way to work?

	Count	Percent of Responses
Radio traffic reports	129	30
Personal experience	89	20
Need to arrive on time	73	17
Mood	56	13
Conditions of the drive	44	10
Electronic freeway signs	36	8
Other		
Heavy traffic	6	1
Bad exhaust	1	—
Other	6	1
Total	440	100

NOTE: Participants were permitted to indicate more than one factor.

Radio Traffic Reports

Radio traffic reports are the most frequently cited factor affecting route change. All respondents were asked how often they listen to radio traffic reports. The majority of the participants report that they listen to radio traffic reports often or very often. Only 9 percent said that they never listen at all. These responses are presented in Table 9.

TABLE 9 RADIO TRAFFIC REPORTS

How often do you listen to the traffic reports on the radio?

	Count	Percent
Very often	176	44
Often	84	21
Sometimes	62	16
Rarely	40	10
Never	37	9
Invalid response	1	—
Total	400	100

Of the 77 respondents (19 percent) who rarely or never listen to radio traffic reports, 58 (14 percent) offer the reasons, given in Table 10, for not listening.

A further analysis reveals that there is no relationship between how often commuters listen to radio traffic reports and delay. In addition, no significant relationship is identified with respect to age, gender, and travel time.

TABLE 10 REASONS FOR NOT LISTENING TO REPORTS

Why don't you listen to radio traffic reports?

	Count	Percent
No radio or dislike radio in general	17	4
Listen only to music	13	3
Not interested in traffic reporting	28	7
Total	58	14

Electronic Freeway Message Signs

Commuters were then asked to state how often they notice a message on the electronic freeway message signs (Table 11). A quarter of the commuters (26 percent) say that they sometimes, often, or very often notice a message on the electronic freeway message signs, and three-quarters (75 percent) say that they rarely or never notice a message. Even though 26 percent may notice the signs, only 8 percent ever use the signs in their decision to change routes (refer to Table 8).

TABLE 11 ELECTRONIC FREEWAY MESSAGE SIGNS

How often do you notice a message on the electronic freeway message signs?		
	Count	Percent
Very often	24	6
Often	21	5
Sometimes	60	15
Rarely	106	26
Never	187	47
Invalid response	2	1
Total	400	100

A further analysis reveals no significant relationship between how often respondents notice a message on the freeway signs and age, gender, travel time, and delay.

A follow-up survey on electronic message signs may include questions on whether commuters see message signs on their travel route and if they ever notice messages displayed on the signs.

IMPROVED TRAFFIC INFORMATION

Potential for Improved Information

Survey participants were asked whether they would leave the freeway if more accurate information about their commute were available and if they knew that surface streets offered shorter travel time to or from their work that day (Table 12). The vast majority of commuters (94 percent) responding to this question said that they would maybe, probably, or definitely leave the freeway if more accurate information about the commute were available and if they knew that surface streets offered a shorter travel time to or from their work that day. Only 5 percent said that they would probably not or definitely not leave the freeway. Interviewers were told to give respondents a list of methods through which the traffic information would become available to commuters (if asked).

The responses in each category were then compared to the traffic conditions that the respondents experience on their way to work (Refer to Table 2). Commuters who reported stop and

TABLE 12 POTENTIAL FOR IMPROVED INFORMATION

If more accurate information about your commute were available and you knew that surface streets offered shorter travel time to or from your work that day, would you use this information to leave the freeway?

	Count	Percent
Definitely	274	69
Probably	76	19
Maybe	25	6
Probably not	9	2
Definitely not	10	3
Don't know	4	1
Invalid response	2	—
Total	400	100

go traffic conditions are more likely than expected (chi-square analysis) to report that they would definitely or probably leave the freeway. Additionally, those commuters that reported normal traffic conditions as flowing freely are less likely to leave the freeway (probably not or definitely not). This analysis illustrates consistent responses by commuters among questions in the survey.

Commuters' propensity to leave the freeway was compared to age, gender, travel time, and delay. The results show that no relationship exists between leaving the freeway and travel time, and no significant correlation is identified with age, gender, and delay within this confidence range (95 percent).

The 375 participants (94 percent) who said that they would (maybe, probably, or definitely) leave the freeway were then asked whether they would use the accurate information to leave the freeway and use another freeway or street or make no changes. Approximately half of the respondents (45 percent) said that they would leave the freeway and use streets, an eighth would use another freeway, and approximately a third (32 percent) would make the choice based on circumstances at the time. Respondents' answers to this question may have been affected by choices influencing the existing commute; for example, not all commuters may have the choice of using another freeway. The responses are given in Table 13.

A further analysis showed no significant relationship between reasons for leaving the freeway and age, gender, travel time, and delay. Nineteen of the commuters who said that they

TABLE 13 DIRECTION AFTER ROUTE CHANGE

Would you use the accurate information to leave the freeway and		
	Count	Percent
Use another freeway?	51	13
Use surface streets?	178	45
Make no changes?	9	2
Depends	126	32
Don't know	6	1
Invalid response	30	7
Total	400	100

would not leave the freeway and would make no changes offered the following explanations:

- Did not want to change habit (mentioned 12 times).
- Streets were too slow (mentioned 4 times).
- Everyone else would have also changed to the same route (mentioned 3 times).

The participants were asked for ways in which traffic information could be improved. Eighty percent (319 people) of all commuters surveyed responded to this question (Table 14). Respondents were permitted multiple responses. Only 17 percent (mentioned 57 times) of those responding think that information is already good enough, and 19 percent (mentioned 64 times) do not know how it can be improved. The remaining respondents (64 percent) made suggestions. The most frequent suggestion for traffic information improvements was having more timely and accurate information. This was followed by

TABLE 14 IMPROVED TRAFFIC INFORMATION

How could traffic information be improved to make it more useful to you?

	Count	Percent
More timely and accurate	89	27
Don't know	64	19
Already good enough	57	17
More frequent reporting	50	15
More or better use of electronic freeway message signs	28	8
Suggest alternative routes	17	5
Localized reports	16	5
Other	12	4
Total	333	100

more frequent reporting and more and better use of electronic freeway message signs.

Continuous Traffic Reports

Participants were asked how often they would listen to a radio station that only gives highway traffic reports. The majority of respondents favor continuous traffic reporting, saying that they would listen to it sometimes or often. Respondents in each category were then compared to the traffic conditions that they experience on their way to work (refer to Table 2). Commuters who reported stop-and-go traffic conditions are more likely than expected (chi-square analysis) to listen to radio stations that give highway traffic reports often or sometimes. Commuters who reported free-flowing traffic conditions were less likely than expected to listen (never). The responses are given in Table 15. A further analysis reveals no major correlations by age, gender, and travel time.

TABLE 15 CONTINUOUS RADIO TRAFFIC REPORTS

How often would you listen to a radio station that only gives highway traffic reports?

	Count	Percent
Often	125	31
Sometimes	150	37
Never	114	29
Don't know	3	1
Invalid response	8	2
Total	400	100

Traffic Information Telephone Number

The survey participants were asked whether they would use a traffic information telephone number to compare traffic conditions on their normal route with those on alternative routes. Fifty-three percent of the commuters surveyed say that they would probably or definitely use the traffic information telephone number, 28 percent said that they would not or probably would not, and 18 percent say that maybe they would or they didn't know whether they would use it. Overall these results showed that commuters would use a direct access real-time telephone number. The responses are presented in Table 16.

TABLE 16 TRAFFIC INFORMATION TELEPHONE NUMBER

If you could make a telephone call to compare current traffic conditions on your usual route with alternative routes, would you use this number?

	Count	Percent
Definitely	122	30
Probably	92	23
Maybe or don't know	70	18
Probably not	76	19
Definitely not	38	9
Invalid response	2	1
Total	400	100

The 284 respondents (71 percent) who say that they would (maybe, probably, or definitely) use the traffic information number were asked how many times a week they think that they would use this number if it were available. Their responses are given in Table 17.

TABLE 17 USE OF TRAFFIC INFORMATION NUMBER

How many times a week do you think you would use such a traffic information number?

	Count	Percent
Less than 1 call per week	31	8
1 call per week	45	11
2 calls per week	64	16
3 calls per week	47	12
4 calls per week	16	4
5 calls or more per week	68	17
Probably not or definitely not	114	28
Don't know or invalid response	15	4
Total	400	100

A further analysis reveals no major trends between use of the traffic information number and age, gender, travel time, and delay.

The respondents who said that they would not use the number (28 percent) gave the reasons indicated in Table 18 for their responses. The most frequent reason cited by respondents for not wanting to use the traffic information number is that it is not useful to them and that it takes too much time and is inconvenient.

TABLE 18 REASONS FOR NOT USING INFORMATION NUMBER

Why would you not be interested in using a traffic information number?

	Count	Percent
Service not useful to them	40	10
Too much time or inconvenient	39	10
Radio reports are good enough	9	2
Wouldn't trust reports	6	1
Other	10	3
Don't know or invalid response	25	6
Would use information number	271	68
Total	400	100

CONCLUSIONS

The conductors of this study mainly collected information on three areas of commuter characteristics, factors leading to route change, and attitudes toward improved information systems. According to survey results, on the average, freeway commuters travel 37.3 min to work and 41.9 min from work. The average one-way delay for commuters was 18 min. The statistics show that commuters (freeway) in Los Angeles County are facing long commutes, great portions of which are accounted for by delays.

Survey results also showed that 71 percent of the surveyed commuters knew of alternate routes to work, which indicates that the idea of taking alternative routes may not be that uncommon to Los Angeles commuters. Survey results also showed that commuters with stop-and-go traffic were more likely than other commuters to change routes. In fact, only 12 percent of all commuters experienced free-flow traffic to work. The most frequently cited factor that made commuters change routes was radio traffic reports (30 percent), followed by personal experience (20 percent), and having to arrive on time (17 percent).

One of the valuable findings of the survey was that nearly 70 percent of commuters would definitely leave the freeway if more accurate information regarding their commute were available and if they knew that surface streets offered a shorter route to work. This piece of information can be useful to LACTC because it shows that if given more accurate information, commuters perceive that they will divert from congested freeways.

Overall, commuters want timely and accurate information (27 percent), more frequent reporting (15 percent), and better uses of electronic freeway message signs (8 percent). Only 17 percent of the commuters said that current traffic information was adequate. These figures show that Los Angeles County commuters want better information on traffic, and their responses were favorable toward both continuous radio traffic reporting (68 percent) and a traffic information number (53 percent).

The results of this survey could be useful in considering and implementing the "smart street network" project, however further research could place a greater emphasis on commuter demographic characteristics such as occupation and income, and commute characteristics such as commuting mode and commuting distance. Commuter attitudes as they correlate to origin and destination of commute and freeway of travel may

prove useful in tailoring frequency and volume of traffic information that will be generated. Further research could also help identify the optimum sources for the dissemination of traffic information, such as personal computers, car phones, downtown parking lots, and so on.

This study and other related research can demonstrate the potential for traffic information systems and their effect on route diversion in metropolitan areas.

ACKNOWLEDGMENTS

This study was conducted by Commuter Transportation Services, Inc., for the Los Angeles County Transportation Commission. The survey and report were prepared with guidance from Ginger Gherardi and Stephen H. Lantz of LACTC. The survey questions were reviewed by S. E. Rowe, Los Angeles City Department of Transportation; Jerry B. Baxter, District 7, California Department of Transportation; Everett N. Rogers, Annenberg School of Communication; and Daniel Brand, Charles River and Associates.

REFERENCES

1. C. L. Dudek, G. D. Weaver, D. R. Hatcher and S. H. Richards. Field Evaluation of Messages for Real-Time Diversion of Freeway Traffic for Special Events. In *Transportation Research Record 682*, TRB, National Research Council, Washington, D.C., 1978, pp. 37-45.
2. C. L. Dudek, J. D. Friebele, and P. C. Loutzenheiser. Evaluation of Commercial Radio for Real-Time Driver Communications on Urban Freeways. In *Highway Research Record 358*, HRB, National Research Council, Washington, D.C., 1971, pp. 17-25.
3. D. G. Capelle. *Freeway Traffic Management*. Project 20-3D. National Cooperative Highway Research Program, TRB, National Research Council, Washington, D.C., 1979, pp. 16-17.
4. C. L. Dudek, R. D. Huchingson, and R. Q. Brackett. Studies of Highway Advisory Radio Messages for Route Diversion. In *Transportation Research Record 904*, TRB, National Research Council, Washington, D.C., 1983, pp. 4-9.
5. P. Zove and C. Berger. *Integrated Motorist Information System (IMIS) Feasibility and Design Study*. Sperry Rand Corporation; Federal Highway Administration, U.S. Department of Transportation, 1978.
6. R. W. McNees and R. D. Huchingson. *Human Factors Requirement for Real-Time Motorist Information Displays*. Vol. 6. Texas Transportation Institute; Federal Highway Administration, U.S. Department of Transportation, 1978.

Publication of this paper sponsored by Committee on User Information Systems.