CALIFORNIA PATH PROGRAM
INSTITUTE OF TRANSPORTATION STUDIES
UNIVERSITY OF CALIFORNIA, BERKELEY

Investigation of Traveler Information and Related Travel Behavior in the San Francisco Bay Area

Asad J. Khattak, Felipe Targa, Youngbin Yim

California PATH Working Paper
UCB-ITS-PWP-2003-6

This work was performed as part of the California PATH Program of the University of California, in cooperation with the State of California Business, Transportation, and Housing Agency, Department of Transportation; and the United States Department Transportation, Federal Highway Administration.

Report for MOU 363

March 2003

ISSN 1055-1417

Investigation of Traveler Information and Related Travel Behavior in the San Francisco Bay Area

ASAD J. KHATTAK, Ph.D.

FELIPE TARGA

YOUNGBIN YIM, Ph.D.

Acknowledgement

This work was performed as part of the California PATH Program of the University of California, in cooperation with the State of California Business, Transportation, and Housing Agency, Department of Transportation; and the United States Department of Transportation. The content of this report reflects 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 or policies of the State of California. The report does not constitute a standard, specification or regulation. The data presented in this report are based on the TravInfo Evaluation study. The authors wish to acknowledge the TravInfo Evaluation Oversight Team for their comments and GLS Research for their assistance in Computer Aided Telephone Interview (CATI) survey design and administration.

Abstract

Advanced Traveler Information Systems are becoming an integral part of urban transportation systems. This paper discusses issues related to how people access, acquire and use travel information. The perceived benefits and willingness to pay for dynamic information are discussed. Empirical evidence from a major field operational test is examined to answer questions about why, how and who uses travel information.

Empirical evidence suggests that information helps travelers to switch routes and departure time. The potential for information benefits is perhaps higher in cases of unexpected incidents. However, only one-third of the Target survey respondents changed their travel decisions in response to the incident. While this is a significant number in terms of demand reduction due to information, perhaps the full benefits of dynamic information are not realized because the quality of information available in just such situations is relatively low. New information media can focus on variables that are sensitive to travel-time uncertainty in order to improve the quality of information in high-uncertainty situations.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

Understanding traveler response to new technologies is at the core of knowing which innovative traveler information systems will be successful. The extent of individual and social benefits from Advanced Traveler Information System (ATIS) is not clear. They certainly will depend on how individuals acquire, understand and use information. The purpose of this paper is to describe how ATIS might affect travelers. The empirical data used for this paper are from a series of travel surveys conducted in the San Francisco Bay Area. The surveys were conducted to evaluate TravInfo®, the Bay Area advanced traveler information system. First, a conceptual structure of the traveler information system is presented based on the earlier work (Schofer, Khattak, and Koppelman, 1993; Yim, Khattak, and Raw, 2002). It discusses traveler behavior and information, factors affecting traveler response to ATIS, and evaluation issues. Then, the TravInfo® project is described including its goals and objectives, and the structure of the project evaluation as a field operational test. Finally, conclusions are reported based on the results of the traveler response surveys and empirical findings documented in earlier studies (Khattak, Yim, and Stalker, 2002, 1999; Wolinetz, Khattak, and Yim, 2001; Yim, Khattak, and Raw, 2002).

The outcome of ATIS demonstrations depends on many factors; among them are ATIS design (both the overall system and the human-machine interface) and performance (in terms of data collection, processing, and dissemination), attributes of the test location (particularly the availability of alternative modes and surplus capacity on alternate routes, and network characteristics), public and private support, organizational structures, and ultimately the extent of individual and social benefits. Individual benefits may be tangible, such as travel-time savings, and intangible, such as anxiety reduction. Society may benefit from ATIS through reductions in congestion and pollution. ATIS designs are likely to focus on benefits at the level of the individual user, and perhaps move the system closer to user equilibrium. While this may result in system-wide benefits, it is unlikely to lead us to a social optimum.

In this paper, we described the results of traveler response to ATIS using several surveys conducted for the TravInfo® evaluation study. The Broad Area surveys refer to randomly selected household telephone interviews in the San Francisco Bay Area. The TATS (Traveler Advisory Telephone System) surveys refer to telephone interviews among TravInfo® callers. The Target surveys refer to telephone interviews among those who traveled in a 16-mile segment of the US-101 corridor between the interchange of US-101 and SR 92 to the south and the interchange of US-101 and I-280 to the north.

How do people access and use travel information? In the Broad Area survey, the results show that 100% of the respondents accessed or owned at least one device (on average about 4 devices), 66.4% of all respondents received travel information either regularly or occasionally, and 33.1% changed their travel decisions in response to that information. The main reason cited by those not seeking dynamic information was that it was not relevant to their travel patterns. The findings about access and ownership of information sources and about acquisition and use of travel information suggest that a significant gap exists between access and use. Also, decisions about access and ownership of information sources and about acquisition and use of travel

information themselves should be analyzed explicitly in planning for advanced traveler information systems.

What sources of information do people access? The Broad Area surveys indicate that most travelers received some form of dynamic traffic information. Radio and, to a lesser extent, television, were the prevalent media through which information was obtained. Respondents used a variety of information sources to obtain travel information during the pre-trip as well as en-route stages, with cellular phones and the Internet representing important future growth markets; their use increased substantially during the TravInfo® test.

What type of information do people desire? The Broad Area surveys indicated that the most desirable types of information in order of desirability are: frequent updated traffic conditions on radio or television, detailed information about alternate routes around congestion, in-car navigational computer showing highways and roads, estimation of the time of delay and directions to get from the point of departure to the point of arrival, information about traffic conditions at specific locations, information about mass transit alternatives, and automatic notification of unexpected traffic congestion. The results also suggested that the relevance of travel information is very important to travelers, both in making the decision to acquire travel information, and in changing their actual travel decisions.

What travel decisions do people change in response to information? Dynamic information seekers who called TravInfo® TATS or accessed dynamic information on the TravInfo®-supported Internet websites were more inclined to change their travel decisions compared with Broad Area respondents, as expected. Clearly people who are pre-disposed to changing their travel decisions will seek out information from new sources implying simultaneity in their access and change decisions, which needs to be investigated further. Those who changed travel plans due to dynamic information were more inclined to change routes and then departure times. Mode changes and trip cancellations were rare, as expected.

Why is information important to travelers? Saved travel time and help with travel planning were the key perceived benefits of dynamic information. Interestingly, a reduction in anxiety was also cited by many respondents as a perceived benefit. Respondents demanded high-quality information, and some are willing to pay for premium information services. While the new information services and media seem to suffer from a lack of publicity, they seem to appeal to information seekers and early adopters.

Are travelers willing to pay for dynamic information? There seems to be significant (latent) demand for personalized information services that would allow users to retrieve information when needed, to the point where a significant number of Bay Area travelers stated they would be willing to pay either on a per-call basis or a monthly subscription fee for a customizable service. However, the new information must be superior to the information that can be obtained for free through radio or television or other Internet outlets and services. The benefits from new information technologies may be limited due to competition with existing information sources such as the radio and television (but these benefits are likely to improve incrementally over time).

Empirical evidence suggests that information helps travelers to switch routes and departure time. The potential for information benefits is perhaps higher in cases of unexpected incidents. However, only one-third of the Target survey respondents changed their travel decisions in response to the incident. While this is a significant number in terms of demand reduction due to information, perhaps the full benefits of dynamic information are not realized because the quality of information available in just such situations is relatively low. New information media can focus on variables that are sensitive to travel-time uncertainty in order to improve the quality of information in high-uncertainty situations.

I. INTRODUCTION

Advanced Traveler Information Systems (ATIS) can improve mobility/accessibility through the use of technology. ATIS are intended to help individuals make more informed travel decisions, and thereby moderate the effects of traffic congestion on both themselves and other travelers (Schofer, Khattak, and Koppelman 1993). These systems can be as simple as incident information available from radio broadcasts, or as sophisticated as a GIS-based in-vehicle route guidance system (Yim, Khattak, and Raw 2002). Dynamic information systems can support destination, mode, route and departure time selection, en-route diversion, trip chaining, and parking choices (Heathington, 1969; Boyce, 1988; Al-Deek et al., 1988; Mahmassani and Jayakrishnan, 1991; Khattak, Schofer and Koppelman, 1993; Polydoropoulou et al., 1996; Liu and Mahmassani, 1998; Ben-Akiva, Bottom, and Ramming, 2000; Srinivasan, and Mahmassani, 2002). They may save people travel time and also reduce navigational errors and traveler anxiety due to congestion and route-finding stress. However, in some instances they can distract drivers and increase crash risk.

Conceptual and empirical studies have been conducted to determine the feasibility, benefits, and risks of ATIS technologies. Specifically, conceptual models that characterize how people make their travel decisions and use travel information have been developed over the past decade (e.g., Ben-Akiva, Bowman, and Goupta 1996). Furthermore, there is a growing body of empirical evidence regarding traveler decisions and the impacts of new and improved information systems acquired through federally sponsored field operational tests conducted in the US. One such effort is TravInfo®, a regional traveler information system in the San Francisco Bay Area (Yim and Miller, 2002), which is the focus of this paper. It began in September 1993 with funding from the Federal Highway Administration and the California Department of Transportation, and has now moved to full deployment. The PATH Program in the Institute of Transportation Studies at the University of California, Berkeley conducted an evaluation of the field test, the results of which are documented in this paper.

The outcome of ATIS demonstrations depends on many factors; among them are ATIS design (both the overall system and the human-machine interface) and performance (in terms of data collection, processing, and dissemination), attributes of the test location (particularly the availability of alternative modes and surplus capacity on alternate routes, and network characteristics), public and private support, organizational structures, and ultimately the extent of individual and social benefits. Individual benefits may be tangible, such as travel-time savings, and intangible, such as anxiety reduction. Society may benefit from ATIS through reductions in congestion and pollution. ATIS designs are likely to focus on benefits at the level of the individual user, and perhaps move the system closer to user equilibrium. While this may result in system-wide benefits, it is unlikely to lead us to a social optimum.

The extent of individual and social benefits from ATIS is not clear. They certainly will depend on how individuals acquire, understand and use information. Our purpose in this paper is to describe how ATIS might impact travelers using TravInfo® surveys. First, we will present a conceptual structure, based on our earlier work (Schofer, Khattak, and Koppelman, 1993; Yim, Khattak, and Raw, 2002), which discusses traveler behavior and information, factors affecting traveler response to ATIS, and evaluation issues. Then we will present a brief description of TravInfo®, its goals and objectives, and the structure of the evaluation project conducted when TravInfo® was a field operational test. Finally, we will conclude with the traveler response results based on TravInfo®'s empirical findings and documented in earlier studies (Khattak, Yim, and Stalker, 2002, 1999; Wolinetz, Khattak, and Yim, 2001; Yim, Khattak, and Raw, 2002). The Broad Area surveys refer to randomly selected household telephone interviews in the San Francisco Bay Area. The TATS (Traveler Advisory Telephone System) surveys refer to telephone interviews among TravInfo® callers. The Target surveys refer to telephone interviews among those who traveled in a 16-mile segment of the US-101 corridor between the interchange of US-101 and SR 92 to the south and the interchange of US-101 and I-280 to the north.

II. CONCEPTUAL STRUCTURE

To understand the relationships between ATIS design and performance and traveler behavior, we must examine the effect of dynamic information on mode, departure time, route decisions, and diversions from habitual patterns (Figure 1). Beginning with such a foundation, we can then explore the effects of different ATIS configurations on that traveler behavior.

Traveler behavior and information

Traveler behavior is the process of individual decision-making about what trips to make, where to go, when to depart, what mode of travel to use, and what route to follow. While individuals have considerable latitude in making these choices, making the decision processes more difficult to understand and predict, they are constrained by the spatial geography of travel opportunities, network structure and transportation services, individual resources and capabilities, lifestyle requirements (to work, shop, etc.), and many other forces. Information about travel opportunities, services, network structure, and performance plays an important role in influencing these travel decisions. Conceptually, relevant and accurate dynamic information can contribute to choices that are more informed and perhaps better, either for the individual traveler, society as a whole, or both.

Information to support travel decisions is acquired actively (by reading, asking, listening) or passively (through experience) from various sources, and it is used, along with stored knowledge, to make choices, both long-term (e.g., auto purchase) and short-term (e.g., departure time and route choice). Individuals have limited information-processing capabilities and resources, and as a result their typical decision-making

processes use simple choice rules and rely on limited search efforts, e.g., Simon's (1979) concept of "bounded rationality" to select a satisfactory option (Mahmassani and Chang, 1985). The search for options, such as the home-to-work route, may be well short of the optimal route, depending on the importance of the decision, the expected costs and payoff of additional searching, and the availability of salient information.

Often individuals cannot perform all the computations necessary for the optimal choice and they do not have perfect ability to store and retrieve information. They do not always know the complete set of destination, mode and route alternatives and the important attributes of these alternatives. Furthermore, they may not have the resources to reach an optimal solution in a dynamically changing network (de Palma, 1998).

Gathering, organizing, and conveying information about transportation network options and performance is complicated by the inherent spatial and temporal dimensions of such information. Human knowledge of the spatial environment, the cognitive map (Golledge and Stimson, 1987; Khattak and Khattak, 1998; Ramming, 2002), is based on an often limited mental representation of route locations and the physical environment. Cognitive maps influence travel behavior (Wenger et al., 1990; Khattak and Khattak, 1998; Ramming, 2002); for example, the propensity to divert in the face of congestion is related to the number of routes known to a person (Khattak, 1991; Polydoropoulou et al., 1996). People differ widely in their ability to understand and utilize spatial information. The potential for expanding and enriching cognitive maps through ATIS may be substantial, and the value of doing so needs to be explored.

Travel conditions on networks change over time, and thus what is a good choice now may be a poor decision tomorrow, or ten minutes from now. Conditions vary regularly over daily, weekly, and seasonal cycles, and they can shift quickly and sporadically as the result of incidents such as accidents, breakdowns, load spills, special events, and extreme weather. ATIS can inform travelers about near-real-time roadway conditions, and this might influence short- and intermediate-term travel choices.

Thus, there is much information that may positively influence travel choices, and that information may be quite complex in its structure and content. The information itself must be used by an advanced processor, the human brain, which has adapted to simplify choices to make it feasible to make a large number of decisions quickly (Tversky and Kahneman, 1974). Since many travel decisions are made repeatedly as a matter of daily routine, experienced trip-makers have evolved tactics to cope with the stress of routine choices. The challenge for ATIS is to intervene in these behavioral processes, to provide dynamic information that is accessed and used, and contributes to improved travel experience for individuals and their community.

Factors affecting traveler response to ATIS

The development and evaluation of information systems requires an understanding of both short- and long-term traveler responses to information about travel conditions. These responses are likely to be influenced by the content of information, dissemination media

and by the attributes of information such as accuracy and relevance. Peoples' utilization of travel information is also likely to be influenced by the attributes of travelers themselves, their household characteristics and their situational constraints.

Information source. Travel information can be received from various media, including radio, television, computer (Internet), telephone, hand-held devices, personal digital assistants, and in-vehicle devices. People are expected to have different levels of access to and ownership of these devices and use these devices differently on various types of journeys and at different times.

Information content. The content of information is critically important for supporting travel decisions. For example, business and service directory information may be useful for destination choice, as might information about the location and availability of parking; incident congestion and travel time information may influence route choice. Whether the information is *static* or *dynamic* is likely to have an effect on decision making. For example, static information about location of shopping malls may guide destination choice, whereas dynamic information on incidents is likely to be particularly effective in diversion decisions. The effect of *qualitative* (non-numerical) and *quantitative* (numerical) information may differ: Qualitative descriptions of congestion, such as roadway "jammed" or "operation at posted speed limits," may have less influence on route choice than quantitative estimates of travel time delay in minutes (Drand Roche, 1992). Some presentation styles may be more useful and more effective than others, depending on the context. For example, travelers may prefer terse messages rather than a conversational style. Some travelers are likely to find map-based (pictorial) information more useful than others.

Information attributes. Perceived attributes of information are likely to influence the extent to which individuals accept and use it. Information is more likely to influence decision-making if it is perceived as credible, relevant, and accurate. The challenge is to develop an information system that is widely accessed and perceived as providing relevant and accurate information.

Since the 1990s demonstration studies have been designed to evaluate, in a structured manner, the effects of these aspects of information on traveler behavior. Repeated observations are necessary to separate the effects of differences in information media, content, and quality.

The magnitude of market penetration of ATIS technologies will influence their effect on travel conditions in the long term. The costs of these systems, as well as preferences for privatization, suggest that consumers will be asked to pay for all or part of ATIS equipment and services (Wolinetz et al., 2001). Since we can expect price to have an important influence on acquisition and use decisions, it becomes essential to understand consumer willingness to pay for various ATIS attributes and services.

Willingness to pay is likely to be strongly differentiated across types of ATIS services, e.g., whether the information is customizable, whether users pay on a monthly

or per-call basis, and whether the information provided is static and/or dynamic. It will be important to differentiate consumer responses to different service types so that effective price structures can be identified and tested. A map of the willingness-to-pay response surface, in terms of ATIS performance, management policies/subsidies, and individual characteristics, will be important for supporting implementation decisions through benefit-cost analyses and system-financing (cost-revenue) studies. However, willingness to pay is a moving target, because the price-performance mixes offered by ATIS will change as the technologies mature. Price can be expected to drop as communications technologies become cheaper and the volumes of information increase; in addition, the manufacturing of communications technologies and the installation of surveillance and travel data processing will benefit from adoption of lessons learned, as illustrated by cellular telephones. ATIS effectiveness can be expected to rise over time, and the mix of service offerings is likely to become increasingly focused on what consumers truly value. Successful travel information services might be those bundled with other services (Khattak, Yim, and Stalker, 2002).

Evaluation Issues

A key purpose of ATIS evaluation experiments is to understand the traveler behavior implications well enough to build a basis for designing future systems and making decisions about their implementation. To accomplish this, we must measure behavior and potentially causal factors so that the following types of questions can be answered:

Do travelers access or own information devices? One of the stages in making repetitive travel decisions relates to information device access and ownership. Access and ownership are not synonymous, because in some instances a person may have ownership but not access (e.g., access to home cable TV while the person is at work), or access but not ownership (e.g., Internet at work may not be owned). Understanding behavioral responses to ATIS access and use requires that practitioners and researchers collect data on device access and ownership and travel information acquisition/use.

Do travelers use ATIS? Use can be defined in several ways. Some travelers may feel reduced anxiety because of the information, but may not make direct use of its information for changing decisions. Others may review the information on a regular basis but make only limited use of route guidance advice. Still others may use dynamic information to adjust many travel decisions and accept advice without question. Utilization patterns can be expected to vary with traveler characteristics, including demographics (age, gender, education) and personality (Khattak, 1991; Schofer, Khattak, and Koppelman, 1993). Individual travelers may mix these various patterns of ATIS use. It will be important to capture all of these modes of ATIS utilization, because each may produce a different set of individual and social benefits. Relating use to traveler characteristics will contribute to projections of future market acceptance of ATIS.

How and when do travelers use ATIS? There are likely to be particular kinds of circumstances that promote or discourage ATIS use. These might be defined in terms of location on the network and the availability of routing options, travel conditions, weather,

lighting, and situational factors (trip purpose, time of day, destination), moderated by traveler characteristics as described above. To the extent that ATIS is more useful under particular circumstances, perhaps high-uncertainty incident situations, it is important, albeit challenging, to fine-tune system design and performance for better functioning in those circumstances

Why do travelers use ATIS? For the purposes of design and development, it is not sufficient to measure ATIS utilization; it also is important to understand the forces motivating ATIS use in terms of the benefits and of design and performance attributes. Exploring behavioral responses to ATIS media, content and attributes will require variation of those attributes in experimental settings, for example, testing different human/machine interfaces, different services, and different performance levels. Such controlled experimentation may sometimes conflict with the operational orientation of private sector equipment suppliers wishing to market their proprietary products, and public sector funding agencies focused on providing good information to travelers and improving network performance.

How do travelers perceive ATIS? To anticipate future market response to these emerging technologies, it will be necessary to go beyond measures of observed behavior to explore how users feel about ATIS. Levels of user satisfaction, comfort, and traffic-related anxiety can be correlated with observable ATIS utilization, but they may also vary substantially across individuals as a function of demographics and personality. These perceptions will be important in service purchase decisions.

What are the consequences of using ATIS? These consequences are first observable at the level of the individual traveler, in terms of objective outcomes such as travel time reductions relative to unassisted navigation, as well as psychological impacts such as changes in stress/anxiety levels. Whereas individual consequences may affect market potential, public intervention in the development and implementation of ATIS must be justified in terms of social benefits (i.e., improvements in network performance).

There are several experimental approaches to evaluating ATIS behavioral responses. We can learn about behavioral responses to ATIS by asking people what they want and how they would react to different services and attributes. This is the stated preference approach, and it is useful for exploratory studies of new concepts and technologies or for understanding willingness to pay. Yet stated preference studies sometimes produce results that may not correspond to real behavior; respondents sometimes want to please the researcher by giving the right or expected answer, but this may not reflect their beliefs or future behavior.

More definitive results can be achieved, at considerably higher costs, through observational studies, in which people are given better travel information with ATIS technologies and services, and their responses are observed and reported. Such observations can be conducted in a laboratory using simulations, or in the field with simulations or operational ATIS. The value of the observational approach is that it presents subjects with more realistic systems and allows researchers to record how people

respond. The level of realism varies with the sophistication of the experiment, but it is always greater than that achievable in stated preference studies, because observational studies show preferences revealed through behavior. Conducting surveys to ask about revealed behavior is also popular among transportation professionals.

Observational studies conducted in the laboratory are generally less costly than field studies, and are more easily controlled, in the sense that ATIS attributes and services may be varied systematically, and subjects may be presented with a carefully managed set of test conditions. On the other hand, achieving a level of realism sufficiently high to support generalization of results is more difficult in the laboratory, because of both the limitations of simulation and the biases brought about by the observation procedures themselves. Field experiments are more costly and complex, but offer the potential to be more realistic and thus more readily generalized to other settings.

Observations of travel behavior, as well as surveys to capture perceptions and feelings, can provide a more realistic and comprehensive picture of behavioral responses to ATIS. Extended field experiments with this natural flavor and automated, unobtrusive measurement of traveler actions can reduce or even eliminate observational biases. On the other hand, natural field experiments require greater resource commitments, because they must be operated for extended time periods, and because of the need to measure potentially contributing phenomena such as weather, traffic conditions, and situational factors, which the researcher would control for in managed experiments.

Recently, transportation researchers have successfully combined Stated Preference (SP) experiments, where individuals choose from a given set of hypothetical scenarios, with Revealed Preferences (RP), which is how people (report they) behave in real-life situations. Revealed preference data are richer in information about observed behavior, whereas stated preference data provide information about how people might respond to a new alternative or how much they are willing to pay for a new service. A combination of the two types of data can give deeper insights.

III. TRAVINFO® EVALUATION

TravInfo® is one element in a growing body of empirical evidence (field observational studies) regarding traveler decisions and the impacts of new and improved information systems. We present a brief description of TravInfo®, its goals and objectives, and the structure of the evaluation project conducted when TravInfo® was a field operational test. Then, using TravInfo® evaluation surveys, we will describe the traveler response results[1] and, provide some answers to the following questions:

- How do people access and use travel information?
- What sources of information do people access?

[1]The evaluation project of the Field Operational Test included four principal elements: 1) Assessment of traveler response, 2) Institutional evaluation, 3) Technology assessment evaluation, and 4) System performance evaluation. However, our analysis is based on the traveler response component, which is concerned with acquisition and dissemination of TravInfo® data.

- What types of information (content) do people desire?
- What travel decisions do people change in response to travel information?
- Why is information important to travelers?
- How much are travelers willing to pay for travel information?

TravInfo®'s goal is to broadly disseminate accurate, comprehensive, timely, and reliable information on traffic conditions and multi-modal travel options to the public in the Bay Area). Funded by the U.S. Department of Transportation as one of the sixteen field operational tests in 1993, TravInfo® provided free dynamic information about traffic conditions and multimodal travel options.

The evaluation of the field test was performed using various data sources from field observations, focus group discussions, a series of telephone surveys with travelers, in-person interviews with project partners and Traveler Information Center staff, and field measurements. Significant resources were devoted to designing surveys and collecting behavioral data. The surveys were based on a contemporary understanding of traveler behavior and the factors that might influence it, including dynamic information. Particularly, the TravInfo® assessment sought data in a number of areas including the importance of delays and congestion to traveler behavior in the short term; attributes of alternative routes and modes; attributes of individual travelers; the efficacy of various media, including new media such as the Internet, in delivering travel information; and willingness to pay for travel information. Evaluation surveys were designed to assess traveler response to, and perception of, the TravInfo® project and the various information sources and devices made available to the public.

The evaluation surveys of travelers and system users were conducted between November 1995 and November 1998 (Figure 2). Although existing sources of dynamic information, including commercial radio and television reports for traffic and transit information, were not formally part of the TravInfo® system, the use of these sources by travelers was also considered in the assessment surveys. The overall evaluation strategy was to study the response of the whole population, response of people more inclined to use information technology (early adopters), and traveler decision-making in high-benefit incident situations. For the traveler response part, the evaluation consisted of four coordinated studies, all of which used survey research. A "before and after" study design was used to understand traveler response. The large surveys were conducted before and after TravInfo® implementation. The before study established "base" travel conditions. The surveys were conducted to study in-depth the changes in behavior over time.

In the surveys respondents were asked about their perceived uncertainty, incident delays, travel times and costs, revealed choices and stated willingness to pay for information. The surveys were meant to provide a better understanding of traveler response to dynamic information. Telephone surveys were conducted before, during, and after the field test. These included: two Broad Area surveys (BAS1 and BAS2) conducted before and after the field operational tests (Yim, Hall, and Weissenberger, 1997; Yim, 2000); four waves of surveys (Target) focusing on incidents that occurred on a heavily used freeway segment (Koo, Yim, and Hall, 1998, 2000); and two surveys of

callers to the TravInfo® Traveler Advisory Telephone System (TATS) (Yim et al., 1998; Koo and Yim, 2001; Khattak, Yim, and Stalker, 2002). In addition, a web-based online survey was conducted of users of TravInfo® information through web sites maintained by private Information Service Providers (ISP) (Yim, 2000; Miller and Loukakos, 1998). To obtain initial insights, six focus groups were also used (Yim, 1999).

IV. TRAVELER RESPONSE RESULTS

The surveys that are the basis of the empirical findings presented below were intended to evaluate the impacts of the TravInfo® project. Each survey targeted a different population, and reflected an evolving understanding of the factors influencing travel decisions in different situations. The purpose is to integrate the survey results, interpret them, and draw suggestive inferences regarding preferences for information access devices, information acquisition and use, and willingness to pay for dynamic information.

How do people access and use travel information?

Both access and ownership of information devices and acquisition and use of travel information were investigated rigorously in the 1998 Broad Area survey (Targa et al., 2002). In this Broad Area survey, respondents were asked about 1) their access and ownership of information devices including cable television, cellular telephones, hand-held devices, pagers and personal digital assistants, computers at home and work with Internet access, and in-vehicle navigation devices, 2) the use of these devices for receiving travel information and 3) changes in routine travel decisions due to dynamic information. The results show that 100% of respondents access or own at least one device (on average about 4 devices), 66.4% of all respondents receive travel information, and 33.1% change their travel decisions in response to that information. Information device access and ownership (captured by the number of devices) increased with higher income and certain professions. The use of these devices for acquiring travel information increased with access or ownership of more information devices, longer times residing in the study area, highway/freeway use, higher exposure to unexpected congestion and longer travel time. More frequent use of dynamic travel information was associated with higher propensity to change routine travel behavior (e g., route diversion).

What sources of information do people access?

The Broad Area surveys indicate that most travelers receive some form of dynamic traffic information (Table 1.1). They also suggest that radio, and to a lesser extent, television, are the prevalent media through which information is provided during the pre-trip stage (Table 1.2). The predominant change between the two phases of the Broad Area Study is that radio reports were used less in the second study. Internet use increased as a source of pre-trip information (from 1% to 4%) and cell-phone use doubled from 1% to 2% as a source of en-route information (Table 1.3). Telephone access to travel information was essentially constant. This suggests that new technologies (specifically cell phone and Internet) are the main growth markets for acquisition of travel information. The potential for these two media is further indicated by a more than ten-fold increase in cellular phone

subscriptions, from nearly 4% in the first Broad Area survey to almost 57% in the second Broad Area survey. At the time of the second survey, 52% of respondents had Internet access either at home or at work or both. Clearly, there is great room for expansion in the use of these technologies for delivery of travel information.

What types of information (content) do people desire?

A higher propensity for seeking travel information as indicated in the second Broad Area survey was significantly related to respondents who took longer trips, faced unexpected congestion, were female, employed, and owned a cellular telephone (Yim et al., 1999). That survey also indicated that the most desirable type of information in order of desirability is:

1) Current traffic conditions on radio or television that are updated every minute.
2) Detailed information about alternate routes around congestion, including where to exit and what surface streets to take, with comparative travel times.
3) An in-car navigational computer with a display showing highways and roads. The computer could show where congestion exists and map the fastest routes in terms of time around congestion.
4) An estimate of the time of delay on the usual route from unexpected traffic congestion.
5) An estimate of the travel time to get from the point of departure to the point of arrival on the usual route and any planned alternate routes.
6) Information about traffic conditions at specific locations, which a traveler could request over the telephone or on-line through a computer.
7) Detailed information about mass transit alternatives to avoid congestion including up-to the-minute bus, ferry, and train schedules and routes.
8) Automatic notification of unexpected traffic congestion on a traveler's usual route through a pager or cellular phone.

Of the travelers who did not receive traffic information approximately half stated that the reports do not cover the route that they take (Table 1.4). Radio coverage is the most common source of dynamic information, yet the coverage was restricted. The morning peak hours typically received the widest traffic information coverage, with only a few radio stations reporting traffic conditions during afternoon peak and off-peak hours. Also, during 1996, radio reports ran no more than once every eight minutes, and only in half-minute segments. The area covered by traffic reports was limited to major freeways, and reporting was not consistent throughout the Bay Area and somewhat lacking in detail (Yim et al., 1996). These results suggest that the relevance of travel information is very important to travelers, both in making the decision to acquire travel information, and in changing their actual travel decisions. Lack of alternate routes was also a significant consideration for travelers.

Though market penetration of TravInfo® technologies was small (only 9% of respondents in the second Broad Area study were aware that it existed), new users were attracted both to the telephone system and to travel Web sites (Yim and Miller, 2002).

Approximately one-third of phone callers and one-third of Web site visitors switched to TravInfo® from radio/television reports. Other users who reported never listening to radio and television reports also began to use TravInfo®, as did some users who continued to use radio reports and supplemented them with access to TravInfo®. Those who switched were long freeway commuters and high-mileage drivers. The average commute time for both groups was 45 minutes, versus an average commute time in the Bay Area of 28 minutes (one-way). Traffic Web site users perceived the quality of Web site information to be far superior to radio/television traffic reports. Maps and verbal descriptions of freeway speeds and the locations of incidents were considered valuable for making travel decisions. The focus group participants also preferred obtaining information from the phone or the Internet compared to tuning in to radio or television reports, despite the effort required on their part.

What are the changes to travel decisions (behavioral change) in the presence of information?

Based on the Broad Area 1 survey, the propensity to (ever) adjust pre-trip travel decisions on the basis of travel information was highest for respondents who reported that they commute to work compared with other travelers (Khattak, Yim, and Stalker 2002). However, a significant portion (between 18 and 52 percent, depending on the mode and trip purpose) of trip makers did not divert because of travel information. Individuals who experienced higher travel-time uncertainty (measured by reported times of one-way automobile and transit commute when traffic congestion is severe) and reported the occurrence of unexpected delays (for automobile commuters and non-commuters) during the past month had a higher propensity to make pre-trip decision changes in response to travel information. Unexpected delays significantly increased the route change propensities of automobile commuters and non-commuters. Radio travel information seemed to increase the probability that the respondent will change route, departure time, or both.

One-third to one-half of users who acquired travel information made changes in their travel decisions (Table 1.5). The percentage increased from the first Broad Area study to the second. This may be partly due to the lower percentage of radio listeners appearing in the Broad Area study. The TATS and ISP studies revealed that users who actively seek information via telephone or Internet are more likely to change their travel behavior than travelers who relied on radio and television, as expected. At the same time, people who are more willing to change their travel decisions are more likely to access travel information.

Among travelers who changed their behavior, altering their route was the most frequent change (Table 1.6). The second most common change was altering departure time. Few travelers changed to transit despite the relatively good transit opportunities in the Bay Area, mainly because they perceived it to be inconvenient and more time-consuming than driving, even in congested conditions.

The Broad Area studies also revealed that non-commuting drivers changed their travel habits more than commuting drivers, perhaps reflecting the flexibility inherent in non-work trips. Among commuting drivers, those who sought travel information at work were more likely to leave earlier or take an alternate route.

Why is information important to travelers?

Results regarding the reasons that travelers valued information suggested that time savings and the opportunity to plan the trip differently were most important (Table 1.7). An interesting result is the level of users who reported that travel information reduced their level of anxiety or stress. This percentage was much higher among Broad Area and Target study respondents than among telephone and Internet users. This is consistent with the observation that telephone and Internet users were more likely to seek information (since they had to be proactive in order to acquire it) and were more likely than the average user to change their travel decisions based on the information they received. This suggests that an important value of radio traffic reports is to help drivers feel in control of what is going on around them, perhaps because congestion that has an explanation is less stressful than congestion that is unexplained.

How much are travelers willing to pay for travel information?

Willingness to pay was investigated rigorously in the 1998 Broad Area survey (Wolinetz, Khattak, and Yim, 2001) as well as in the TATS surveys (Khattak, Yim, and Stalker, 2002). In the Broad Area survey, the vast majority of those who already had electronic devices such as personal computers or Palm Pilots indicated that they would be willing to pay to subscribe to traffic information. Respondents were asked if they seek travel information, and, if so, about their willingness to pay for a hypothetical ATIS that provided: 1) Automatic notification of unexpected congestion on respondents' usual route, 2) Estimated time of delay from unexpected congestion on respondents' usual route, 3) Automatic alternate route planning around congestion, and 4) Estimated travel time on respondents' usual route and on any planned alternate routes. Sixty-six percent of the respondents sought travel information, and of these information seekers 71% (48.5% of the respondents) were willing to pay for ATIS. Those who preferred to pay on a per call basis were 37.1% of the respondents, and they were willing to pay for ATIS as follows: $1.00, 21.7%; $0.75, 4.2%; $0.50, 6.8%; $0.25, 2.4% ; $0.00 (average $0.74 per call). Some respondents said that they would not pay any for travel information**.** Those who preferred to pay on a monthly basis were 11.0% of the respondents and they were willing to pay as follows: $7.00, 8.3%; $5.00, 1.7%; $3.00, (average $3.84 per month). Increased willingness to pay for ATIS was related to respondents who altered their trips in response to information and stated a greater desire for dynamic information. Males and younger respondents were more inclined to pay for the service.

The survey of TravInfo® callers indicated that the average use of the system would decline if a service charge was initiated without further improving the service (Khattak, Yim, and Stalker, 2002). Callers expressed a willingness to pay if the service could be customized to suit their information needs. Consumer response to purchasing

travel information services seemed cost-sensitive, but the demand for information was relatively inelastic for travelers making longer trips. Trip characteristics and personal attributes seemed to play an important role in information acquisition, use and willingness to pay. People who experience longer trips with greater travel time uncertainty and those who are younger and male seem to desire dynamic information. Higher willingness to pay for travel information received via telephone was associated with preference for customized travel information, longer trips, commuting, and listening to radio traffic reports. Fee-based information services are likely to be more successful in situations where the demand for information is relatively inelastic and improvement or customization of travel information is achievable.

V. SUMMARY AND CONCLUSIONS

Understanding traveler response to new technologies is at the core of knowing which innovative traveler information systems will be successful. We described the traveler response results using TravInfo® evaluation surveys, providing some answers to the following questions:

How do people access and use travel information? In the Broad Area survey, the results show that 100% of the respondents accessed or owned at least one device (on average about 4 devices), 66.4% of all respondents received travel information either regularly or occasionally, and 33.1% changed their travel decisions in response to that information. The main reason cited by those not seeking dynamic information was that it was not relevant to their travel patterns. The findings about access and ownership of information sources and about acquisition and use of travel information suggest that a significant gap exists between access and use. Also, decisions about access and ownership of information sources and about acquisition and use of travel information themselves should be analyzed explicitly in planning for advanced traveler information systems.

What sources of information do people access? The Broad Area surveys indicate that most travelers received some form of dynamic traffic information. Radio and, to a lesser extent, television, were the prevalent media through which information was obtained. Respondents used a variety of information sources to obtain travel information during the pre-trip as well as en-route stages, with cellular phones and the Internet representing important future growth markets; their use increased substantially during the TravInfo® test.

What type of information do people desire? The Broad Area surveys indicated that the most desirable types of information in order of desirability are: frequent updated traffic conditions on radio or television, detailed information about alternate routes around congestion, in-car navigational computer showing highways and roads, estimation of the time of delay and directions to get from the point of departure to the point of arrival, information about traffic conditions at specific locations, information about mass transit alternatives, and automatic notification of unexpected traffic congestion. The results also suggested that the relevance of travel information is very important to travelers, both in

making the decision to acquire travel information, and in changing their actual travel decisions.

What travel decisions do people change in response to information? Dynamic information seekers who called TravInfo® TATS or accessed dynamic information on the TravInfo®-supported Internet websites were more inclined to change their travel decisions compared with Broad Area respondents, as expected. Clearly people who are pre-disposed to changing their travel decisions will seek out information from new sources implying simultaneity in their access and change decisions, which needs to be investigated further. Those who changed travel plans due to dynamic information were more inclined to change routes and then departure times. Mode changes and trip cancellations were rare, as expected.

Why is information important to travelers? Saved travel time and help with travel planning were the key perceived benefits of dynamic information. Interestingly, a reduction in anxiety was also cited by many respondents as a perceived benefit. Respondents demanded high-quality information, and some are willing to pay for premium information services. While the new information services and media seem to suffer from a lack of publicity, they seem to appeal to information seekers and early adopters.

Are travelers willing to pay for dynamic information? There seems to be significant (latent) demand for personalized information services that would allow users to retrieve information when needed, to the point where a significant number of Bay Area travelers stated they would be willing to pay either on a per-call basis or a monthly subscription fee for a customizable service. However, the new information must be superior to the information that can be obtained for free through radio or television or other Internet outlets and services. The benefits from new information technologies may be limited due to competition with existing information sources such as the radio and television (but these benefits are likely to improve incrementally over time).

Empirical evidence suggests that information helps travelers to switch routes and departure time. The potential for information benefits is perhaps higher in cases of unexpected incidents. However, only one-third of the Target survey respondents changed their travel decisions in response to the incident. While this is a significant number in terms of demand reduction due to information, perhaps the full benefits of dynamic information are not realized because the quality of information available in just such situations is relatively low. New information media can focus on variables that are sensitive to travel-time uncertainty in order to improve the quality of information in high-uncertainty situations.

REFERENCES

Al-Deek, H., Martello, M., May, A., and Sanders, W. (1988) "Potential Benefits of In Vehicle Information Systems in a Real Life Freeway Corridor Under Recurring and Incident Induced Congestion." PATH Research Report UCB-ITS-PRR-88-2, Institute of Transportation Studies, University of California, Berkeley.

Ben-Akiva M., J. Bowman, and D. Goupta, (1996) Travel demand model system for the information era, *Transportation*, Vol 23, pp. 241-266.

Ben-Akiva, M. E., Bottom, J., and Ramming, M. S. (2000) "Route Guidance and Information Systems." Prepared for *Journal of Systems and Control Engineering*, Special Issue on Road Traffic Modelling and Control. Markos Papageorgiou and Christina Diakaki, eds.

Boyce, D. (1988) "Route guidance systems for improving urban travel demand and location choice." *Transportation Research,* 22A, 2X-281.

de Palma, A. (1998) Individual and collective decision making: Application to travel choice, *Theoretical Foundation of Travel Choice Modeling*, T. Garlang T. Laitila and K. Westin (Ed), Pergamon Press, pp. 33-50.

Golledge, R., and Stimson, R. (1987) *Analytical Behavioral Geography*. Croom Helm, New York.

Heathington, K. (1969) "On the Development of a Freeway Driver Information System." Unpublished Ph.D. Dissertation, Civil Engineering Department, Northwestern University, Evanston, IL.

Khattak A. (1991) "Driver Response to Unexpected Travel Conditions: Effect of Information and Other Factors." Unpublished Ph.D. Dissertation, Department of Civil Engineering, Northwestern University, Evanston, IL.

Khattak A., J. Schofer, and F. Koppelman, (1993) "Commuters' en-route diversion and return decisions: Analysis and implications for Advanced Traveler Information Systems," *Transportation Research*, Pergamon Press, Vol. 27A, No. 2, pp. 101-111.

Khattak, A. J., and Khattak, A. J. (1998) "A Comparative Analysis of Spatial Knowledge and En-Route Diversion Behavior Across Chicago and San Francisco: Implications for ATIS." *Transportation Research Record 1621*, pp. 27-35, Transportation Research Board, National Research Council, Washington D.C.

Khattak, A. J., Yim, Y., and Stalker, L. (1999) "Does travel information influence commuter and noncommuter behavior? Results from the San Francisco Bay Area

Travinfo project." *Transportation Research Record 1694*, pp. 48-58, Transportation Research Board, National Research Council, Washington D.C.

Khattak, A., Yim Y., and Stalker L. (2002) "Willingness to pay for travel information: Combining revealed and stated preferences with a random effects negative binomial model," Forthcoming in *Transportation Research-Part C*, Pergamon Press.

Koo. R., Yim Y., and Hall. R. (1998) "TravInfo Evaluation Traveler Response Element: the Target Study, Phase 1 Results," California PATH, UCB-ITS-PWP-98-24, University of California, Berkeley, September 1998.

Koo, R., and Yim. Y. (2000) "TravInfo Evaluation Traveler Response Element: The Target Study, Final Results," California PATH, UCB-ITS-PWP-2000-3, University of California, Berkeley, March 2000.

Koo. R., and Yim. Y. (2001) "TravInfo Evaluation Traveler Response Element: TravInfo 817-1717 Caller Study Phase 2 Results," California PATH, UCB-ITS-PWP-2001-07, University of California, Berkeley, 2001.

Liu Y., and Mahmassani H. (1998) "Dynamic Aspects of Departure Time and Route Decision Behavior Under Advanced Traveler Information Systems (ATIS): Modeling Framework and Experimental Results." Presented at the 77th Annual Meeting of the Transportation Research Board, Washington, DC.

Mahmassani, H., and Chang, G. L. (1985) "Dynamic aspects of departure time choice behavior in a commuting system." *Transportation Research Record,* 1037, 88-101.

Mahmassani, H. S., and Jayakrishnan, R. (1991) "System Performance and User Response Under Real-Time Information in a Congested Traffic Corridor." *Transportation Research*, 25A, 5, 293-307.

Miller. M., and Loukakos. D. (1998) "TravInfo Evaluation (Technology Element) Traveler Information Center (TIC) Study: *System Reliability and Communications Interface (9/96 –12/97*)", California PATH, UCB-ITS-PWP-98-21, University of California, Berkeley, September 1998.

Miller. M., and Loukakos. D. "Final Report for TravInfo Evaluation (Technology Element) Traveler Information Center (TIC) Study," to be published PATH Research Report.

Polydoropoulou, A., Ben-Akiva, M., Khattak, A., and Lauprete, L. (1996) "Modeling revealed and stated en-route travel response to advanced traveler information systems." *Transportation Research Record 1537.*

Ramming. S. M. (2002) “Network Knowledge and Route Choice”, Department of Civil and Environmental Engineering, Massachusetts Institute of Technology. Ph.D. Dissertation.

Schofer, J., Khattak, A., and Koppelman, F.S. (1993) “Behavioral Issues in the Design and Evaluation of Advanced Transportation Information Systems.” *Transportation Research C*, Vol 1, No. 2. pp. 107-117.

Simon, H. (1979) *Models of Thought*. Yale University Press, New Haven.

Srinivasan. K. K., Mahmassani. H. S. (2002) “Trip time Perception and Judgment Processes in Tripmaker Decisions under Real-time Traffic Information.” Presented at Transportation Research Board, 81st Annual Meeting. Washington, D.C., CD ROM.

Targa, F., Khattak, A. J., Yim, Y.B. (2002) “Understanding access and use of dynamic travel information.” Working paper.

Tversky A., and Kahneman D. (1974) “Judgments under uncertainty, heuristics and biases.” *Science*, 185, 1124-l 131.

Wenger, M., Spyridakis, J., Haselkom, M. D., Bartield, W., and Conquest, L. (1990) “Motorist behavior and the design of motorist information systems.” *Transportation Research Record,* 1281, 159-167.

Wolinetz, L., Khattak A., and Yim. Y. (2001) “Why will some individuals pay for travel information when it can be free? Analysis of a Bay Area travel survey.” *Transportation Research Record*, 1759, TRB, National Research Council, Washington, D.C.

Yim,Y., Hall. R., and Weissenberger. S. (1997) “TravInfo Evaluation Traveler Response Element: the Broad Area Study, Phase 1 Results,” California PATH, UCB-ITS-PWP-97-9, University of California, Berkeley, March 1997.

Yim. Y., Hall. R., Koo. R., and Miller. M. (1998) “TravInfo Evaluation: TravInfo 817-1717 Caller Study Phase 1 Results” California PATH, UCB-ITS-PWP-98-25, University of California, Berkeley, September 1998.

Yim. Y. (1999) “Consumer Response to Advanced Traveler Information Systems: Focus Group Results,” ITS America, 9th Annual Meeting Conference Proceedings, April 19-22, 1999.

Yim. Y. (2000) “TravInfo Evaluation: Information Service Provider Study – Traffic Web Site Users and Their Travel Behavior,” California PATH, UCB-ITS-PWP-2000-5, University of California, Berkeley, May 2000.

Yim, Y. (2000) “TravInfo Evaluation Traveler Response Element: the Broad Area Study, Phase 2 Results,” unpublished working paper.

Yim, Y., Khattak, A. J., and Raw J. (2002) “Traveler response to new dynamic information sources: analyzing corridor and area-wide behavioral surveys.” Forthcoming in *Transportation Research Record*.

Yim. Y., and Miller. M. A. (2002) “Evaluation study of the TravInfo® regional transportation information system.” Presented at Transportation Research Board, 81st Annual Meeting. Washington, D.C., CD ROM, 2002.

Figure 1: Conceptual model of traveler behavior.

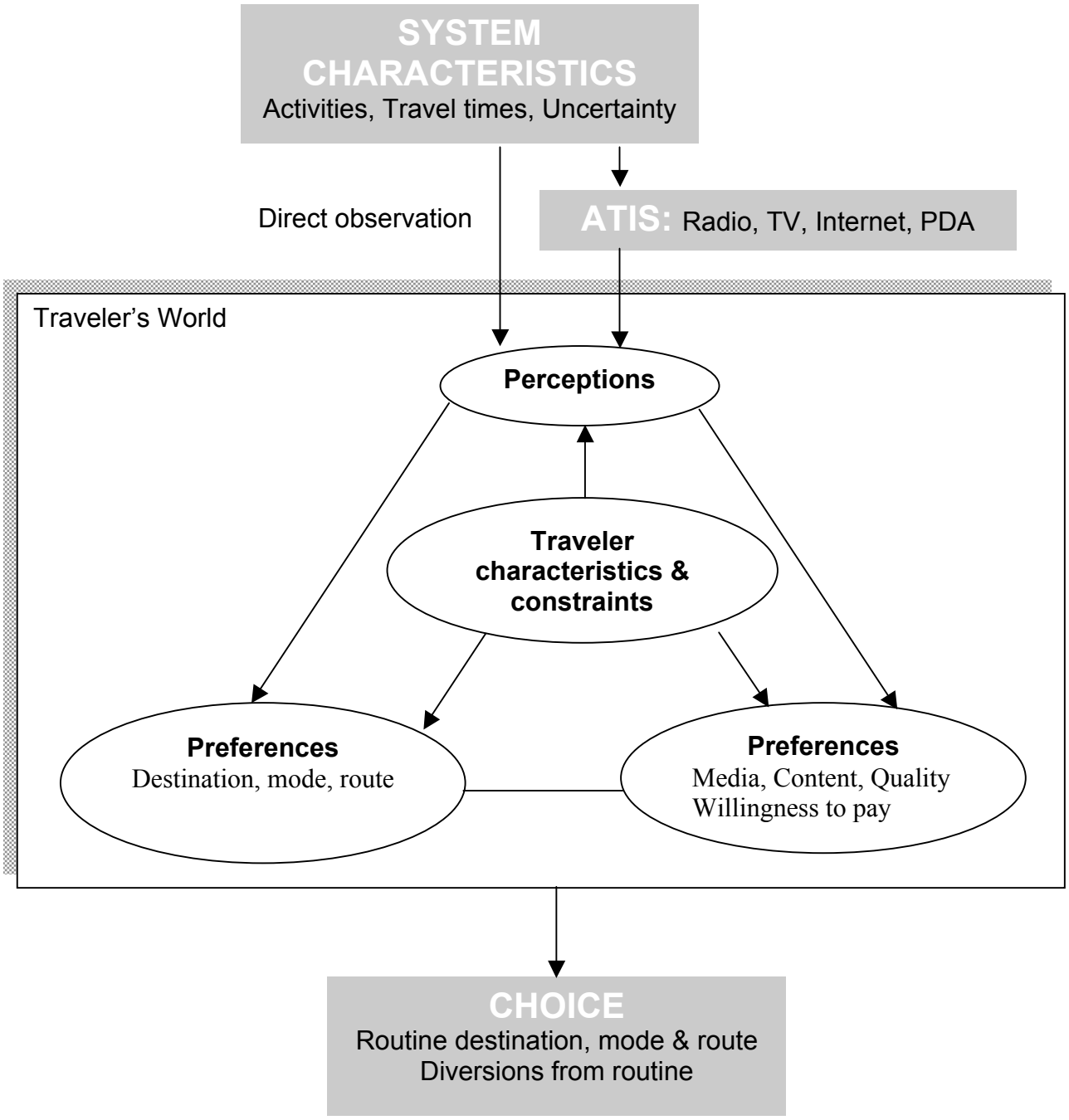
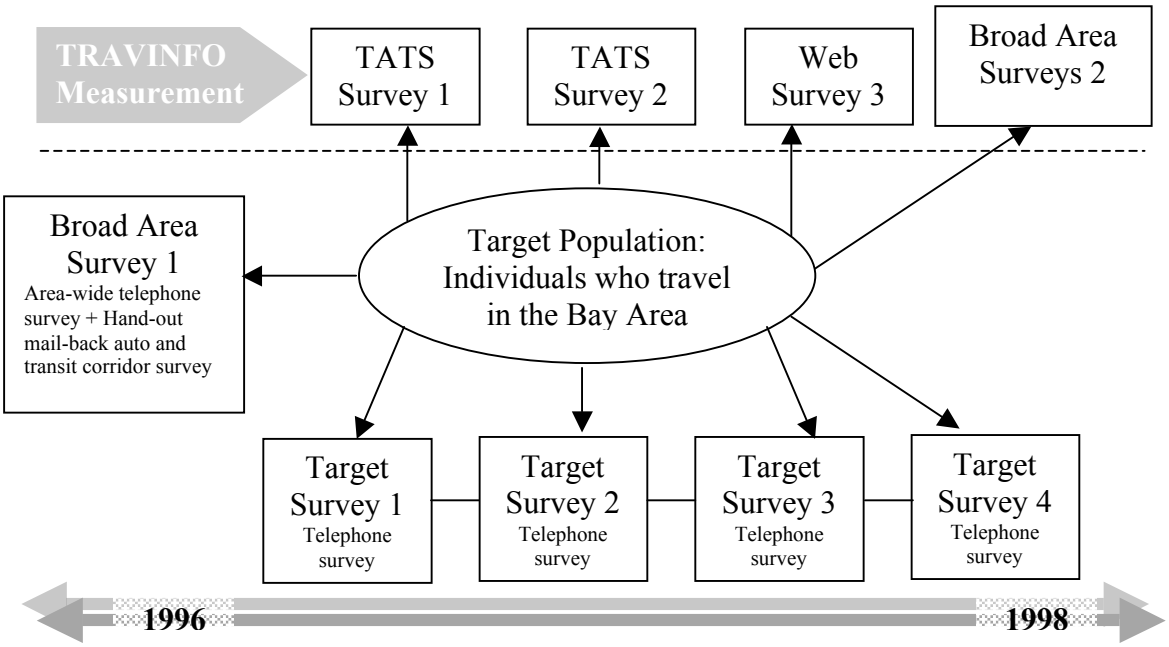


Figure 2. TravInfo Traveler Behavior Surveys



NOTES:
TATS = Traveler Advisory Telephone System
Target Surveys = Responses of a panel in the Bay Area I-580 corridor after the occurrence of a major incident.

TABLE 1: Selected Survey Results—automobile users

	BAS1	BAS2	Target	TATS 1	TATS 2	ISP
1.1 Users of dynamic information (freeway drivers)						
Regular [a]	33%	36%	N/A	80%	85%	64%
Occasionally	34%	38%	N/A	20%	15%	36%
Never	33%	26%	N/A	N/A	N/A	N/A
1.2 Source from which information was obtained (pre-trip)						
Radio	54%	30%	47%	N/A	N/A	N/A
Television	23%	22%		N/A	N/A	N/A
Telephone	19%	18%	N/A	69%	53%	N/A
Internet	1%	4%	N/A	N/A	N/A	100%
Cell Phone	N/A	N/A	N/A	N/A	N/A	N/A
1.3 Source from which information was obtained (en route)						
Radio	68%	48%	45%	N/A	N/A	N/A
Cell Phone	1%	2%	N/A	31%	47%	N/A
1.4 Reasons for not seeking information						
Do not listen	18%	18%	N/A	N/A	N/A	N/A
Info not relevant	55%	47%	N/A	N/A	N/A	N/A
No alternatives	5%	17%	N/A	N/A	N/A	N/A
Unreliable	2%	8%	N/A	N/A	N/A	N/A
Incomprehensible	2%	1%	N/A	N/A	N/A	N/A
Not sure	18%	9%	N/A	N/A	N/A	N/A
1.5 Travelers who changed plans due to information [b]						
Any Change	30%	53%	34%	48%	56%	84%
No Change	70%	47%	66%	52%	44%	16%
1.6 Types of travel decision changes (by travelers who changed plans (multiple response permitted)						
Departure Time	44%	44%	55%	16%	13%	37%
Route	71%	71%	70%	33%	29%	~50%
Mode	10%	10%	9%	1%	11%	1%
Cancel Trip	10%	2%	N/A	4%	6%	7%
1.7 Perceived benefits from dynamic information (multiple response permitted)						
Saves Time	21%	23%	15%	31%	23%	10%
Reduces Anxiety	18%	22%	24%	4%	3%	5%
Travel Plan	35%	49%	26%	53%	33%	24%
Other/Unsure	26%	6%	35%	12%	41%	27%
General Benefit	N/A	N/A	N/A	N/A	N/A	34%

[a] "Regular" in Broad Area means those who acquire information most of the time when they travel. "Regular" in TATS survey means at least once a week. "Regular" in ISP means at least once a week.

[b] Broad Area studies only considered travelers who changed decisions based on pre-trip information.