Perspectives and Expectations of Drivers: A Literature and Best Practices Scan

Project identification number 0092-02-12

Final Report

Kurt Ian Weisser
Alan Horowitz
University of Wisconsin, Milwaukee

Submitted to the Wisconsin Department of Transportation May 2002

NOTICE:

This research was funded by the Wisconsin Council on Research of the Wisconsin Department of Transportation and the Federal Highway Administration under Project #SPR-0092-02-12. The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views of the Wisconsin Department of Transportation or the Federal Highway Administration at the time of publication.

Technical Report Documentation Page

1. Report No.	2. Government Accession No	3. Recipient's Catalog No

4. Title and Subtitle	5. Report Date
A Literature and Best Practices Scan: Perspectives and Expectations of Drivers	May 2002 6. Performing Organization Code

7. Authors	8. Performing Organization Report No.
Alan Horowitz	

9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
University of Wisconsin, Milwaukee P.O. Box 784 Milwaukee, WI 53201	11. Contract or Grant No. 0092-02-12

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

Many of the mechanisms for delivering information to drivers are expensive, have long lead-times or require complex partnerships. Given the expectations of drivers for good information and the possibility of costly mistakes and redundancies, it is critical that mechanisms be carefully chosen and implemented.

This is a literature scan and review and a useful digest of best practices for delivering information to drivers.
It includes:

- An annotated bibliography of relevant work;
- A breakdown of driver information demand by different market segments;
- A summary of driver perceptions of different technologies and media for delivering information;
- List of the information that drivers want from such media; and
- Recommendations for future research.

17. Key Words	18. Distribution Statement
ITS, ATIS, driver, perception, CMS, radio, television, media, literature scan, best practices.	No restriction. This document is available to the public through the National Technical Information Service 5285 Port Royal Road Springfield VA 22161

18. Security Classif.(of this report)	19. Security Classif. (of this page)	20. No. of Pages	21. Price
Unclassified	Unclassified		

Executive Summary

PROJECT SUMMARY

Many of the mechanisms for delivering information to drivers are expensive, have long lead-times or require complex partnerships. Given the expectations of drivers for good information and the possibility of costly mistakes and redundancies, it is critical that mechanisms be carefully chosen and implemented.

This is a literature scan and review and a useful digest of best practices for delivering information to drivers. It includes an annotated bibliography of relevant work, a breakdown of driver information demand by different market segments, a summary of driver perceptions of different technologies and media for delivering information, list of the information that drivers want from such media, and recommendations for future research.

BACKGROUND

The Wisconsin Department of Transportation (WisDOT) initiated this study to determine the existing body of knowledge on drivers perspectives and expectations of Intelligent Transportation Systems (ITS). ITS deployment strategies are heavily dependent upon the degree of driver acceptance. Thus, knowledge of drivers' reactions to and impressions of various ITS elements is essential to making good deployment decisions. Considerable research has already been performed on this subject. The purpose of this study is to determine missing research elements that are critical to WisDOTs mission.

The project was carried out by the Center for Urban Transportation Studies at the University of Wisconsin, Milwaukee. Project scope and direction was by the WisDOT Technical Oversight Committee (TOC).

PROCESS

The literature scan took about three months, and yielded 158 articles, plus many interviews at FHWA, DOTs, and research centers nationwide. These articles were used to determine preliminary directions for future research.

Reading and winnowing out the relevant articles and conclusions took another three months, resulting in an annotated bibliography with 84 entries. The annotated bibliography is the scan of useful literature. The bibliography is the source for conclusions on best practices and future research.

This project was designed to be useful immediately to traffic engineers and planners, and useful for further research. The final report shows the demand for ITS services by type of person, trip, time, and technology or media. The project identified 15 unexplored research concepts, plus six recommended research areas, and suggested next steps.

FINDINGS AND CONCLUSIONS

ITS users by type of person:

- Technophiles: Likely to use new technology, "control seekers", 30% of commuters, young, male, wealthy.
- General Public: Likely to use radio or Changeable Message Sign (CMS) or other "low-hassle" media. Less likely to seek out information.

Conclusion: Improving existing media may be a powerful tool at modest cost.

ITS users by type of trip:

- Commuters: High demand for information, low tolerance for delay.
- Shoppers (non-peak regular trips): Medium demand for information, medium tolerance for delay.
- Special Trips (airport, stadium, appointments): High demand for information, low tolerance for delay.
- Other Trips (tourism, misc.): Low demand for information, high tolerance for delay.
- Truck: High demand for information, medium tolerance for delay.

Conclusions: Trip types have different information needs; no single information format is useful to all trips. Highest demand for information is by Commuters and Special Trips.

ITS users by information technology/media:

- Pre-trip: Radio and television are the dominant media. Very few travelers use telephone, internet, or other technologies where these services are available.
- En-route: Radio and CMS are the dominant media. Very few travelers use telephone or on-board technologies where these services are available. Willingness to pay for on-board technologies is low.

Conclusion: Existing media (radio, television, CMS) are very popular, even though their current usefulness is limited. Drivers generally want to receive information as they listen to or watch other programming or observe their environment.

What do ITS Users Want?

Drivers want more information at the right time. They want enough information to weigh their priorities and make a decision. Independent of media or technology, drivers want to know:

- *Is There a Problem?*
- *What Is the Problem?*
- *How Long Is the Delay?*
- *What Is the Prescribed Solution or Alternate Route?*
- *How Does the Alternative Compare with the Highway Delay?*

RECOMMENDATIONS FOR FURTHER ACTION

The market and driver information in the report is useful to traffic engineers and planners in understanding driver perceptions of ITS information technologies.

Recommendations for future research:
Improving radio, television, and CMS information.
General guidance for implementation of ITS for work zones.
Special trip and special event driver needs.
Intercity or rural driver needs.
Truck driver needs.
Public safety / homeland security needs.

Driver Perspectives and Expectations of ITS: Results from a Literature Scan

Introduction

In the interests of refining the research agenda related to Intelligent Transportation Systems (ITS), the Wisconsin Department of Transportation initiated this study to determine the existing body of knowledge on drivers perspectives and expectations of ITS. It is recognized that deployment of ITS strategies is heavily dependent upon the degree of driver acceptance. Thus, knowledge of drivers' reactions to and impressions of various ITS elements is essential to making good deployment decisions. Considerable research has already been performed on this subject. The purpose of this study is to determine missing research elements that are critical to WisDOTs mission.

Approximately 160 separate documents were identified as being related to the subject. Of these, 84 of the most pertinent documents were included in an annotated bibliography.

This report contains a summary and analysis of the best practices scan, an annotated bibliography, a list of missing research elements, and a recommendation as to the most fruitful next step in WisDOTs research agenda relating to this topic.

Best Practices Scan

This scan of existing ITS literature to find drivers' perspectives and expectations is intended to locate gaps in existing research, and develop a summary of best-practices and research results.

Most existing ATIS (Advanced Traveler Information Systems) research follows new technology ("gee-whiz"), including pretrip information by Internet or telephone and en route information by telephone, changeable message sign (CMS), or in-vehicle devices. Except for comparison purposes, the most popular existing information systems of radio and television are ignored.

The results of the research are consistent and clear: Drivers do not care about ITS as a concept. They like specific technologies or programs that benefit them directly (38,42,48).

Drivers need a minimum amount of information to consider changing their trip route or time. New ATIS technologies provide adequate information, while existing radio, television, and CMS do not. The flaws in existing systems are not fundamental; they can be improved to provide adequate information. Despite their low usability, existing information sources are highly rated by drivers. (29,39,48)

The market for information can be segmented into a series of different trip types. The best markets for useful implementation of improved information systems are with commuters and infrequent special trips. New-technology ATIS systems can have high rates of driver diversion, especially in these markets.

Drivers prefer low-hassle information sources. The amount of hassle is a major hurdle for new technologies, even greater than cost. In one study, a free service had low use by drivers because they had to press three buttons. (38,39)

WHO ARE ITS USERS?

Most ITS users see only the ATIS interface. Drivers do not care about the ITS concept, since they gain nothing from the knowledge (43). They have a basic expectation of transportation safety and administration, but have low interest in knowing what happens "behind the scenes".

Types of ATIS Users

Drivers fall into two categories of ITS user: technophiles and general public.

- Technophiles are more likely to use new information technology, including telephone, Internet, wireless device (PDA, pager), and in-vehicle information. They are more willing to actively seek information. These users are sometimes referred to as "control-seekers" or "webheads" in some studies. They make up 20-30% of commuters. They tend to be young, male, wealthy, have families, and have many demands on their time (50).
- General public uses radio, television, and en route changeable message signs to obtain information. The common characteristic is that their source is already part of their existing routine, a low-hassle way of obtaining information.

The defining characteristic is how drivers acquire information, using new "gee-whiz" technology, or low-hassle existing sources. New technology for travel information is attractive to a small segment, up to 30% of commuters, while existing information sources are satisfactory to 60-80% of commuters (20,35,60,63).

For example, telephone-based information services encountered several barriers to common use including the fact that most phone owners were unwilling to use three-digit dialing to obtain alternate route information, even when they knew about delays ahead (9,17,38). Most drivers were unfamiliar with the concept of ATIS, were unaware of the personal information technologies available, and showed little interest in them (17,35). Only a small cadre of repeat customers used personalized information services (17,35,63). These users love the service as long as it is free and accurate. ATIS users had high rates of route or time switching based on delay information.

Most drivers were satisfied with their existing sources of information, radio, television, and CMS, but found them to be of limited use (16). Radio traffic reports were most popular, but had very low rates of route or time switching in response to delay. These sources are capable of offering drivers the information needed to make route decisions, but currently do not. Improving existing media and CMS information may be a powerful tool at modest cost.

TRAVEL INFORMATION DEMAND: ATIS MARKET SEGMENTS

Drivers can be segmented into the following information markets: commuters, shoppers, special trips, other trips, and trucks.

	Travel Information Demand	Parking Information Demand	Delay Tolerance	Likely To Change Route or Time	ATIS Market Potential
Commuters	High	Low	Low	Route	High
Shoppers	Medium	Medium	Medium	Time	Medium
Special Trips	High	High	Low	Route	High
Other Trips	Low	Low	High	Neither	Medium
Truck	High	Low	Medium	Route	High

- Commuters traveling during peak times, have the highest demand for travel information, the lowest tolerance for delay, the least likelihood to change trip time, and the greatest likelihood to change trip route. Commuters showed low interest in parking information, and high interest in "whole trip" information including arterials before and after their highway segment. Commuters are time-sensitive, and most interested in door-to-door trip time, including parking. The great majority of ITS studies target commuters.
- Shoppers are regular travelers during off-peak times. They have moderate demand for travel information, moderate tolerance for delay, are most likely to change trip time, and only moderately likely to change trip route. They have a higher interest in parking information, and a moderate interest in "whole trip" information. Shoppers are interested in perceived safety and convenience. Some of the more comprehensive studies include shoppers as part of their study population.
- Special trips are infrequent trips to special events or attractions, such as the airport or a sporting event or concert. These travelers on such trips have high demand for travel information, low tolerance for delay, and are very interested in parking information. They seek information primarily as a means of gauging trip time. Special trips are ignored by most studies, though they appear to be a prime market for ATIS.
- Other trips are short or recreational or infrequent trips, including tourism. These travelers have low demand for information, may be unfamiliar with the area, have high tolerance of delay, and have low likelihood of changing routes or times. Other trips are ignored by nearly all studies in this review. First-time visitors will generally not know the local road network, and will ignore ATIS messages that refer to local places. However, ATIS is popular among repeat or regular travelers, particularly for pretrip planning (56). Based on limited results of tourist and local surveys dealing with non-commuter trips, this is a moderate market for ATIS.
- Truck includes delivery vehicles and long-distance freight transportation. Travel information demand for trucks includes en route updates of "whole-trip" information and en route trip planning. Truck drivers have high demand for travel information, moderate tolerance for delay, and are likely to change routes if they feel that the information is accurate. A few studies have looked at trucker needs.

For most trips, the priorities of each driver are a balance of trip time, convenience, and safety. Drivers have incomplete information when approaching a delay, and will weigh their priorities to make a decision. Some drivers prefer the convenience of a known (but congested) route to the uncertainty of an alternate path (16,21,23,36).

The markets with primary ATIS demand are commuters and special trips. They are the most sensitive to delay and have the highest demand for traffic information. These markets are most likely to use new technology ("gee-whiz") ATIS, but acceptance of new technology in these markets is still relatively low.

TRAVEL INFORMATION SUPPLY: WHERE ATIS FITS IN

Drivers Seek Different Types of Information: Pretrip and En route

- Pretrip information in the morning is mostly by radio and television. Pretrip information in the afternoon is mostly radio. A very few travelers used telephone or Internet, even when such services were free and advertised.
- En route information is by CMS and radio. A very few commuters use phones or other wireless devices or in-vehicle ATIS.

Technophiles found their ATIS very useful, with high satisfaction and usability rates. ATIS users had moderate rates of changing route or time (averaging about 50%) around a delay. However, use of ATIS was very low (26,39,64,76).

Among the general population of drivers, radio market share varies from study to study, with an average of 40% of all trips, and 60% of commuters listening to radio traffic reports (19,21,29,30,34,35,36). Radio share goes up when traffic problems are expected, such as during peak hours, special events, or construction. Television information is similar to radio information, and the split between radio and television is due to personal habits and not due to seeking specific information. Special TV and radio traffic information had very low use (35,63). People choose their morning or afternoon entertainment that happens to have traffic information; they generally do not actively seek out information.

Radio and television traffic reports are popular, averaging 80% satisfaction, but they are not very usable, averaging 20% route or time change at least once each month among ATIS users and lower among other drivers. Message signs were popular, averaging 70% recognition, 80% satisfaction, but only 20% route or time change at least once each month among ATIS users and lower among other drivers. Drivers accept existing media and CMS information, but do not find it very helpful – there is room for improvement in existing sources.

The popular information media were the simplest for users – existing radio, TV, and CMS. In each case, users receive information as they listen to or watch other programming or observe their environment.

Other ITS Users

Auto drivers were mixed on the subject of safety technology. They like the idea of being safer and are willing to pay a modest sum for packages built into new cars. They are sometimes skeptical of the safety claims of technologies. They welcome warning devices, but reject the idea

of turning over "control" to a system. Drivers were overwhelmingly in favor of an on-board "mayday" system (2,32).

Truckers were mixed on the subject of CVO (Commercial Vehicle Operations) ITS implementations. Most truckers liked the ideas, but were skeptical of governments' ability to implement a system that would be convenient and lessen their workload. A large minority worried about additional bureaucracy and regulation, erasing ITS benefits. Truckers were overwhelmingly in favor of safety technologies such as automated hazardous materials information. They saw little benefit in automated payment, since they already do not use cash. They liked the concept of automated permitting, but feared an inadequate or incomplete implementation. Some truckers worried about their privacy (4,53).

WHAT DO ITS USERS WANT?

Drivers want more information at the right time. They want enough information to weigh their priorities and make a decision. Generally, drivers want to know if there is a problem, what the problem is, the delay, a prescribed remedy or alternate route, and how the alternate delay compares with the highway delay.

- *Is There a Problem?* Drivers in most stated preference surveys were mixed on extraneous or irrelevant messages, but focus groups disliked them. Weather, events, and slogans were considered wasteful and distracting unless there was a traffic-related reason for them. Anti-rubbernecking slogans at accident zones, "Maintain Speed," were popular.
- *What Is the Problem?* Drivers liked to know what was going on. This has not been explored further in the reviewed studies.
- *How Long Is the Delay?* Drivers tend to care about problem location and travel time. Travel time is not related to the current backup queue length, but relates most strongly to the predicted queue length. The difference between stated and actual queue length, for example on the shoulder of a peak, causes drivers to misjudge their alternatives, and damages the credibility of the information source. Clarity of information is an issue with radio traffic reports, which often give delay length in distance instead of time.
- *What Is the Prescribed Solution or Alternate Route?* Prescribed alternate routes significantly increase rate of diversion. Surveyed drivers want very well defined alternate routes, since they often are passing through an area that they do not know very well.
- *How Does the Alternative Compare with the Highway Delay?* Surveyed drivers have repeatedly said that they need this information to weigh their choices accurately. Otherwise, they are guessing.

Each driver is different, and each market has different information demands. For example, middle-aged drivers, who tend to be most familiar with their communities, care the least for alternate routes since they find their own. Commuters and special trip drivers want time information and alternate route information most, and generally do not care what the problem is.

When and how the message reaches the driver is also vital. Drivers need time to process the message content before they reach a decision point, but not so long that they forget or consider the information obsolete (6,21,25,29,51).

Most new-technology ATIS include most or all of the desired information. Systems that provided more information had higher rates of diversion and lower average trip times. Existing radio, television, and CMS sources, are popular but do not answer several of the questions, and have correspondingly lower rates of diversion.

CONCLUSIONS FROM THE BEST PRACTICES SCAN

Most existing ATIS research follows new technology and or concerns applications to commuters.

An exploration of how ITS technology can improve existing (low-hassle) information systems has potential to impact commuters at low cost. In addition, evaluation of driver needs for non-commute special, infrequent, intercity, and truck trips also has potential to improve driver satisfaction and safety.

The results of research so far are consistent and clear on driver perceptions, ATIS' ability to affect trip choices, and market willingness-to-pay for services. Key findings relate to the minimum information drivers need to make good choices and how active they are in pursuing the information.

Directions for Future Research

RESEARCH DEFICIENCIES WITH RESPECT TO ITS NATIONAL ARCHITECTURE USER SERVICES

Based on the literature scan (the 84 documents reported upon here and the other documents that were identified), there appears to be at least 22 ITS elements in need of additional research. This list was developed by comparing the topics in the existing literature to user services in the National ITS Architecture.

- Technologies not yet widely implemented within the United States (including lane control signs, variable speed limit signs, and 511)
- Higher-risk drivers (impaired drivers, older drivers, young drivers)
- Vision/awareness enhancements (including signs, markings, and on-board vehicle systems)
- Parking management (especially at sport events, major events, and major centers)
- Traffic management for special events
- ITS in work zones - general guidance for deployment (excluding devices studied in Smart Work Zone Pooled Fund Study)
- ITS impacts on air quality
- Information sharing for intermodal operations and marketing (applications to multi-modal trips, ride sharing, and multiple carriers)

- ITS in transit information dissemination (including, connections between carriers, en route information, and larger system integration)
- ITS in enhancing transit services (including, electronic payment, local traveler services, demand responsive, and intercity traveler services)
- Passenger safety and security applications of ITS (on-vehicle, stops, stations, public facilities, pedestrian paths and other access modes, yards and private facilities)
- Advanced vehicle safety systems (AVSS) applicability to transit
- Electronic payment
- CVO ITS technologies (including, CVISN, real-time route guidance, hazmat route information, truck information outside of cabs, and in-cab information for owner-operators)
- Advanced vehicle safety systems applicability to commercial vehicles
- School bus ITS applications (AVL, security, AVSS)
- Civil defense and homeland security (particularly emergency notification and evacuation)
- Incident management beyond emergency assistance
- Automated/monitored enforcement systems (except red-light running)
- Safety and security applications of ITS (including, quality of security at transportation facilities, transit vehicle security, privacy and monitoring issues
- Statewide/interstate implementation of rural ITS (including, delays and workzone information, 511, 911, CVO, statewide and/or interstate freeway information, intermodal information)
- Applications for local TMC (Traffic Management Center) integration beyond original scope

RECOMMENDATIONS

Given the holes in existing literature and other deficiencies, there are many avenues for future research on ATIS that may be pursued in Wisconsin and elsewhere.

- *Improving radio, television, and CMS information*. Most drivers already use these popular sources to obtain information. Using ITS to enhance these existing systems offers a powerful tool to enable drivers to make informed trip choices.
- *General guidance for implementation of ITS for work zones*. Evaluate how much information drivers need and how far in advance they want it. Identify the key decision points for drivers to enhance safety and reduce delay.
- *Special trip and special event driver needs*. Infrequent trips to airports, stadiums, festivals, and other regular congestion areas have not been studied. These trips are a special challenge since they are delay-sensitive. A whole-trip approach may be useful, including parking information, destination information, and intermodal alternatives. Defining the range of useful information and preferred sources is needed.

- *Intercity or rural driver needs.* Intercity or rural driver information needs on travel time, weather, construction zones, delays, etc., have not been explored.
- *Truck driver needs*. Truck drivers have been asked about their perceptions of ITS, and gave a mixed response. Truck driver ATIS needs, including designated routes, delays, construction, hazards, and weather, have not been explored.
- *Public safety / homeland security needs*. The needs of drivers responding to public emergencies has not been addressed. The need includes news flashes and evacuation route designation.

In Appendix II, this report suggests a next step for WisDOTs research program in particular. A project, "Driver Information Needs Relating to Infrequent Trips or Infrequent Events", is described that would address many of the knowledge deficiencies related to ATIS deployment.

Acknowledgments

This study was sponsored by the Wisconsin Department of Transportation. The authors acknowledge the valuable assistance of John Corbin of WisDOT, our principal technical contact, and Linda Keegan of WisDOT, our administrative contact. We also want to thank members of the Technical Oversight Committee, who provided many helpful suggestions on project scope and direction.

Appendix I. Annotated Bibliography

1. Kim, K.; Vandebona, U.; *User Requirements and Willingness to Pay for Traffic Information Systems: Case Study of Sydney, Australia*; Transportation Research Record #1694, 1999.

Explores market segmentation in ATIS. Questionnaire with 83 respondents and 45 questions comparing radio, Internet, phone and VMS messages. Information types desired (in descending order): Crashes, traffic conditions, construction, weather, and alternate routes. Groups with higher likelihood to pay for ATIS services: female drivers, older drivers, and high-income drivers.

2. Turrentine, T.; Sperling, D.; Hungerford, D.; *Consumer Acceptance of Adaptive Cruise Control and Collision Avoidance Systems*; Transportation Research Record #1318, 1991.

Evaluation of market potential and willingness to pay for in-vehicle safety equipment. Focus groups with 44 respondents. General interest in a warning system (for tailgating or collision avoidance) was moderate, interest in a positive-control safety system was low. Average willingness-to-pay was under $1000 per vehicle.

3. Morris, M.; Lee, W.; *Survey of Efforts to Evaluate Freeway Service Patrols*; Transportation Research Record #1446, 1994.

Not a user evaluation at all, instead this is a survey of different cost-benefit and program evaluation criteria for service patrols. In the absence of a standard for evaluations, each patrol is evaluated by wildly different criteria nationwide. Not surprisingly, service

patrols are popular, generate good media coverage, and tend to have large political constituencies.

4. Kavalaris, J.; Sinha, K.; *Intelligent Vehicle Highway System Commercial Vehicle Operations: Perceptions, Needs, and Concerns of Indiana-Based Interstate Motor Carriers*; Transportation Research Record #1511, 1995.

A large study of CVO attitudes. 492 respondents, most from large and medium-sized firms. The low number of responses (87 out of 1000) from single owner-operators is a concern. Firms show great interest in tracking mileage and driver productivity. Firms show moderate interest in reducing bureaucratic overhead (fuel-tax-payment, automatic tolls, pre-clearance, etc.) but also show concern over potential "big brother" enforcement and additional bureaucratic requirements. Willingness-to-pay approximately $100-$250 per vehicle transponder.

5. Giuliano, G.; Golob, J.; *Los Angeles Smart Traveler Information Kiosks: A Preliminary Report*; Transportation Research Record #1516, 1995.

A survey of 273 kiosk users before web pages became easily available. Installed kiosks displayed traffic, transit, and rideshare information. Highest use occurred in transit centers and shopping malls, medium use in grocery and discount stores and office buildings, and lowest use in hospitals and low-density office clusters. Respondents and likely users were disproportionately wealthier and better educated than the regional population. Kiosks had low use, average of 20 uses per day, but high satisfaction (83% would use kiosks again). Users investigated multiple services: Freeway conditions (83%), transit (56%), rideshare (26%).

6. Polydoropoulou, A.; Ben-Akiva, M.; Khattak, A.; Lauprete, G.; *Modeling Revealed and Stated En route Travel Response to Advanced Traveler Information Systems*; Transportation Research Record #1537, 1996.

Two surveys: A survey of stated preference – how commuters think they would react to a VMS or CMS, and a survey of reported past behavior – how commuters have reacted to congestion and radio reports in the past. The preference and behavior are compared, and then form the basis of a model for predicting ATIS preference and behavior based on travel time, congestion levels, and information provided. The model algorithm is presented. The authors do not analyze driver preferences, but focus on modeling behavior changes. Maximum change occurred in the model when ATIS offered a preferred alternate route and accurate comparative travel times for both routes.

7. Polydoropoulou, A.; Ben-Akiva, M.; Khattak, A.; Lauprete, G.; *Modeling Revealed and Stated Pretrip Travel Response to Advanced Traveler Information Systems*; Transportation Research Record #1537, 1996.

Two surveys: A survey of stated preference – how commuters think they would react to a pretrip ATIS report of congestion or delay, and a survey of reported past behavior – how commuters have reacted to pretrip (radio/TV, phone, Internet) information in the past. The preference and behavior are compared, and then form the basis of a model for predicting ATIS preference and behavior based on travel time, congestion levels, and information provided. The model algorithm is presented. The authors do not analyze driver preferences of one ATIS system over another, but focus on modeling behavior

changes. Possible model results include the following behavior changes (switches): No change, change route, leave earlier, change route and leave earlier, leave later, change mode, or cancel trip. Model results indicate a low threshold to switching (2-4 minutes of delay), but also low elasticity (e.g. 10 minutes more delay results in only 1-2% additional switches). Most ATIS systems without a prescribed alternate route had a 12-18% maximum predicted number of switchers. Prescribed alternate routes showed 50-55% maximum number of switchers in the model.

8. Englisher, L.; Juster, R.; Bregman, S.; Koses, D.; Wilson, A.; *User Perceptions of SmarTraveler Advanced Traveler Information System: Findings from Second-Year Evaluation*; Transportation Research Record #1537, 1996.

9. Also Bernett Research Services, Inc.; *Evaluation of Phase II of the SmarTraveler Advanced Traveler Information System Operational Test*; Boston Metropolitan Planning Organization, 1994.
http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/6J301!.PDF

A survey to determine the effectiveness, satisfaction, and market potential of phone-based traffic and transit information in Boston. Even in the early 1990s, when wireless phones were rare and expensive, cell phone calls to SmarTraveler were well over 50% of all calls. Customer satisfaction was high. Price sensitivity was high; callers liked the service but were unwilling to pay for it. Influences on customers decision to call were: weather conditions, hearing a radio report, having a critical arrival time, time of day, when they are running late, and construction on the route. 43% of callers, mostly commuters, called before each trip. Customers reported benefits of: Reducing anxiety (60%), avoid traffic problems, save time, arrive on time.

10. Frayer, C.; Kroot, L.; *California Consumer Perceptions of Potential Intelligent Transportation Innovations*; Transportation Research Record #1537, 1996.

Thirty focus groups of drivers and transit users. Evaluated ATIS/ITS objectives: Convenience, safety, arriving on time, available when needed, under user control, gives user freedom, reliable, comfortable, quick, easy to use. Focus groups had difficulty understanding the possible future implementations of ITS without examples to try. Users welcomed most new technologies that promised to make their travel more convenient. General frustration with existing DOT and transit providers led to a lack of trust, and skepticism about their ability to implement effective ATIS or ITS solutions. Widespread belief among customers that ATIS or ITS solutions would not meet multiple objectives (i.e., quick, but not under user control or not convenient) due to current dissatisfaction.

11. Hobeika, A.; Sivanandan, R.; Jehanian, K.; Ameen, M.; *User Needs in The I-95 Northeast Corridor*, Transportation Research Record #1537, 1996.

Survey with 2000 respondents plus 16 focus groups. Identified the stated user needs for different traveler markets: local autos, long-distance auto, transit, intercity rail, air. Identified the state needs for both pretrip and en route information. Both types of auto travelers had similar information needs. The pretrip priority of information desired were: weather, construction, traffic conditions. The en route priorities of information needs were: alternative routes, construction, weather, and traffic.

12. Polydoropoulou, A.; Gopinath, D.; Ben-Akiva, M.*; Willingness to Pay for Advanced Traveler Information Systems: SmarTraveler Case Study*; Transportation Research Record #1588, 1997.
http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPT_MIS/87D01!.PDF

A survey of stated preference and past behavior using the Boston SmarTraveler telephone information (ATIS) system. The data is used to model customer demand, elasticity, and satisfaction for a revenue version of SmarTraveler. The model itself is not presented. The three top satisfaction ratings on a scale of 1-10 were that the system was free (9.76), that it was available on demand (9.24), and that it was easy to use (9.06). Overall satisfaction was 8.65, and the worst attribute was suggestion of alternate routes (6.61). The model results show a high barrier to use of a subscription service (only 60% willing to subscribe, even if the price is still free). Elasticity of one at $0.10 per call or $10.00 per month

13. Schofer, J.; Koppelman, F.; Charlton, W.; *Perspectives on Driver Preferences for Dynamic Route Guidance Systems*; Transportation Research Record #1588, 1997.

14. Also US Dept of Energy; *The ADVANCE Project: Formal Evaluation of the Targeted Deployment Volume II*; US Dept of Energy Argonne National Laboratory, 1997.
http://www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/2KC01!.pdf

Survey of 100 drivers plus three focus groups evaluating ADVANCE (Advanced Driver and Vehicle Advisory and Navigation Concept), an in-vehicle navigation aid. Results indicate that drivers familiar with area like the concept, but were dissatisfied with the fairly rudimentary implementation for the test project. Users held in-vehicle navigation systems to a standard of approx. 95% reliability and accuracy in determining the locations of the trip origin, vehicle, and destination. Users had lower standards for route planning ability, and held the system's planning ability to be inferior to their own local experience. These drivers were very interested in realtime traffic information, with or without alternate route guidance.

15. Yim, Y.; Hall, R.; Koo, R.; Miller, M.; *TravInfo 817-1717 Caller Study*; TRB 1999 CD ROM, Transportation Research Board, 1999.

Survey of telephone-based ATIS. Of en route travelers who knew about problems or delays, 53% made no change to their trip, 20% made a route change en route, 8% made a pretrip route change, and 10% made a time change. Drivers claimed their favorite benefits were: helped make travel decisions (39%), save time (36%). Like other phone systems, this had low use with many repeat callers.

16. Khattak, A.; Yim, Y.; Stalker, L.; *Does Travel Information Influence Commuter and Noncommuter Behavior? Results from the San Francisco Bay Area TravInfo Project*; Transportation Research Record #1694, 1999.

1995 Survey with 947 respondents investigating stated driver response to different sources of travel information. The survey and model are presented. Commuters were more likely to change routes based on radio information over telephone information. Non-commuters were less likely to change routes in general. No exploration of perspectives on ATIS.

17. Yim, Y.; Miller, M.; *TravInfo Field Operational Test*; California PATH Program, 2000. http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/9YF01!.PDF

Four surveys to evaluate an ATIS in San Francisco, California. Includes before and after implementation. Samples range 86-1000 respondents to each survey. 15% of commuters changed routes or times, 12% based on radio or television reports. In this program, transit information calls were the majority (65%). Majority of respondents had never heard of the service. Key findings: 35% of callers and 80% of website visitors claim to have changed their route or time based on the information. Most callers were repeat callers, making evaluation difficult at times. No significant analysis of traveler behavior or trends that affect the results. The surveys and summaries are not presented.

18. Yim, Y.; Miller, M.; *Evaluation Study of the TravInfo Regional Transportation Information System*; TRB 2002 CD ROM, Transportation Research Board, 2002.

19. Also, Yim, Y.; Khattak, A.; Raw, J.; *Traveler Response to New Dynamic Information Sources: Analyzing Corridor and Area-Wide Behavioral Surveys*; TRB 2002 CD ROM, Transportation Research Board, 2002.

Evaluation of telephone-based ATIS. 25% of radio listeners, 45% of phone-based ATIS users, and 81% of web site ATIS visitors changed routes away from a delay. Each type of information service had a loyal base of repeat users. Radio had a static market share during evaluation, phone market share increased slowly, and web share increased quickly. 33% of all drivers listened to radio traffic reports regularly, increasing to 66% when traffic delays were expected.

20. Mehndiratta, S.; Kemp, M.; Lappin, J.; Brand, D; *What Advanced Traveler Information Systems Do Users Want? Evidence from In-Vehicle Navigation Device Users*; Transportation Research Record #1679, 1999.

Survey of the participants in three (Seattle, Boston, Chicago) in-vehicle navigation tests, and an evaluation of market patterns and willingness to pay. The most important factor to commuters was information accuracy: Updated, reliable information, and extensive knowledge of the road network. Drivers showed a clear preference toward updated information, not static, with maximum value at updates every 30 minutes instead of continuously. Some sophisticated commuters preferred delay data only, preferring their own road network knowledge over the navigation system. Others liked the ability to program preferences into route searches such as avoiding certain intersections or “keep moving” routes. Willingness to pay ranges from $8-36 per month depending on the market.

21. Wells, K.; Horan, T.; *Toward a Consumer-Demand-Driven Intelligent Transportation System Policy: Findings from Southern California*; Transportation Research Record #1679, 1999.

Survey with 610 respondents investigating driver satisfaction with current traffic information, interest in ITS concepts, and California state government policy. Respondents generally agreed with most survey questions, even when they led to contradictory results. For example, 64% of commuters were satisfied with current info, yet 64% also wanted improved information. Survey did not include VMS/CMS in current

information or in ITS concepts to be added. Survey did not differentiate between pretrip and en route information demands. Most drivers (50%-65% agreement) favored in-vehicle navigation or TV/radio traffic reports as their favorite ITS concepts. Males, the young, and the wealthy welcomed ITS concepts more.

22. Wissinger, L.;Hummer, J.;Milazzo, J., II; *Using Focus Groups to Investigate Issues of Red Light Running*; Transportation Research Record #1734, 2000.

Sixteen focus groups in North Carolina evaluating the issues of using ITS technology for enforcement. Drivers did not know the applicable laws relating to automated enforcement. Drivers preferred systems that hold the vehicle driver, not the vehicle owner, accountable for violations. Participants favored universal enforcement, but were worried about unspecified potential "big-brother" abuse. Participants wondered about effects on rental cars, law enforcement ability to catch additional violations normally caught at traffic stops (DWI, drugs, no license), and were concerned about the lapse of time between violation and notification by mail.

23. Benson, B.; *Motorist Attitudes about Content of Variable-Message Signs*; Transportation Research Record #1550, 1996.

Seven focus groups plus a survey with 517 respondents exploring user stated preference of VMS information. The results of each survey question are presented. Focus groups and the survey came up with different results. Focus group participants were unhappy with inaccurate VMS (due to known problems with an old system) and against VMS safety messages and other messages they deemed irrelevant. Survey respondents claimed general satisfaction with VMS accuracy, and favored VMS safety and other messages. Both groups agreed on ways to maximize information value, such as using "this exit" instead of "next exit", using exit numbers rather than street names, placing VMS on feeder streets before the freeway ramps, anti-rubbernecking messages "Accident Ahead/All Lanes Open/Maintain Speed." Study did not investigate general user response to ITS.

24. Marwah, S.; Gifford, J.;Maggio, M.; Stough, R.; *End User Perspectives of a Smart Card-Based Commercial Driver's License*; Transportation Research Record #1640, 1998

Interviews with 106 truck and bus drivers to determine user perspective of an ITS technology. Drivers view smart Commercial Driver's License (CDL) as an enabling technology rather than useful by itself. Without specific advantages, drivers were unwilling to pay additional fees for smart cards. The main advantages to a smart CDL are secure identification and simplified or "transparent" borders and inspections. However, drivers had privacy concerns and were skeptical about government ability to implement more convenient inspections. Drivers saw an additional advantage in states' ability to track credentials, but saw no personal benefit or savings. Most drivers saw great benefit from in-cab information technologies, and most had experience with these systems.

25. Peeta, S.; Ramos, J.; Pasupathy, R.; *Content of Variable Message Signs and On-Line Driver Behavior*; Transportation Research Record #1725, 2000.

Survey with 248 respondents evaluating the effectiveness of VMS/CMS using driver stated preference. Respondents were 47% truck drivers and 53% non-truck drivers, and mostly male. Survey results were used to model VMS effectiveness. The model is

presented, but survey results are not. The model does not incorporate differences between stated and demonstrated preferences. Model results indicate truck response to information to be different from information, but the differences are not explored or explained.

26. Kraan, M.; Mahmassani, H.; Huynh, N.; *Traveler Responses to Advanced Traveler Information Systems for Shopping Trips*; Transportation Research Record #1725, 2000.

Interactive web-based simulation and survey investigating driver response to different pretrip and en route information. Innovative game-type layout and data collection maintained respondent interest. 199 respondents, 60% male, 46% University of Texas employees. Likely demographic of "early adopters", the same users who would adopt new ITS/ATIS technologies first. Survey results were used to model driver behavior. The model is presented, but the survey is not. Model results indicate older drivers less likely than the general population to change destination, but older divers are more likely than the population to change routes based on pretrip or en route information. However, this may be a function of older drivers' familiarity in an area with high turnover of younger residents. Drivers were more likely to change routes when delay is known but cause is not revealed,

27. Rong-Chang, J.; Ta-Yin, H.; Chien-Wen, L.; *Empirical Results from Taiwan and their Implications for Advanced Traveler Pretrip Systems*; Transportation Research Record #1607, 1997.

Taiwanese survey with 925 respondents exploring stated preference for travel information for different trip types and modes. Driver information priorities were: Parking convenience, travel distance, traffic conditions. Very few respondents ranked tolls or parking charges, crashes, construction, or alternate routes as important. These results are very different from studies of stated preference in the United States. Results were used to develop a model of predicted behavior. No comparison with measured or recorded behavior. The developed model is not presented. No perspectives on preferred ITS strategy or technologies were presented.

28. Giuliano, G.; Moore, J.; II; Golob, J.; *Integrated Smart-Card Fare System: Results from Field Operational Test*; Transportation Research Record #1735, 2000.

Survey of transit riders in a county-wide smart-card demonstration project among seven service providers. Customers wanted an easy and convenient fare system. The implementation suffered from technical problems and barriers to non-English speakers and occasional riders. Surveyed users had no strong opinion on the technology, not seeing a benefit to them in this case, and were generally dissatisfied with inconvenience and technical problems.

29. Reed, T.; *Commuter Perception of Commercial Radio Traffic Information*; ITS 2000 Conference Proceedings CD ROM, ITS America, 2000.

Survey of commuters and highway users' perceptions of realtime information, and the effectiveness of existing commercial radio traffic reports. 1535 respondents, users of the Detroit area freeway system. 89% of respondents listened to radio reports, reporting it as the most convenient existing system at the best price (free). However, information and system reliability were rated only moderate (3 on a 1-5 scale), information usability and benefit was moderate (3.5 on a 1-5 scale), and only 50% of respondents considered the

reports to be useful more than twice a month. Users sought more detailed information in a more timely manner than existing radio report formats provided. The biggest improvements sought by respondents were: report incidents sooner (79% of respondents), make information more complete (45%) and suggest alternate routes (45%). There are similar to improvement suggestions for ATIS, such as VMS/CMS and in-vehicle systems.

30. Lerner, N.; Steinberg, G.; *Driver Information Requirements for Decision Making: Implications for ATIS Design*; ITS 2000 Conference Proceedings CD ROM, ITS America, 2000.

Interview, diary and video record of 24 drivers in Washington D.C. At a decision point, participants tend to continue to drive toward known congestion/delay points in the hope of obtaining more information (or that the delay report is wrong). Visual cues of congestion at key decision points are critical. The perceived complexity of an alternate route is important. Commuters consistently want better-timed and more precise information about congestion. Respondents were not satisfies with existing radio report accuracy, timeliness, and relevance. Younger drivers were much more likely than older drivers (14 vs. 1) to use telephone pretrip information.

31. Koziol, J.; Hitz, J.; Lam, A.; Inman, V.; *Evaluation of an Intelligent Cruise Control System*; ITS 2000 Conference Proceedings CD ROM, ITS America, 2000.

32. Also *Evaluation of the Intelligent Cruise Control System*; US Dept of Transportation Volpe National Transportation Systems Center, 1999.
http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/95001!.PDF

Drivers evaluated an in-vehicle automatic control technology. Additional development is necessary to overcome several safety issues; however the test model provided net safety improvement. Users liked the system more after trying it out. They felt that the Intelligent Cruise Control (ICC) system enhanced safety, and preferred it to conventional cruise control. Most users took more than one week to become comfortable with the system. Drivers valued the technology at $275-475.

33. Nowakowski, C.; Green, P.; Kojima, M.; *A Human Factors Approach to the Design of Traffic-Information Web Sites*; ITS 2000 Conference Proceedings CD ROM, ITS America, 2000.

User testing of web site formats for driver information by five drivers. Using web site usage statistics, many users were downtown workers and university faculty and students checking their afternoon commute routes. Most web sites saw higher use in the afternoon. Most requested information: Congestion overview map, directory index, detailed congestion and speed information for specific routes, construction information. Paper includes web site design guidelines and examples.

34. Nee, J.; Hallenbeck, M.; Legg, B.; *Designing Arterial Traveler Information Systems from a Traveler's Perspective*; ITS 2001 Conference Proceedings CD ROM, ITS America, 2001.

Web survey of 610 drivers investigating preferences and usefulness of different information. Respondents tended to be young, male, and well-educated. Respondents preferred the following types of information (in order): delay/incident location, congestion level, speed, and travel time. Video or still picture feeds were ranked least useful. Respondents preferred the following information delivery (in order): web, radio,

in-vehicle device, phone, PDA. Television, pagers, and kiosks were ranked lowest. The questions did not include VMS/CMS, and web has a disproportionately high share due to survey method and respondent characteristics.

35. Jeanotte, K.; Sankar, P.; Krechmer, D.; *Evaluation of the Advanced Regional Traffic Interactive Management and Information System (ARTIMIS)*; ITS 2001 Conference Proceedings CD ROM, ITS America, 2001.

Telephone survey of 375 drivers plus two focus groups evaluating public perception of ATIS deployment. 40% of respondents were aware of the system as a whole; 74% were aware of the CMS/VMS, and 67% were aware of the freeway service patrols. About half (53%) had a favorable impression of the system based on media reports. About 65% of respondents were very satisfied or somewhat satisfied that the local freeway system met their needs. Favorite information mode was: radio (56%), television (21%), CMS/VMS (11%), telephone (6%), DOT traffic radio (4%), Internet (2%). Users most common comments were to improve the content and format of CMS/VMS and phone reports to make them more usable.

36. Aultman-Hall, L.; *ARTIMIS Telephone Travel Information Service: Overall Public Awareness*; ITS 2001 Conference Proceedings CD ROM, ITS America, 2001.

Telephone survey of 1052 households to evaluate awareness of telephone-based ATIS. About 15% of respondents recognized and correctly identified the system. 39% of respondents were aware of the local traffic management center. Of the ATIS-aware segment, 84% had learned from radio and television, 8% from road signs, 7% from newspaper, and 1% from Internet. Nearly 50% of respondents claimed that they would never use the service. Men tended to be more aware than women, and higher education tended to slightly higher awareness, but wireless phone users were most aware of all segments (60%).

37. Clemons, J.; Aultman-Hall, L.; Bowling, S.; *ARTIMIS Telephone Travel Information Service: Current Use Patterns and User Satisfaction*; University of Kentucky, 1999. http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/@3C01!.PDF

38. Also, Aultman-Hall, L.; Bowling, S.; Asher, J.; *ARTIMIS Telephone Travel Information Service: Current Use Patterns and User Satisfaction*; Transportation Research Record #1739, 2000.

Call-intercept customer satisfaction survey. 84% of participants were repeat callers. Frequent callers phone from their vehicle (53% of their calls), work (16%), and home (8%). Occasional callers phone from home (42% of their calls) and work (34%). 70% of callers were in their vehicle (en route travel information). 70% of callers “always” traveled alone. Callers claimed a diversion rate of 70% based on ARTIMIS information, which the authors believe may be a bit high. Callers were twice as likely to change routes as change times, and three times more likely to change routes than restructure their trip (destination, mode, delay trip). 50% of frequent users call during the morning peak hours, while 80% call during the afternoon peak. First-time or rare users were more likely to call for trip planning information: special event traffic, trip assistance when running late, and road construction information. Users were nearly all suburban; calls from urban zip codes were very low.

39. Cambridge Systematics, Inc.; *OKI Evaluation of Intelligent Transportation System*; Ohio-Kentucky-Indiana Regional Council of Governments, 2000.
http://www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/@7j01!.pdf

Summary of survey and evaluation driver recognition, use, and usability of ARTIMIS ATIS. The name "ARTIMIS" was not recognizable or useful to commuters. Driver knowledge and use of phone information was low. Poor relationship with the press and media. 65% of respondents were satisfied with information, mostly from CMS. 43% said that highway traffic conditions had improved over the past three years. Without a list of options, 81% said they relied on radio as their primary traffic information source. With a list of options, 83% used CMS, 67% television, and 63% radio. In terms of changing travel behavior, 56% of morning commuters and 62% of afternoon commuters had changed their route based on ATIS. Frequent ATIS users were even more likely to divert. Respondents saved an average of 7 minutes when they changed routes. Users were mostly inter-suburban commuters, with relatively few respondents for downtown or urban trips.

40. Kolb, S.; Hibbard, J.; Alff, K.; *Georgia's Call Box Project: Evaluation and Future Deployment Recommendations*; ITS 2001 Conference Proceedings CD ROM, ITS America, 2001.

Survey with 249 respondents plus web questionnaire with 50 respondents. 64% owned a wireless phone, yet 78% were willing to pay higher taxes/fees to fund roadside call boxes and 97% thought the call boxes to be a good idea. The survey questions and respondent characteristics were not presented.

41. Ng, L.; Barfield, W.; Mannering, F.; *Analysis of Private Drivers' Commuting Behavior and Commercial Drivers' Work-Related Travel Behavior*; TRB 1998 CD ROM, Transportation Research Board, 1998.

Survey of 928 commuters and 324 commercial drivers to determine the effect of ATIS on trip factors such as saving trip time and increasing trip enjoyment. Survey and cluster model analysis are presented. The travel information market segments found are: route changers, route and time changers, non-changers, and pretrip changers. Each segment has unique information needs. In-vehicle systems have a greater effect on drivers than CMS/VMS systems. Drivers most valued time-saving ("reducing time") and general safety ("increasing safety") benefits. Drivers least valued ATIS' promised route planning ("decreased distance") and stress reduction ("increased enjoyment") benefits.

42. Yang; Fricker; Kuczek; *Designing Advanced Traveler Information Systems from a Driver's Perspective*; TRB 1998 CD ROM, Transportation Research Board, 1998.

Survey of driver information preferences plus a simulation of five in-vehicle information systems. No single technology, delivery method, or message was optimal under all tested conditions. No information system was able to make unfamiliar drivers behave in a manner consistent with familiar drivers. The survey and model are not presented.

43. Blythe, K; DeBlasio, A.; *Analysis of ITS Operational Tests: Findings and Recommendations*; US Dept of Transportation Volpe National Transportation Systems Center, 1995.
http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/JG01!.PDF

An excellent analysis of early ITS deployments and their evaluations, this paper does not deal directly with user perspectives. It does, however, point out the lack of standard evaluation criteria, the differences in user input across different implementations, and the lack of agreement on the role for user perspectives at the time. While dated, many of the management critiques are still valid today, and many of the same mistakes are still being made with new implementations.

44. Castle Rock Consultants, Inc.; *Rural IVHS Scoping Study: an Assessment of Rural Minnesota Travelers' Needs*; Minnesota DOT, 1994.
http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/65R01!.PDF

Six focus groups and telephone survey to determine traveler information needs. Travelers wanted: road and weather information, construction zone information, transit information, and assistance for stranded vehicles. Survey and results are presented.

45. Short Elliott Hendrickson, Inc.; Olson Market Research; *Advanced Rural Transportation Information and* Coordination (ARTIC) Operational Test Evaluation Report*;* Minnesota Dept of Transportation, 2000.
http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/@@801!.PDF

Evaluation, including user interviews, of an advanced communication and coordination system for state and local agencies. Users included law enforcement, MN DOT, local transit, and other government users; no ATIS or component accessible to the general public. Interviews of users only, not driving population. Users found increased coordination improved their own efficiency; they liked the system and found it useful. No statistics presented.

46. Trombly, J.; Wetherby, B.; Dixson, A.; *Seattle Wide-Area Information for Travelers (SWIFT) Consumer Acceptance Study*; Washington DOT, 1998.

Surveys and focus groups evaluating a regional ATIS, including personalized and in-vehicle message technologies. Drivers agreed (4 on a scale of 1-5) that the ATIS: kept them moving, reduced stress, and reduced commute time. Drivers were neutral about improving on-time performance, and negative (2 on scale of 1-5) on changing to transit based on messages. Respondents found information accuracy lacking at times, and were more willing to change routes based on radio reports than SWIFT messages. In-vehicle systems had problems communicating in downtown and hilly areas.

47. Turnbull, K.; *Assessment of the Seattle Smart Traveler*; US Dept of Transportation Federal Transit Administration, 1999.
http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/8R401!.PDF

E-mail survey of 141 users of an Internet-based ridesharing matching system. 35% of users found a ride match, and 25% of matches went on to form carpools, both statistics higher than ride-matching services in general. The technology was cheaper than comparable manual services elsewhere. The test population was at the University of Washington, Seattle, a single destination, but this is not accounted for in comparison with other systems.

48. Mehndiratta, S.; Kemp, M.; Lappin, J.; Nierenberg, E.; *Likely Users of Advanced Traveler Information Systems: Evidence from the Seattle Region*; Transportation Research Record #1739, 2000.

Marketing analysis of Seattle ATIS implementation data. Stated commuter pretrip information sources in the morning: 62% none, 31% radio, 16% television. Afternoon pretrip sources: 84% none, 13% radio. En route information sources: 45% none, 49% radio, 20% CMS. Respondents grouped into three market segments. Group 1 (road warriors), 23% of sample, wealthy, young, males, technophiles, flexible hours, encounter congestion frequently, most likely to pay attention to traffic reports and change routes. Group 2 (workers), 33% of sample, larger households, more alternate routes available, shorter trips, fewer rush hour trips, less likely to pay attention to traffic reports, willing to change routes based on information. Group 3 (placid), 48% of sample, encounter few delays, unlikely to pay attention to traffic reports, unlikely to change route or trip.

49. Lappin, J.; *ATIS Data Collection Guidelines Workshop: What Do ATIS Customers Want?*; US Dept of Transportation Volpe National Transportation Systems Center, 2000. http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/8R401!.PDF

Summary presentation of ATIS driver and transit user preferences based on numerous previous projects. No new data, but excellent introductory or briefing material. Includes summary of market analyses. Originally a PowerPoint presentation, stored in PDF format.

50. Lappin, J.; *Advanced Traveler Information Service: What Do ATIS Customers Want?*; US Dept of Transportation Volpe National Transportation Systems Center, 2000. http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/9H801!.PDF

Summary presentation of ATIS driver and transit user preferences based on numerous previous projects. No new data, but excellent introductory or briefing material. Includes summary of market analyses.

51. Amodei, R.; Bard, E.; Brong, B.; Cahoon, F.; Jasper, K.; Manchester, K.; Robey, N.; Schneck, D.; Stearman, B.; Subramaniam, S.; *Atlanta Navigator Case Study*; US Dept of Transportation Federal Highway Administration, 1998. http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/7H101!.PDF

Focus groups conducted with stakeholders of a large ITS implementation, including traveler information (ATIS), transit management (ATMS), and a transportation management center (TMC) linking eight regional agencies. No public input was solicited for the project. The two main stakeholder issues were: procedures and measures of effectiveness for programs, and personnel and funding resources to apply the procedures and standards. Agencies must be able to coordinate at all levels to use the new systems effectively, not just at the TMC. DOTs and public stakeholders lack the systems engineering skills and internal resources to adequately plan and implement (or supervise planning and implementation of) integrated ITS systems.

52. Thornton, C.; *User Acceptance Test Report from the Independent Evaluation of Georgia's ATIS Kiosk System (TraveLink)*; Georgia DOT, 1997. http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/78601!.PDF

Questionnaires and focus groups investigating user acceptance of travel information Kiosks during and after the 1996 Atlanta Olympic Games. Participants preferred kiosks that were conducive to a relaxed, unhurried encounter. Residents tended to be business travelers checking traffic conditions (repeat users). Non-residents tended to browse with

no specific inquiry. Most popular queries were: traffic, weather, travel and tourism, and route planning. Users were, understandably, pleased with the promise of the technology.

53. Penn & Schoen Associates; *Driver Acceptance of Commercial Vehicle Operations (CVO) Technology in the Motor Carrier Environment*; US Dept of Transportation Federal Highway Administration, 1997.
http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/J_01!.PDF

Interviews with 50 commercial truck and bus drivers and managers about their perceptions of ITS. Drivers evaluate services from the perspective of their own experience with technology, government, and management. Managers were enthusiastic about the technology, while drivers were mixed, interested only in a direct effect on saving their labor. Drivers most liked hazardous material incident response. Drivers moderately liked commercial vehicle electronic clearance, but many did not trust DOTs to implement it effectively and feared greater regulation and paperwork. Drivers did not like commercial vehicle administrative processes and automated roadside safety response. On-board safety monitoring (except hazardous materials) was disliked by drivers, possibly due to perceived intrusion. Truck and bus drivers reacted very differently to different technologies. 42% of the interviewees were skeptical about the technology, but did not reject it; they were open to the ideas. Most favorable responses came from questions using the phrasing "useful for me" and "will work/would rely on it." Divers with technology experience were more welcoming of CVO technologies.

54. Volmer Associates LLP.; *E-Z Pass Evaluation Report*; New York State Thruway Authority, 2000.
http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/@6L01!.PDF

Comparison of predicted and actual use of electronic payment system by drivers. A 1993 survey resulted in an estimate of 15-18% of Thruway drivers purchasing the E-Z Pass. The estimate correctly predicted the number of early adopters of the technology, and their trip characteristics. A 2000 survey evaluated driver perception of the electronic payment system. 63% of drivers learned of the system through advertising at toll plaza. 73% of pass users bought it to save time. 70% of pass users did not increase their use of the tollway, despite a discount. Satisfaction with elements of the program range 73%-95%. Of those drivers not using the E-Z Pass (cash drivers), 98% knew about the system, 87% approved of it, but 52% refused to use it. Summary of survey results is included.

55. Charles River Associates, Inc.; *User Acceptance of ATIS Products and Services: a Briefing Book on the Current Status of JPO Research*; US Dept of Transportation Federal Highway Administration, 1996.
http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/4NB01!.PDF

Summary presentation of ATIS driver preferences and project best practices based on numerous previous projects. No new data, but excellent introductory or briefing material.

56. Pierce, B.; *Traveler Information Services in Rural Tourism Area*; US Dept of Transportation ITS Joint Program Office, 2000.
http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/@3501!.PDF

Surveys evaluating user needs for rural ATIS for tourists and non-local travelers. 80% of respondents preferred CMS/VMS and radio advisory information, but less than 80%

found the pilot project information reliable. Only 53% of respondents found phone-based information to be convenient, and only 10% found Internet information to be useful. Internet and phone information was more popular among repeat visitors.

57. Inman, V.; *Your Travtek Driving Experience: Rental Users Summary*; TravTek, 1993. http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/92701!.PDF

Survey of rental car drivers using an in-vehicle navigation system. Survey and results are presented without analysis. Drivers were neutral about the system (2.5 on a 1-6 scale), likely due to unfamiliarity or non-use. Drivers did prefer voice cues (3.5 on a 1-6 scale) to graphics only.

58. Inman, V.; Sanchez, C.; Porter, C.; Bernstein, L.; *TravTek Evaluation Yoked Driver Study*; US Dept of Transportation Federal Highway Administration, 1995. http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/3S701!.PDF

Survey of rental car drivers using an in-vehicle navigation system. Customer perception of the technology is initially governed by the perceived convenience. Customer perception changes immediately upon contact with the system, and is governed by the interface. Different drivers prefer different interfaces: different keyboard layouts, different voices and voice cues, etc. Drivers with TravTek tend to make more trips, longer trips, and faster trips that a control group.

59. Inman, V.; Fleischman, R.; Sanchez, C.; Porter, C.; Thelen, L.; Golembiewski, G.; *TravTek Evaluation Rental and Local User Study*; US Dept of Transportation Federal Highway Administration, 1996. http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/3_C01!.PDF

Evaluation of 50 local users and 2000 non-local renters to an in-vehicle navigation system. About half of rental drivers during the test period chose to use the navigation system. Perceptions by locals and renters were similar: Both liked the system (~5 on a 1-6 scale), both said it saved them time, and both said it helped them drive more safely. Renters who used the navigation system made more trips and longer trips than renters who did not use the system.

60. O'Donnell, J.; Lappin, J.;*Customer Acceptance of Automotive Crash Avoidance Devices*; US Department of Transportation ITS Joint Program Office, 1998. http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/2$R01!.PDF

Eight focus groups to determine customer acceptance of in-vehicle ITS technologies. Vehicle purchases are based on: prior experience and recommendations from trusted sources, dealership visits and test drive, and consumer-oriented publications. Customers are interested in new technologies, and expect them to be easy to use, fully integrated into the vehicle, and that the reviews of vehicles will include the "whole vehicle" including on-board technologies. Older drivers prefer fully-loaded standard packages while younger drivers prefer option packages. Older drivers favored safety technology: Warning systems (not buzzers), vision-enhancing systems, impaired driver-detection, and crash-avoidance systems. Parents wondered if their children might become over-reliant

on technology, and be more dangerous drivers. Most participants were skeptical of surrendering driving control to automation, even cruise control. This study looked at safety systems only.

61. Levine, J; *Driver and Dispatcher Perceptions of AATA's Advanced Operating System*; US Dept of Transportation ITS Join Program Office, 1999. http://www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/@5@01!.pdf

Focus groups with bus drivers and dispatchers evaluating advanced transit management system (ATMS) implementation. Drivers cited significantly improved communication with dispatchers and customers, easier transfers, smoother interactions with passengers. Some features lowered driver stress, while others caused unanticipated problems. Drivers liked security cameras, automated announcements, and automated data collection that would result in accurate timetables. Drivers disliked passengers' ability to see realtime on-time/late information, since some passengers would become difficult. Drivers also felt that the system quashed some of the creativity they could bring to the job.

62. Also, Levine, J.; Hong, Q.; Hug, J., Jr; Rodriguez, D.; *Impacts of an Advanced Transportation System Demonstration Project*; Transportation Research Record #1735, 2000.

Evaluation of an advanced transit management system (ATMS) using driver focus groups and passenger surveys. ATMS improved schedule adherence and transfers. Passengers liked automated stop announcements, visual display of schedule adherence (minutes early/late), and the automated transfer system. Passengers were generally happy with the technology, but this did not translate into increased satisfaction with transit service in general. Drivers liked the technology if it lowered their stress or decreased their workload, such as automated stop announcements or transfer coordination. Drivers disliked the implementation of the communications system, which limited their options to reach a dispatcher in an emergency, and disliked the increased stress of passengers who saw the bus late but did not understand why.

63. Zimmerman, C; Marks, J; Jenq, J; Cluett, C; DeBlasio, A; Lappin, J; Rakha, H; Wunderlich, K; *Phoenix Metropolitan Model Deployment Initiative Evaluation Report*; US Dept of Transportation ITS Joint Program Office, 2000.

Focus group, telephone survey, and web log analysis of ITS deployment in Phoenix. Drivers are interested in integrated highway and arterial ("whole trip") information, and dissatisfied with services that provide only one segment, or place barriers between segments, like linked web pages instead of a single page. Willingness to pay is very low. Four commercialized ATISs served the market; none has been a financial success. Each of the two evaluated modes if information (web site and cable TV) attracted a small but growing cadre of regular viewers. ATIS demand was deemed to be a function of delay. This area had low delay.

64. Charles River Associates, Inc; *User Acceptance of ATIS Products and Services: a Report of Qualitative Research*; US Dept of Transportation ITS Joint Program Office, 1997. http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/2B_01!.PDF

Twelve focus groups investigating public acceptance and market potential of ITS technologies. All groups complained about congestion. Most claimed to use radio and TV traffic reports for pretrip and en route planning. Many thought that alternative information sources (phone, Internet, etc.) but did not know how to access them. Few knew how to access realtime information. Very few were repeat users of ATIS. New ATIS users were lukewarm, with the promise of better or personalized information offset by the effort to go out and get it. After first use, however, new users felt they had a positive experience, and claimed to be willing to try it again. When describing the concepts, the presentation must be carefully crafted, and videotapes and demonstrations were not effective in explaining ATIS to the focus groups. Participants liked the concept of having destination and travel information integrated.

65. Lappin, J.; *What Have We Learned About Intelligent Transportation Systems? Chapter 4: What Have We Learned About Advanced Traveler Information Systems and Customer Satisfaction?*; US Dept of Transportation Federal Highway Administration, 2000. http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/@@001!.PDF

Summary presentation of ATIS driver preferences and project best practices based on numerous previous projects. No new data, but excellent introductory or briefing material. Customer demand for ATIS traffic services is based on four factors: (1) the regional traffic context, (2) the quality of the ATIS services, (3) the individual trip characteristics, and (4) the characteristics of the traveler. ATIS transit customers want services that provide real-time information both pretrip and en route, a good quality user interface, and convenient access to detailed system information. Customers cite the following benefits of transit ATIS: reduced stress, improved satisfaction with the decision to take transit, and greater control over time and travel decisions.

66. Zimmerman, C.; Marks, J.; Jenq, J.; Cluett, C.; DeBlasio, A.; Lappin, J.; Rakha, H.; Wunderlich, K.; *Phoenix Metropolitan Model Deployment Initiative Evaluation Report (Draft)*; US Dept of Transportation Federal Highway Administration, 2000. http://ntl.bts.gov/data/9tz01!.pdf

Part of this ATIS project tracked stated user preferences for information by web, cable TV, and other sources. Includes analysis of potential markets and pricing for ATIS services, general user satisfaction, and compares user response with a similar project in Seattle. Users liked the services, but rates of use among the general population were very low.

67. Gent, S.; Logan, S.; Evans, D.; *Evaluation of An Automated Horn Warning System at Three Highway-Railroad Grade Crossings in Ames, Iowa*, Mid-Continent Transportation Symposium Proceedings, 2000. http://www.ctre.iastate.edu/pubs/midcon/Gent.pdf

This study replaced moving warning devices with static warning devices, and surveyed the relative nuisance value and effectiveness of both motorists and residents. Includes an analysis of the most useful road/rail warning devices to different motorist types. Residents found the devices annoying, only slightly less annoying than the original train horn. Motorists liked the devices, but were unwilling to pay for them.

68. Boyle, J.; Dienstfrey, S.; Sothoron, A.; *National Survey of Speeding and Other Unsafe Driving Actions, Volume III: Countermeasures*, US Dept of Transportation National Highway Traffic Safety Administration, 1998. http://www.nhtsa.dot.gov/people/injury/aggressive/unsafe/counter/cov-toc1.html

Surveyed attitudes of motorists on photo-enforcement devices and responses to driver education efforts on the devices. Analysis of acceptability by location or type of violation. Comparison of stated preference with demonstrated behavior. Drivers liked the safety enhancement, but disliked the idea of additional enforcement that might target them. Some participants voiced privacy concerns.

69. Kantowitz, B.; Hooey, B.; Simsek O.; *Advanced Traveler Information Systems And Commercial Vehicle Operations Components of The Intelligent Transportation Systems: on-Road Evaluation of ATIS Messages*; US Dept of Transportation Federal Highway Administration, 1998. http://www.fhwa.dot.gov/tfhrc/safety/pubs/99132/99132.pdf

Comparison of different ways of sending the same on-board ATIS message. Analysis of the potency of messages, when and how drivers prefer to receive information, and how their demonstrated behavior changes with message potency. Comparison of stated preference with demonstrated behavior, and comparisons of risky actions from each. Applicable to all drivers, not just CVOs. More "potent" messages get more results from drivers. Action verbs, detailed times and routes, and other message enhancements are explored.

70. Benekohal, R.; Shim, E.; Resende, Paulo T.; *Analysis of Truck Drivers' Opinions on Safety and Traffic Control on Highway Work Zones. Volume I: Summary Of Findings*, US Department of Transportation Federal Highway Administration, 1995. http://ntl.bts.gov/data/atdo.pdf

Stated preference on usefulness of existing traffic control devices and work zone design. Includes preferences on VMS applications, type of information desired, and levels of comfort with different work zone configurations. No exploration of drivers attitude toward VMS implementation.

71. Liu, Y.; Mahmassani, H.; *Dynamic Aspects of Departure Time and Route Decision Behavior Under Advanced Traveler Information Systems Modeling Framework and Experimental Results*; TRB 1998 CD ROM, Transportation Research Board, 1998.

Simulation of ATIS testing participants' reaction to information, and model predicting driver behavior. Findings are based on participant behavior filtered through the model. The most important factor affecting trip-changing behavior is information reliability. Participants were more willing to change routes when they thought they were late. Interestingly, many participants were willing to change routes even when they considered the information unreliable.

72. Gosling, G.; *Evaluation of an Automated Airport Ground Transportation Information System*; TRB 1998 CD ROM, Transportation Research Board, 1998.

Survey with 1064 respondents investigating attitudes of a kiosk-based ATIS. 25% of users claimed that kiosk information influenced their travel choice. Kiosks were not

placed in well-traveled locations. Survey did not address general population use of kiosks, or perception of their usability.

73. Abdel-Aty, M.; Jovanis, P.; *A Survey of the Elderly: an Assessment of Their Travel Characteristics*; TRB 1998 CD ROM, Transportation Research Board, 1998.

Survey of 260 elderly respondents. 5% of respondents needed some kind of mechanical aid for basic mobility.8% require assistance getting in/out of a vehicle. Respondents generally welcomed the promise of technology to assist them. 53% welcomed an in-home pretrip information system for transit, though less than 20% currently use transit. Specific ATIS concepts were not explored in the survey. Generally, older women felt more uncomfortable driving than older men.

74. Schaller, B.; *Enhancing Transit's Competitiveness: a Survey Methodology*; TRB 1999 CD ROM, Transportation Research Board, 1999.

Comparison of different methods for evaluating customer satisfaction, and determining important issues. While geared toward transit, most methods are applicable to any mode. Most important trip characteristics to most travelers (in order): availability of parking, trip time, personal security, and comfort or convenience. No single method (survey, focus group, etc.) of measuring driver attitudes is completely accurate. Stated preference surveys can be very misleading.

75. Kraan, M.; Zijpp, N.; Tutert, B.; Vonk, T.; Megan, D.; *Evaluating Network Wide Effects of VMS's in The Netherlands*; TRB 1999 CD ROM, Transportation Research Board, 1999.

Survey of 1402 drivers as part of larger ATIS evaluation. Dutch drivers liked the CMS. Only 67% found the system reliable. The response and demonstrated behavior are used to calibrate a driver behavior model.

76. Srinivasan, K.; Chen, I.; Reddy, P.; Jovanis, P.; *Pre-Trip Information Systems (PTIS): an Investigation Into Users' Information Acquisition Process*; TRB 1999 CD ROM, Transportation Research Board, 1999.

Simulated trips of 58 drivers investigating factors of ATIS use. Responses were used to construct a model of trip characteristics and ATIS market segments. Commuters were interested in parking, traffic, and other trip-time affecting factors. Non-commuters were interested in cost and convenience.

77. Adler, T.; Ristau, W.; Falzarano, S.; *Traveler Reactions To Congestion Pricing Concepts for New York's Tappan Zee Bridge*; TRB 1999 CD ROM, Transportation Research Board, 1999.

Survey of 3000 drivers stated preference to different traffic information. 72% of respondents claimed to be open to changing trip times in response to accurate information. This is very different from other study findings. Commuters' primary concerns were travel time and travel cost. 62% claimed no flexibility in travel time, 29% could experience delays of up to 30 minutes with no consequence, and 9% could experience delays over 30 minutes with no consequence.

78. Retting, R.; Williams, A.; *Public Opinion Regarding Red Light Cameras and the Perceived Risk of Being Ticketed*; TRB 2000 CD ROM, Transportation Research Board, 2000.

Surveys in ten cities of public perception of automated enforcement. 70-80% of respondents in each city were in favor of red-light cameras. 10-15% knew someone who had received a ticket for red-light violations (by any enforcement method). Automated enforcement was more popular in cities with operating enforcement systems than in cities without operating enforcement systems. Cities with automated enforcement programs maintained high visibility through public relations and frequent media coverage.

79. Khattak, A.; Yim, Y.; Stalker, L.; *Willingness to Pay for Travel Information: Combining Revealed and Stated Preferences with a Random Effects Negative Binomial Regression Model*; TRB 2000 CD ROM, Transportation Research Board, 2000.

Survey of callers to a free telephone information service. Data is used to model willingness-to-pay for the service. As in other studies, few drivers are willing to pay even 25 cents. Willingness to pay is greater for frequent callers, and for drivers desiring premium information content. Implied, but not explored, is that the current information system can be improved.

80. Hall, F.; Wakefield, S.; Al-Kaisy, A.; *Freeway Quality of Service: What Really Matters to Drivers and Passengers?*; TRB 2001 CD ROM, Transportation Research Board, 2001.

Focus groups investigating trip quality. Travel time was the first priority of participants. Wireless phone use and traffic safety was a high priority. Existing CMS and radio information was inadequate for participants to make efficient choices. Participants who had experienced automated speed enforcement (photo radar) liked the program, even those who had received tickets.

81. Teng, H.; Falcocchio, J.; Qi, Y.; Lapp, F.; Price, G.; Prassas, F.; *Parking Difficulty and Parking Information Needs for Off-Street Spaces in the CBD*; TRB 2001 CD ROM, Transportation Research Board, 2001.

Survey of drivers in a congested area with limited parking. Drivers seek additional information if they believe parking to be limited. Parking search time is related to trip purpose, parking information, and household income. 78% of drivers had a specific parking destination in mind before starting their trip. 20% of drivers searched over 6 minutes for parking. Driver attitude about parking information systems was not explored beyond desiring additional information.

82. Shah, V.; Wunderlich, K.; Larkin, J.; *Time Management Impacts of Pre-Trip ATIS: Findings from a Washington, DC Case Study*; TRB 2001 CD ROM, Transportation Research Board, 2001.

Monitoring of drivers using ATIS and a control group. ATIS users, not surprisingly, had more reliable trip times. Users reported decreased stress due to knowing their estimated arrival times, and having reliable estimates.

83. Zwahlen, H.; Russ, A.; *Evaluation of the Motoring Public's Acceptance of a Real-Time Travel Time Prediction System in a Freeway Construction Work Zone*; TRB 2002 CD ROM, Transportation Research Board, 2002.

Survey with 660 respondents analyzing driver attitudes to a construction zone VMS. 60% of all respondents and 72% of frequent drivers used the sign information to change their

routes. However, only 28% of respondents consider the estimated delay times to be accurate. 86% of respondents felt that VMS information was, may be, or could be useful.

84. Bottom, J.; Hasan, M.; Lappin, J.; *Traveler Response to Information: Who Responds and How?*; TR News #218, Transportation Research Board, 2002.

    Summary of previous findings in market research for ATIS deployments. Markets for ATIS devices are limited to "control seekers, value-added service buyers, wired-with-children". Integrated ATIS has potential to shift trips to transit.

Appendix II. A Suggested Next Step: Driver Information Needs Relating to Infrequent Trips or Infrequent Events

The literature scan indicated that there is a lack of knowledge about the best ways of communicating traffic information for long-distance travel and for travel when there is a known or preplanned traffic disruption. These situations include emergencies (such as evacuations), special events (such as sports events, festivals, fairs, presidential visits), workzones, peaks in seasonal demand, predicted severe weather, and bridge or road closures.

A very large array of information dissemination mechanisms and formats are available for communicating real-time or predicted traffic conditions to drivers. Mechanisms include newspapers, cellular messaging, paging, regular and cell phones, television news, dedicated cable television, radio traffic reports, stationary variable message signs (VMS), portable VMS, workzone VMS systems, Internet, kiosks, onboard information (both commercial vehicles and passenger cars), dispatchers, and highway advisory radio. However, we do not know which mechanisms are most effective for drivers. Those involved in deployment decisions would greatly benefit from knowing the perceived effectiveness of these mechanisms from a driver's perspective, particularly for situations dealing with infrequent trips or infrequent events.

A research project on this subject should use one or more methods of market research or psychometrics to ascertain users needs for information about infrequent trips or infrequent events. Possible methods include questionnaires, focus groups or psychological experimentation. The project should also use case studies to investigate experiences gained in similar implementations in Wisconsin and elsewhere.

Such a project should have these objectives:

- Determine the most effective mechanisms for delivering "infrequent" travel information;
- Determine the best formats and timings for delivering "infrequent" travel information;
- Determine guidelines for effective content of "infrequent" travel information;
- Determine the effectiveness of redundant methods for conveying "infrequent" travel information.

The focus of ITS research here and elsewhere has been on recurrent traffic problems and incidents in urban areas. WisDOT is involved with the Smart Work Zone pooled fund study, but this study is oriented toward specific traffic control technologies and has not addressed the implementation of these technologies in a broader context.

Drivers do not now have adequate information about the effect of known traffic disruptions and their travel options for dealing with the disruptions. Better information will reduce driver frustration, cause drivers to better utilize the capacity of the road network, reduce congestion and improve safety.

Many of the mechanisms for delivering information to drivers are expensive, have long lead-times or require complex partnerships. Given the growing expectations of drivers for good information and the possibility of costly mistakes and redundancies, it is critical that mechanisms be carefully chosen and implemented.