Customer Preferences for Transit ATIS: Research Report

PREPARED FOR:

Federal Transit Administration
U.S. Department of Transportation
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FOREWORD

This document, *Customer Preferences for Transit ATIS: Research Report*, presents the results of a research study of public preferences for transit information that were obtained from surveys and discussion groups conducted in 12 workshops held in four metropolitan locations across the United States. It examines what kinds of information transit customers prefer, their preferred information delivery method, and where in the course of their trip the information is needed, including pre-trip planning, at the wayside, and on board the transit vehicle. It also addresses preferred formats for the presentation of information and draws inferences from the data that may be helpful to transit agencies for the design of traveler information systems.

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Prepared for:

Federal Transit Administration
U.S. Department of Transportation
Washington, DC 20590

by:

Battelle Memorial Institute
&
Multisystems, Inc.

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13. ABSTRACT (Maximum 200 words)

This research report presents findings from 12 workshops in 4 metropolitan areas with 284 transit customers conducted in November 2002 to address the following questions:

- What kinds of transit information do customers want and expect the agencies to provide?
- Where should the information be made available to transit travelers?
- Which delivery system do the users prefer?
- When should the information be made available to be most useful to transit travelers?
- What are the critical human factors issues in presenting and displaying transit information?

The Federal Transit Administration is particularly interested in what transit riders prefer regarding high technology types of information services. Through this research, the FTA is seeking insight and more detailed guidance. The results indicate riders prefer traditional forms of paper-based information and traditional wayside signage (e.g., schedules, maps, and fares). Inaccurate information was perceived as worse than no information, and high-quality traditional forms of information were considered more important than high technology approaches. Awareness of advanced transit information services was low, even in areas where they are available, suggesting that transit agencies need to promote their existing information services more. Guidelines derived from this research will be provided in a separate report.

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EXECUTIVE SUMMARY

Background. The Federal Transit Administration (FTA), in support of the DOT mission to create "a safer, simpler and smarter national transportation system for all Americans," is focusing research on the needs of their main customers, the transit riders. The FTA believes that more effectively targeting and presenting transit information, both static and real-time, can significantly help meet the DOT mission. A recent Transit Cooperative Research Program report on new paradigms for local public transportation organizations asserts "information technology ... provides the single greatest opportunity to enhance the quality of the travel experience" (TCRP, 2000). The FTA recognizes that transit customers today expect more and better information from their local transit agencies that can assist them in their transit and multi-modal trip making. In addition to making the transit experience of current users comfortable and convenient, it is hoped that better information will contribute to the satisfaction of customers, who will choose transit more often and remain as committed transit riders for longer periods, and perhaps attract new riders who are otherwise reluctant to venture onto public transit. The FTA is looking to the findings from this research study to offer transit agencies practical guidance for making effective, and desired, improvements in their provision of information to their customers.

Research Objectives. The FTA initiated this research effort by starting with the transit customers themselves to seek answers to the following questions:

- What kinds of transit information do customers want and expect the agencies to provide?
- Where should the information be made available to transit travelers?
- Which delivery system do the users prefer?
- When should the information be made available to be most useful to transit travelers?
- What are the relevant human factors issues in providing transit information?

These questions have been addressed through a series of 12 workshop sessions, covering 284 participants, both through surveys of customer opinions and preferences, and qualitative discussions with customers, conducted at four locations across the country. A set of practical implications derived from this research will be presented, either separately in a guidance brochure or on the FTA's web site, for transit agencies as they consider how best to improve the provision and communication of information to their customers.

The FTA is particularly interested in understanding the extent to which transit agencies are currently trying innovative, advanced ways of offering information to their ridership, especially real-time information, and how current transit riders are using high technology tools to access this transit information. These tools might include the Internet; handheld devices such as cellular telephones, pagers, and personal digital assistants (PDAs) or other wireless communication devices; and advanced real-time signs and announcements. Through the conduct of this research, the FTA is seeking insight and more detailed guidance regarding what information public transportation customers say they want.

Research Method. To meet these research objectives, this study covered the full range of information preferences of transit customers, and sought to understand their expressed needs in terms of where particular kinds of information were important, how customers preferred to obtain that information, and how information preferences varied depending on whether the

transit trip was familiar or unfamiliar to the traveler. Furthermore, the research sought to understand how information preferences varied by characteristics of the traveler (gender, age, transit experience, transit dependency, attitudes) and the context of the transit system (e.g., bus/rail, size, and information technology availability).

This research constitutes an exploratory study of customer information needs, based on the stated preferences of a self-selected set of transit riders and non-riders across the country. It is looking for patterns in customer information preferences across user types, trip types, and agency context. It seeks to distinguish essential information preferences from less critical information preferences, and explores in a very preliminary way such human factors elements as the form and format in which customers say they like to access information. This study offers a foundation from which guidance can be offered to transit agencies that are struggling with limited funds and competing priorities to decide how they can most effectively meet their customers' information needs. However, there is a large gap between stated preferences and an ability to formulate guidelines, and this gap can only be filled by additional controlled research.

Agreements were reached with four transit agencies to hold three workshops during November 2002 in each of four metropolitan areas: Seattle (WA), Salt Lake City (UT), Columbus (OH), and Providence/Kingston (RI). A total of 284 participants were recruited with aid from transit agencies for participation in 12 two-hour workshop sessions. Each session included a background survey of participant characteristics and travel and technology attitudes, a tutorial that provided an overview of the delivery methods for obtaining different types of transit information, a survey of participants' transit information preferences for both familiar and unfamiliar transit trips, and breakout discussion groups in which participants had an opportunity to provide details about their information preferences in light of their specific transit travel experiences. Findings and conclusions were drawn from the survey data and group discussions and include a description of information preferences organized around three location/time circumstances in the course of both familiar and unfamiliar transit trips: pre-trip planning, wayside, and on-board preferences.

In addition to asking the workshop participants *what* information they wanted, *where* in their trips they wanted to have access to this information, and *how* they wanted to get the information, the surveys asked them to think in terms of information that they considered essential to their trip-making versus information that was not essential but would be nice to have. Then, recognizing that information preferences are likely to vary considerably by how familiar they are with the transit system and the particulars of their trip, the questions were asked in the context of a usual or familiar trip as well as for an unusual or unfamiliar trip.

Research Findings. Figures ES-1 and ES-2 illustrate the patterns of information classified as ***essential*** by the workshop participants in the preference survey, for use in their ***pre-trip*** planning, and at the ***wayside***, respectively, for an ***unfamiliar*** trip. The three-dimensional charts are intended to illustrate general patterns in the data, while the table below each chart provides values for each of the data points in the chart. There are several items of particular interest in these example charts showing the percent of participants selecting various combinations of information preferences by type, location, and access mode.

- For pre-trip planning purposes, the highest preferences were for timetables.
- Traditional or static forms of information were preferred over real-time information for pre-trip planning.
- The two predominant ways transit customers preferred to obtain pre-trip information is in printed form (such as a schedule you can take with you) and via computer (such as Internet or e-mail).
- Trip time forecasts were the most preferred kind of real-time pre-trip information.
- Although not illustrated by these two charts (but shown in the report), pre-trip information needs were much greater when planning an unfamiliar trip than a familiar trip.
- The telephone was third in order of preferred ways to obtain both static and real-time transit information behind printed and computerized.
- The overall level of preference for information while at the wayside was substantially less than for pre-trip planning. Once a transit trip is initiated, the options narrow and the traveler has most of the information he/she wants. As is shown in Figure ES-2, the preferences for information at the wayside focus mostly on real-time information that was preferred to be accessed via electronic message signs or video monitors.
- At the wayside, in addition to real-time information types, static information printed on paper or on signs at the transit stop was also considered essential by many riders, and primarily includes schedules, route maps, and fares.

These points are a selection of the more prominent survey results. In addition to describing information preferences under a variety of transit travel conditions, the overall customer preference data also were examined in terms of the preferences of segments of riders, such as older versus younger, frequent versus infrequent transit users, use versus non-use of high tech communication devices, and a range of attitudes toward technology, transit riding, and information use. Findings from these analyses are documented in the body of the report.

Some Practical Implications. Among these workshop participants, there was a widely held preference for traditional forms of paper-based information and traditional wayside signage (e.g., timetables, maps, and fares). Transit agencies need to make sure that these are widely and easily available to transit users and that the information is both accurate and up-to-date. Inaccurate information was perceived as worse than no information, and high-quality traditional forms of information were considered more important than new high technology approaches.

Many participants were concerned that introducing new advanced information technologies could result in fare increases or service reductions. This belief was held more often by transit-dependent, lower-income participants. While participants acknowledge the benefits of real-time information and recognize that these technological approaches to disseminating and accessing transit information are likely the wave of the future, they pointed out that many passengers cannot afford the computers or PDAs that they would need to access that information.

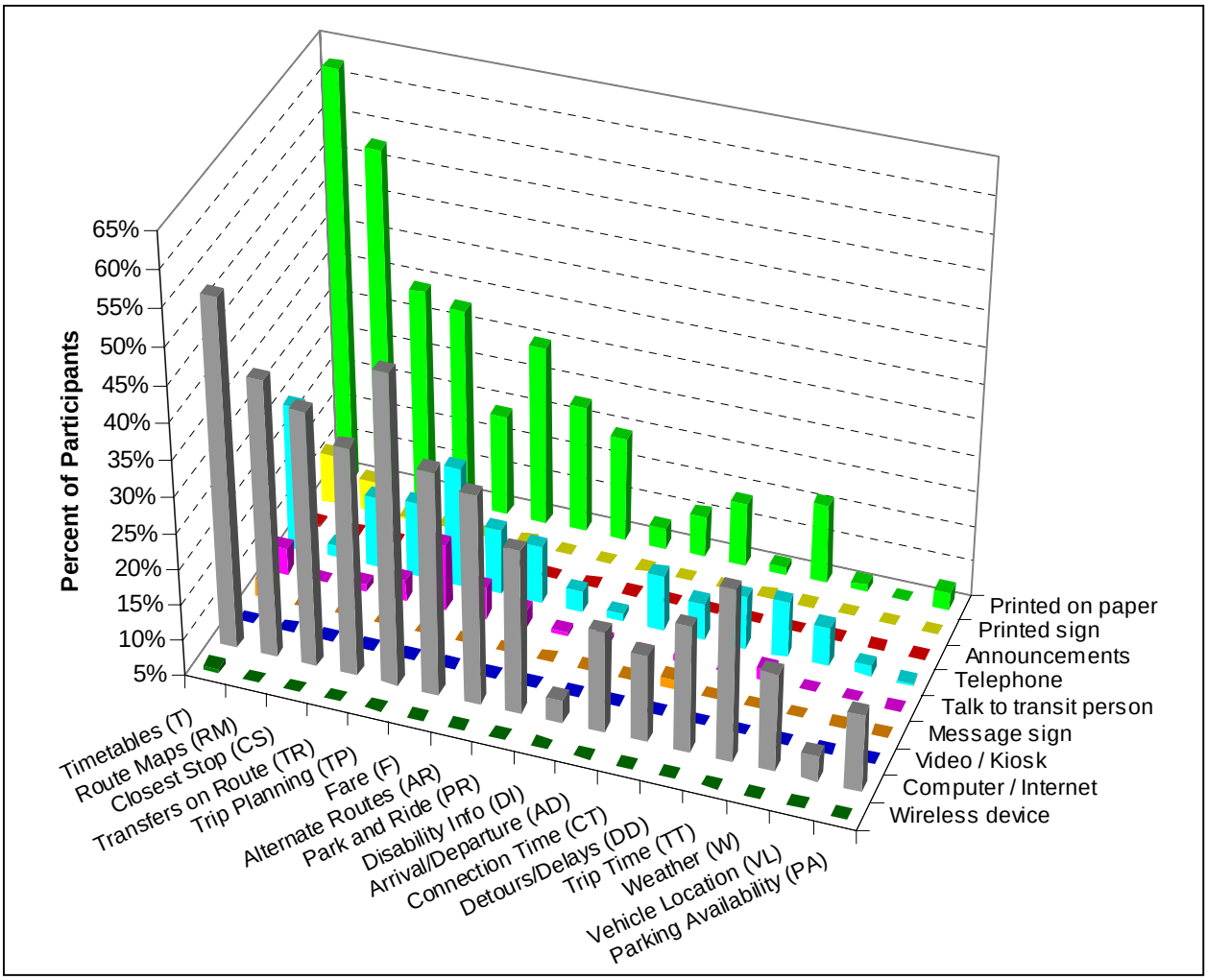
Participants ideally would like to have both static and real-time information available at all wayside locations, but they recognize that the costs are likely to be prohibitive. They suggested options that they thought were lower cost, such as using smaller electronic message signs with abbreviated words that would take less space without confusing people, or installing these

systems only in the most important locations, while upgrading the less-used wayside locations with better traditional forms of information. One suggestion shared by many in these workshops was to provide accurate time-keeping at all waysides and free telephone access to transit agencies (where you just pick up a dedicated phone and are connected), preferably with a live person rather than an automated touchtone or voice response phone information systems.

On board the transit vehicle, participants expressed the greatest interest in information on where to get off the bus and the current location of the bus along its route. Preferred solutions included automatic updating message signs and auditory announcements, indicating proximity of the next two stops. Automated announcements were preferred over driver announcements for both consistent understandability and to allow the driver to concentrate on driving. Some participants suggested providing a linear route map in the bus that included lights to indicate the bus' current position along its route.

Many of the workshop participants said they were not even aware that their transit agency offered some of the more advanced information services, particularly real-time information such as Internet-based trip planners, various wireless communication capabilities, or video applications. There appeared to be several reasons for this. First, many transit users lack the personal communication technologies or the computer facilities and skills to comfortably access the newer forms of information services. Second, transit agencies are slowly introducing some of these new capabilities, and they are typically available only at selected transit centers for selected routes. As a result, not all riders are exposed to these systems. Third, transit agencies for a variety of reasons, not the least of which are resources limitations, are not adequately getting the message out to either their current riders or to potential riders (current non-riders) that these informational capabilities are already available. And fourth, there remains much to be done to make these newer capabilities accessible and easy to use. This suggests that a first step might be for agencies to do more to advertise and promote the information sources they are already offering to encourage more widespread use. Making transit information both easy to find and use are equally important to basic awareness building.

Next steps. This study has taken a broad step forward toward learning the information preferences of public transit customers. The research findings and practical implications as outlined in this report will be made readily available to transit agencies around the country. In addition, they provide a solid foundation for identifying and implementing future research projects that will help the FTA accomplish its goal of better understanding the information preferences of its primary customer – the transit rider.



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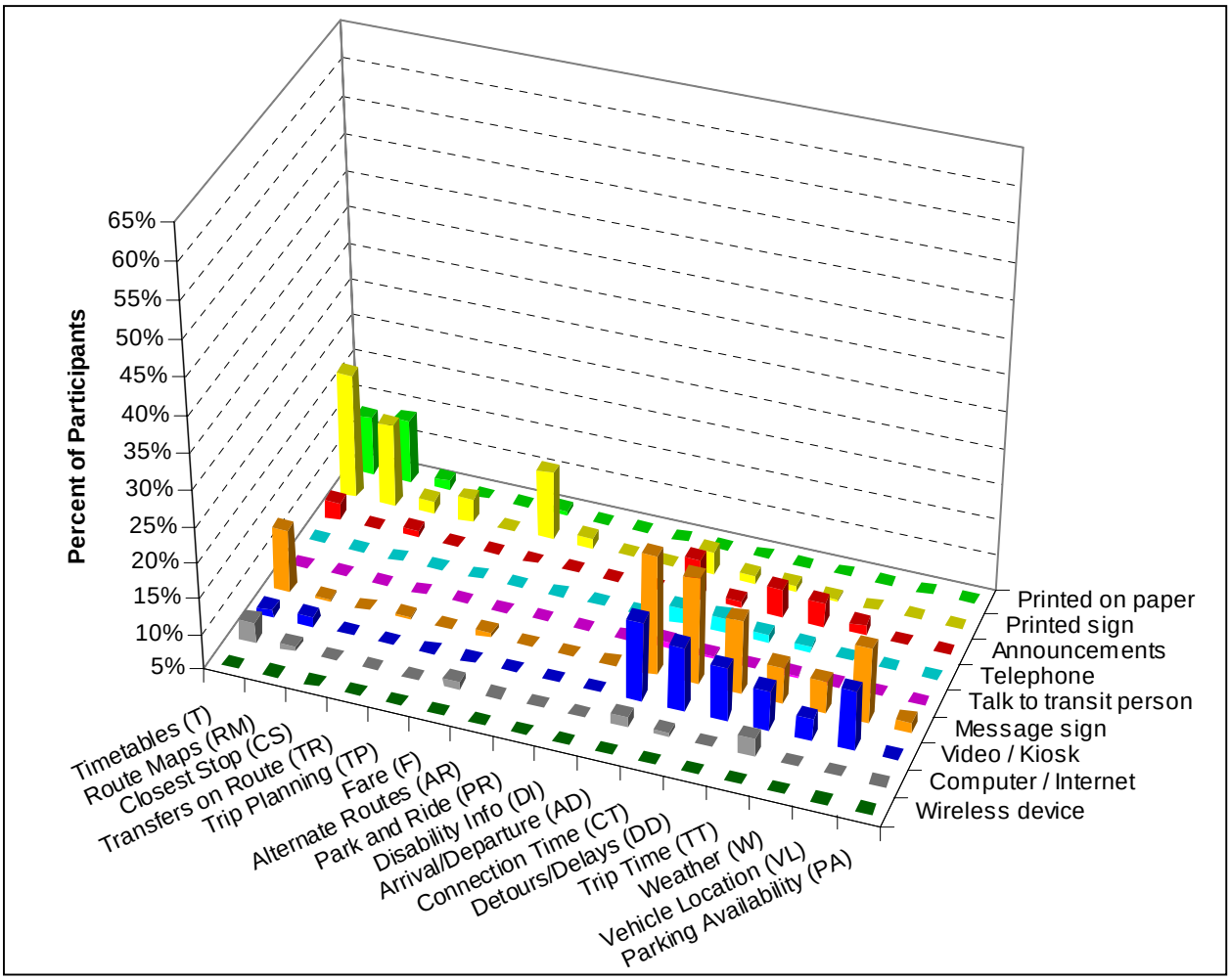
Printed sign	12.0	9.4	5.2	4.9	1.9	5.2	4.1	4.5	4.1	4.1	3.0	2.6	3.7	1.9	1.9	2.2
Announce-ments	5.2	1.5	1.1	1.9	0.7	1.5	0.4	2.2	0.7	3.7	2.6	3.7	3.4	2.2	1.5	1.5
Telephone	25.5	6.7	15.0	15.4	21.7	14.2	13.1	7.9	6.0	12.7	10.1	12.4	12.7	10.5	6.4	5.2
Talk to transit person	8.6	4.5	6.0	7.9	14.2	9.4	7.5	5.6	5.6	4.1	6.0	3.7	6.7	4.9	3.0	3.4
Message sign	7.5	3.7	4.1	3.0	1.9	2.6	2.2	2.2	2.6	4.9	6.4	4.9	4.9	3.4	3.7	3.4
Video / Kiosk	4.1	4.5	0.7	1.1	1.5	3.0	1.5	1.1	1.9	3.7	4.5	4.5	3.4	2.6	2.2	1.9
Computer / Internet	53.2	43.4	40.4	36.7	47.9	36.0	34.1	27.7	8.2	19.1	17.2	22.5	28.8	18.7	8.6	15.7
Wireless device	5.6	3.4	2.2	1.9	1.9	3.0	2.2	2.6	1.5	3.7	2.6	3.7	3.7	3.7	1.9	1.9

Figure ES-1. Percent of participants who classified information types as Essential, by preferred delivery system for each type, for Unfamiliar transit trips: Pre-trip.



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Printed sign	22.5	16.5	6.7	8.2	1.5	14.6	6.4	3.0	3.7	8.2	6.0	6.0	5.2	2.2	3.0	2.2
Announce-ments	7.5	3.7	6.0	4.9	1.9	2.6	3.4	2.6	2.2	10.5	6.0	9.0	8.2	6.4	4.5	2.2
Telephone	5.2	1.1	3.0	3.7	2.6	1.9	2.2	1.9	2.2	7.1	7.1	6.0	5.6	3.4	4.9	2.2
Talk to transit person	3.0	2.2	1.9	3.0	1.9	1.5	2.6	1.5	2.6	6.0	5.2	3.7	5.2	2.6	3.4	2.2
Message sign	13.9	5.2	4.9	5.2	1.5	5.6	4.5	3.4	3.0	21.7	19.9	15.4	10.1	9.4	15.4	6.4
Video / Kiosk	6.0	6.4	2.2	2.6	3.4	3.4	4.5	1.1	1.9	16.1	13.9	12.4	10.5	7.9	13.1	2.2
Computer / Internet	7.9	5.6	3.4	2.6	3.0	6.0	4.1	1.9	1.9	6.4	5.6	4.9	7.5	4.1	3.4	3.4
Wireless device	3.7	1.9	2.2	1.5	1.9	1.5	1.9	1.1	1.1	4.5	3.0	4.1	3.7	3.7	3.4	1.9

Figure ES-2. Percent of participants who classified information types as Essential, by preferred delivery system for each type, for Unfamiliar transit trips: Wayside.

1.0 INTRODUCTION

The U.S. Department of Transportation (DOT)'s mission is to create "a safer, simpler and smarter national transportation system for all Americans."[1] The DOT's fiscal year 2004 budget request includes funding for each of the DOT modal agencies, including the Federal Transit Administration (FTA), "giving states and localities additional flexibility to meet mobility needs in their communities." This broad language reflects a new orientation of government that is focusing on the customer, in this case the traveler, and seeking ways to better meet his or her needs. At the same time the FTA recognizes that these needs vary community by community across the country, and therefore are best met by decentralizing responsibility and resources to local authorities to the extent possible. Consistent with this orientation to meeting customer needs, the FTA is supporting the research presented in this report that seeks to better understand the information preferences of its primary customer – the transit rider.

Can the provision of improved transit information significantly contribute to a safer, simpler and smarter public transportation system? A recent Transit Cooperative Research Program report on new paradigms for local public transportation organizations asserts "information technology ... provides the single greatest opportunity to enhance the quality of the travel experience."[2] The FTA recognizes that transit customers today expect more and better information from their local transit agencies that can assist them in their transit and multi-modal trip making. The leading transit agencies are offering more and better quality information – more useful, more accessible and convenient, more understandable, more comprehensive, and more reliable. In addition to making the transit experience of current users comfortable and convenient, it is hoped that better information will contribute to satisfied customers who will choose transit more often and remain as committed transit riders for longer periods, and perhaps will also attract new riders who otherwise are reluctant to venture onto public transit. The FTA is looking to the findings from this research study to offer transit agencies practical guidance for making effective, and wanted, improvements in their provision of information to their customers.

ENDNOTES

1. *Fiscal Year 2004 DOT Budget Requests $54.3 Billion For Safer, Simpler, Smarter Transportation System.* DOT 11-03. February 3, 2003 [On-line] Available at: http://www.dot.gov/affairs/dot01103.htm

2. TCRP, 2000. *New Paradigms for Local Public Transportation Organizations.* Transit Cooperative Research Program Report 58. Task 5 Report: Opening the Door to Fundamental Change. Washington, DC: National Academy Press.

2.0 RESEARCH OBJECTIVES

An underlying premise of this research is that better quality information will contribute to a better travel experience for transit travelers and thereby increase customer satisfaction with public transportation. The components of quality information include more reliable information on transit services and schedule adherence, more timely information, information that is accessible when and where it is wanted, and information provided in a form that is easy to understand. The FTA initiated this research effort by starting with the transit customers themselves to seek answers to the following questions:

- What kinds of transit information do customers want and expect the agencies to provide?
- Where should the information be made available to transit travelers?
- Which delivery system do the users prefer?
- When should the information be made available to be most useful to transit travelers?
- What are the critical human factors issues in presenting and displaying transit information?

These questions were addressed in this research project through a series of 12 workshop sessions, covering 284 participants, both through surveys of customer opinions and preferences, and qualitative discussions with customers, conducted at four locations across the country. The participants were selected to reflect a diversity of traveler types, geographic settings, agency service characteristics, and other factors believed to affect customer desires and expectations for transit information. They were predominantly transit riders, of varying transit experience, and included a smaller number of non-riders as well.

The FTA is particularly interested in understanding the extent to which transit agencies are currently trying innovative, advanced ways of offering information to their ridership, especially real-time information, and how current transit riders are using high technology tools to access this transit information. These tools might include the Internet; handheld devices such as cell phones, pagers, and personal digital assistants (PDAs) or other wireless communication devices; and advanced real-time signs and announcements. The DOT understands that today's travelers have increased expectations for more and better information. To improve the transit experience of transit riders, the FTA and state and local transit agencies are attempting to meet customers' information demands in a number of ways, including the use of transit Intelligent Transportation Systems (ITS). However, as pointed out in a recent research report, "real-time customer information about surface passenger transportation options and status remains highly fragmented, if it is available at all (TCRP 2000, p. 15)." Through the conduct of this research, the FTA is seeking insight and more detailed guidance regarding what information public transportation customers say they want.

To meet these research objectives, this study covered the full range of information preferences of transit customers, and sought to understand their expressed needs in terms of where particular kinds of information were important, how customers preferred to obtain that information, and how information preferences varied depending on whether the transit trip was familiar or unfamiliar to the traveler. Furthermore, the research sought to understand how information preferences varied by characteristics of the traveler (gender, age, transit experience, transit

dependency, attitudes) and the context of the transit system (e.g., bus/rail, size, and information technology availability).

The research reflected in this report builds upon growing knowledge and experience as reflected in the current research literature. Less emphasis in this study was placed on the Internet because work has already been done on that topic, including current research now underway (Radin, Jackson, Rosner, & Pierce, 2002). Although some research has been conducted on various aspects of transit information, particularly what information is available and in what forms, very little has been done that explores in depth how transit riders prefer to get that information, and where and when they expect to have access to it. Also, much of the prior research has been conducted at arms length from the end user – the customer – as opposed to systematically seeking to find out directly from the customer what information they want, how they want to get that information, and the relative information priorities for different kinds of transit trips.

This research seeks to begin to fill that gap in knowledge. It is looking for patterns in customer information preferences across user types, trip types, and agency context. However, as is explained later in this report, the research objective *is not* to conduct a scientific inquiry with a nationally representative sample of transit riders or non-riders; rather it *is* to explore in a preliminary way how a broad range of transit riders (and some non-riders) express their preferences for transit information, and to provide a foundation from which recommendations can be offered to transit agencies that are struggling with limited funds and competing priorities to decide how they can most effectively meet their customers' information needs. This research was recommended by the transit community and was listed as a high priority in the FTA's Transit ITS Program Plan. Findings from this research are intended to support the FTA's goal of delivering products and services that are valued by FTA customers.

There are two main products of this research. The first is this report—a human factors research report—that comprehensively describes the research that was conducted to determine customers' preferences for information, and presents detailed data and findings from the research. The second is a final report that will provide practical guidance for transit agencies based on findings from the research. This final report is expected to take the form of a short brochure; alternatively, implications and guidance from this research may be presented on FTA's web site.

3.0 RESEARCH DESIGN

3.1 General Approach

Workshops were held in four sites across the country, and transit riders and some non-riders were recruited, with help from the individual transit agencies, to attend these workshops. These included sites in Rhode Island, Ohio, Utah, and Washington (Figure 1). The workshop locations were selected to reflect variation in geography, modal mix, operational characteristics, and type and variety of ATIS services. More details on these workshop locations are provided in Appendix A. Three workshops were held in each city, some at different locations within the city to increase the diversity of participants and their transit experiences. The objective was to recruit 25 participants for each workshop, resulting in a total sample of about 300 participants across the country.

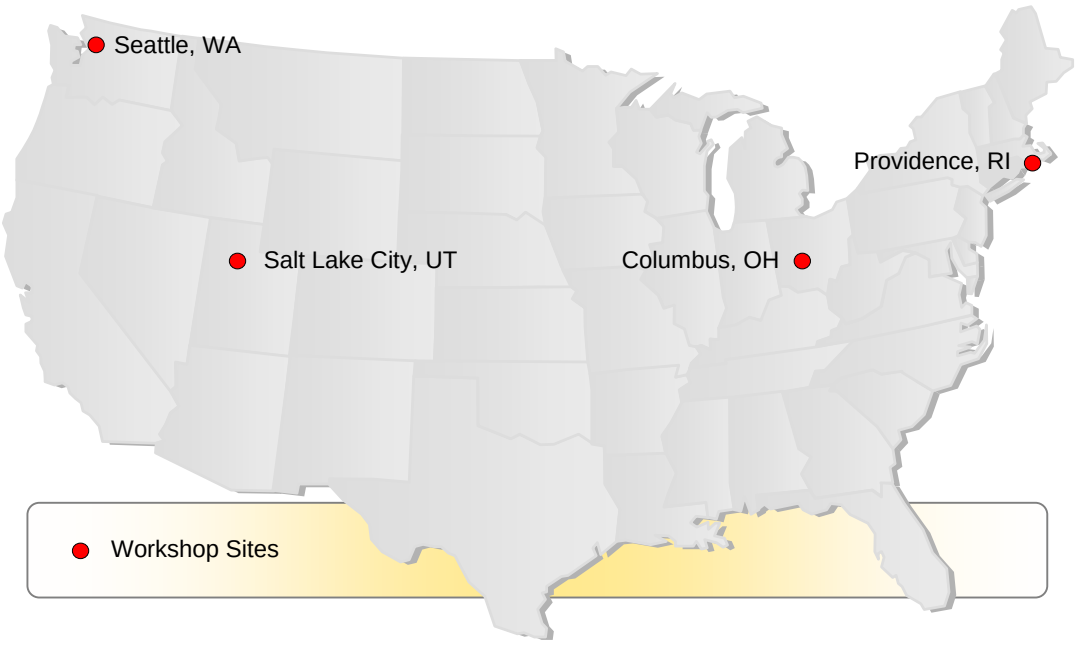


Figure 1. Geographic locations of the four transit information workshops.

The approach to collecting data about what, where, and how transit riders want to get transit information was to follow an objective, written preference survey with focus group-type discussions. In this way collection of both quantitative and qualitative information regarding participants' information preferences was possible. A background questionnaire, administered at the beginning of the workshop, gathered demographic, attitudinal, and transit-related behavioral information about the participants, allowing segmentation of survey responses by participant characteristics. For details regarding the design and administration of workshop materials, see Appendix B.

3.2 Workshop Site Characteristics

Each of the transit agencies at the four workshop sites currently offers a range of static and real-time information services to its customers. Table 1 shows graphically how these services are distributed across the four agencies. Workshop participants were expected to be influenced in their assessment of their preference for information by what they actually experience with the transit systems in their areas. Of course, many travel extensively and talked of their experiences with many different systems in other U.S. cities and even in other countries.

Table 1 mimics the way the workshop participants were surveyed about *what* information they needed and *how* they wanted to get it. As shown in Table 1, the information types (the *what*) are the row headings, and the ways of providing or accessing the information (the *how*) are the column headings. These four agencies currently offer both the traditional, static information services and some of the newer, real-time information services, and some of the agencies are in the process of developing and deploying additional advanced forms of ATIS. Of the more high technology ways of providing and accessing transit information, the Internet has rapidly emerged as a well used and popular medium, but computers and the Internet still mostly convey static information. Electronic message signs, particularly at the transit wayside, are still relatively rare, as is real time information provided over wireless communications or video monitors. Additional data and discussion of the characteristics of these four sites is contained in Appendix A.

Table 1. Information currently offered by transit agencies at each workshop location.

Rhode Island / Ohio / Utah / Washington	Printed on paper		Printed on signs		Dynamic message signs		Announcements		Phone		Talk with a transit person		Wireless device		Computer / Internet		Video monitor	
Timetables / scheduled service changes																		
Route maps																		
Trip planning service																		
Closest stop or station on my route																		
Number/location of transfers on my route																		
Alternate route choice																		
Fare																		
Services for passengers with disabilities																		
Park & ride facilities																		
					1													
Real-time info on arrival/departure times																		
Real-time info on how long trip will take																		
Real-time info on how long I will have to wait for connection																		
Real-time info on where bus/train/ ferry is now																		
Real-time info on impact of weather on my trip																		
Real-time info on short-term detours/delays/problems																		
Real-time info on parking availability at selected locations																		

[1] Utah provided parking information on DMS during the 2002 Olympic Winter Games.

3.3 Participant Recruitment and Screening

Participants were selected for each of the 12 workshops with the assistance of the local transit agencies. The different techniques that were used at each of the sites, including agency lists and contacts with local groups, are described in Appendix C. Recruitment screening criteria were developed in an effort to achieve a balance of participant characteristics, including age, gender, transit dependency, and transit riding frequency (Appendix D). Table 2 shows the numbers of participants in each workshop.

Table 2. Workshop locations and number of participants.

Workshop Location	Number of Participants	Percent of Total
Rhode Island	**82**	28.9%
Providence 1	31	
Providence 2	26	
Kingston (URI)	25	
Ohio	**77**	27.1%
Columbus 1	29	
Columbus 2	24	
Columbus 3	24	
Utah	**54**	19.0%
Salt Lake City	16	
Ogden	17	
West Valley	21	
Washington	**71**	25.0%
Bellevue	25	
Tukwila	21	
Seattle	25	
Totals:	284	100%

3.4 Workshop Protocol

Each two hour and 15 minute workshop consisted of four primary activities: 1) background questionnaire, 2) introductory presentation, 3) survey of transit information preferences, and 4) breakout discussion groups (detailed descriptions of the design, development, and administration of these materials can be found in Appendix B). Upon arrival at the meeting room, participants were handed a packet consisting of a consent form, a background questionnaire, and a sealed envelope containing survey materials. Prior to the workshop, the envelopes had been clearly labeled with the workshop city, specific workshop location where applicable, date, and participant identification number. Participants were asked to immediately read and sign an informed consent form (Appendix E) and not to open the envelope until asked. After signing the consent form they were provided refreshments and asked to fill out the background questionnaire (Appendix F). Questionnaires were returned to the receptionist prior to the start of the

presentation. Efforts were made to ensure that the background questionnaire was filled out before the tutorial presentation and survey to reduce bias from exposure to the current technologies and provide consistency of protocol between participants.

The presentation (Appendix G) consisted of three sections: study introduction, transit technology background, and survey instructions. First, the meeting facilitator introduced the purpose of the study and the workshop agenda. The next part of the presentation included an interactive multimedia background tutorial that defined the terms used throughout the study (e.g., pre-trip, wayside) covering topics such as what kinds of information are available, where different types of information may be useful, and how passengers can get transit information. Finally, the presentation explained in detail how to fill out the surveys included in each participant's sealed envelope.

Participants were asked to open their envelope containing the three survey pages (pink, yellow, and blue sheets, see Appendix F) at the beginning of the survey instructions. A step-by-step detailed example was presented and discussed to ensure that the survey task was fully understood by the participants. Participants then spent approximately 30 minutes filling out the survey. There was no time limit enforced for filling out the survey, and experimenters were available to answer any questions that arose. When participants were finished with their survey, they were instructed to place their survey forms back in the envelope, hand it back to the receptionist, and take a short break.

After the break, the participants were randomly divided into two equal-sized groups for an approximately 45-minute long discussion session. One of these groups typically stayed in the original meeting room and the other group gathered in a separate room. These moderated discussions were audio recorded to ensure accurate collection of participant experiences and preferences. These discussions served to delve into the finer details of what, where, when, and how the study participants want transit information. At the conclusion of the discussion the two groups rejoined in the original meeting room to receive their incentive payment.

3.5 Assumptions and Research Design Characteristics

The nature of this research design is likely to affect the data collected in a number of ways. These are discussed in detail in Appendix H, and summarized here:

- The workshop samples are not statistically representative of either transit riders or non-riders at the national, regional, or local level, because participant recruitment was based on agency lists and a largely self-selection process.
- The samples are not large enough to allow for much disaggregation of the data into rider sub-groups for further analysis.
- The samples are purposively heavily representative of transit riders, with about 20% being non-riders, or at least persons who had not ridden transit in the past 30 days.
- Some important transit rider segments were especially difficult to recruit into the workshops, such as older riders; therefore, their information preferences are under-represented.
- The workshops were short relative to the quantity and complexity of information presented to the participants and requested from them. There is therefore a fairly high likelihood that the quality of the data collected has been affected by this design element.

- The participants are over-representative of users of high technology ways to access travel information, which is a strength of the design that can help us understand information preferences for leading edge information strategies.
- Prior research on this topic is very limited; therefore, this research design was tailored to provide a broad initial examination of these questions of *what*, *when*, *where*, and *how* regarding transit rider information preferences. Clearly additional research will be needed to generate more detailed useful policy guidance for transit agencies interested in upgrading their information services.

4.0 DATA ANALYSIS AND FINDINGS

4.1 Data Compilation

The background questionnaire, preference survey, and discussion tapes needed to be compiled into an accessible form before analysis could proceed. The background questionnaire and survey entries were coded and assembled in an SPSS data file that allowed cross-referencing between demographic and behavioral characteristics and survey responses. The discussion tapes were transcribed and subsequently summarized with respect to the questions outlined in the discussion moderator's guide (see Appendix I). For additional details regarding data compilation see Appendix J.

4.2 Characteristics of Workshop Participants

One of the participants' first tasks in the workshops was to fill out a brief background survey that included selected demographic characteristics, experience riding public transportation systems, their use of communication devices, and their attitudes toward technology and various aspects of the transit riding experience. As noted earlier, a copy of the complete background survey is contained in Appendix F.

There were a total of 284 participants who attended one of 12 workshops held in four metropolitan areas across the country.[1] Participants were asked to estimate how many one-way public transit trips they had made in the last 30 days. Based on responses to that question, the participants were classified as either non-riders (no trips in the past 30 days) or riders (one or more transit trips in the past 30 days). The percent of riders present in each workshop are shown in Figure 2. Among all the participants there were 213 riders, or 75% of the total workshop attendance. It is likely that some, perhaps many, of those who were classified as non-riders for the purposes of this research are actually infrequent riders who just have not ridden transit in the past 30 days. Discussions with many of the participants revealed that most of them have at least tried riding transit sometime in the past. As was explained earlier, we wanted primarily current riders in the workshops in order to get the most useful feedback on transit information options.

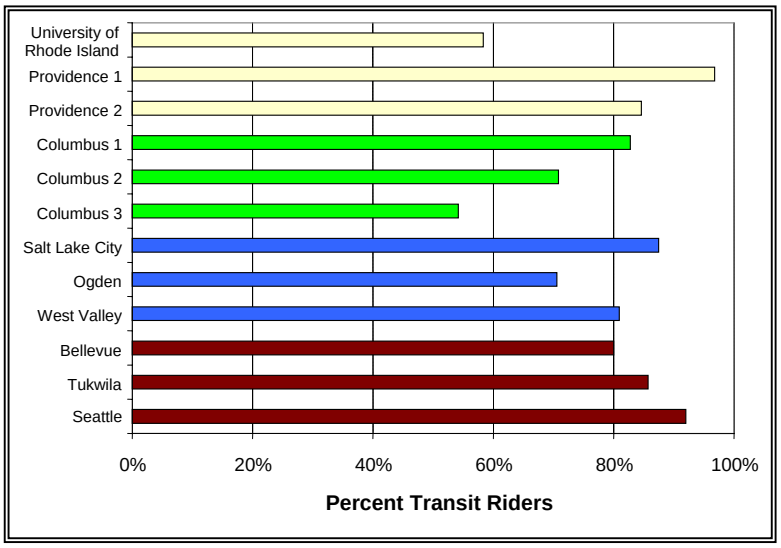


Figure 2. Percent of workshop participants who reported taking at least one transit trip in the past 30 days.

Workshop participants were composed of 44.9% male and 52.3% female overall (data missing for 8 participants). The age distribution varied considerably from one site to another, as can be seen in Figure 3. There were much higher proportions of older participants in the three Washington workshops compared with the Rhode Island and Ohio workshops. One of the Rhode

Island workshops was held at the University of Rhode Island (URI) and was composed almost entirely of students. The Ohio workshops also had high numbers of students. While none of these individual workshops is expected to reflect an age distribution that is closely comparable to the population of frequent and occasional riders in each of their respective metropolitan locations, over all 12 workshops taken together there is a good balance of participants in the ages between 18 and 65 years, with about 30 percent of the participants in each metropolitan area in each of the three age groups in the 18 to 65 age range.

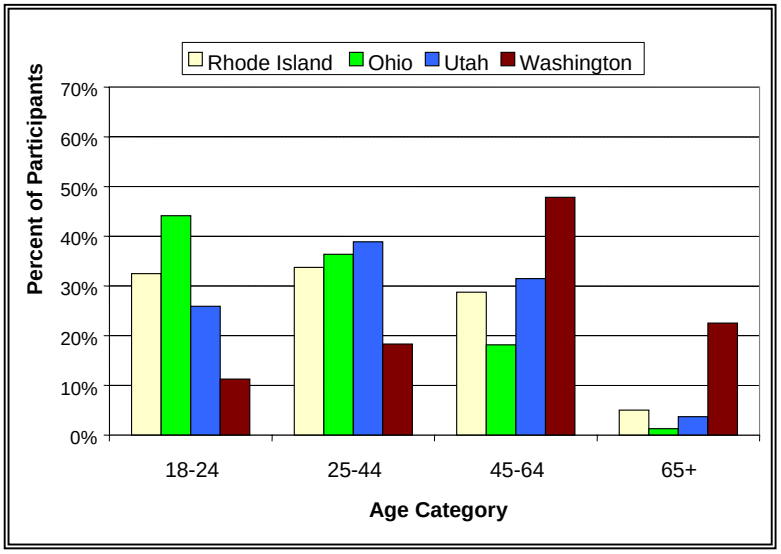


Figure 3. Age distribution of workshop participants by workshop location.

Figure 4 shows the distribution of workshop participants by educational level. As with age, there are noticeable differences across the four workshop locations, with the Rhode Island participants reporting a lower average educational attainment level and Washington reporting a higher level, with the other two locations falling somewhere in between these. All of the participant groups except Rhode Island are clearly much more highly educated than the general population and also more highly educated compared with the populations of transit riders in each of the four urban workshop locations. Across all the sites, 77% of all the workshop participants report having some college education or more and 42% are college graduates or post-graduates. There are several reasons why the average educational attainment of these participants would be high. For example, some were recruited from universities, some locations recruited participants over the Internet, and others volunteered to be included in transit agency research activities and therefore were already self-selected for education on this project's recruitment lists. While better-

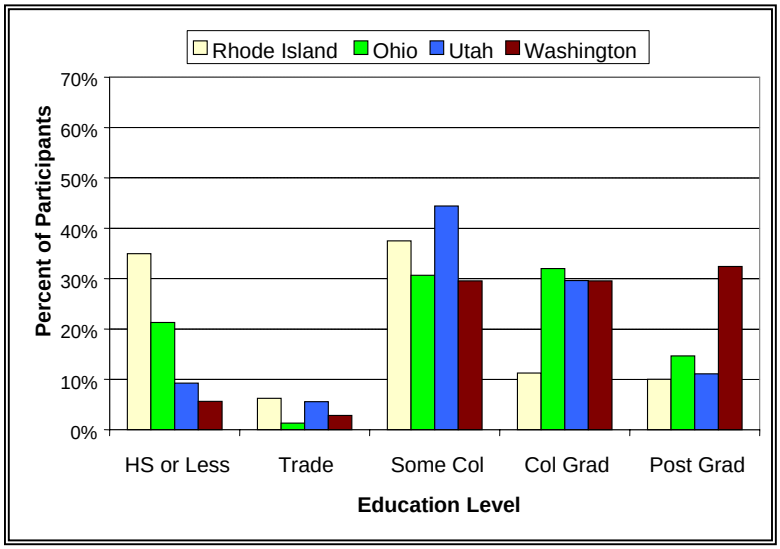


Figure 4. Educational distribution of workshop participants by workshop location.

educated riders are more likely to use and have opinions on high technology transit information strategies, there is enough diversity on education to obtain a balanced sense of the opinions of riders of all educational levels.

Employment status will be important to understand in order to explain differences in transit riders' information preferences. Those who are employed full time can be expected to use transit differently, both in terms of trip timing and frequency, compared with those who are unemployed or retired, for example. As can be seen in Figure 5 there is a substantial difference in the employment characteristics of participants in several of these workshop locations. Participants in the Ohio workshops have about four times the number of persons employed full time compared with the Rhode Island workshops and about twice as many as the average of the other two workshops. The Washington workshops had significantly more retired persons in those workshops compared with the other three. But in spite of these differences between the workshop locations, there is a lot of variation in employment characteristics across all the participants, which will be useful in seeing whether there may be important differences between transit users with different kinds of employment and their preferences for transit information.

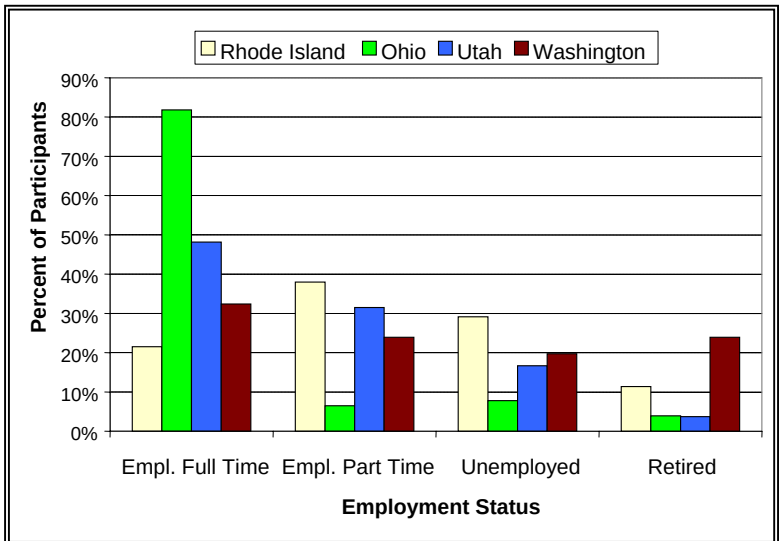


Figure 5. Employment distribution of workshop participants by workshop location.

Transit riders can generally be considered to fall into two groups: non-discretionary (transit-dependent) and discretionary (transit-choice) riders. Transit dependent riders typically have no options for their travel other than taking public transportation. They tend to have limited or no access to a car, or because of economic status, age, or disability transit may be their only viable option. Transit-choice riders may choose transit for travel speed, comfort, and convenience, often to avoid traffic congestion or parking constraints and costs or in response

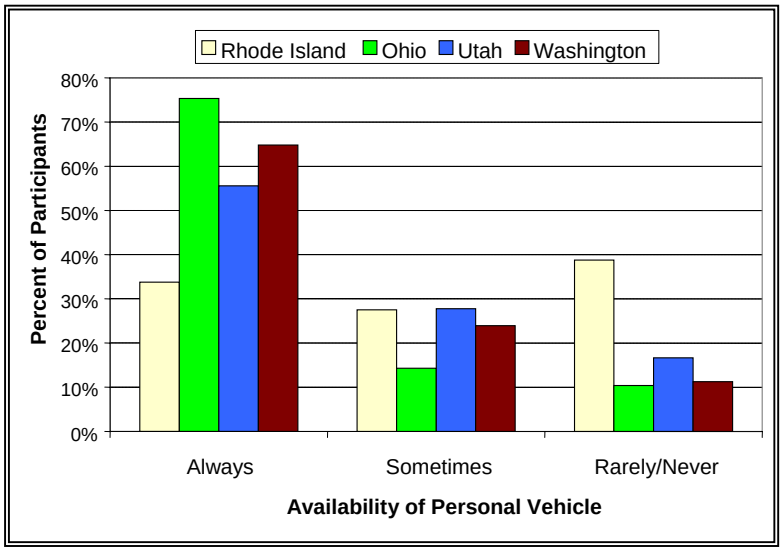


Figure 6. Availability of personal vehicles for workshop participants by workshop location.

to environmental concerns. The background survey asked the workshop participants whether they have a personal vehicle available to them when they want it. As shown in Figure 6, while the majority of respondents in most of the workshops said they "always" have access to a personal vehicle, a significant number do not always have an alternative to transit available to them ("most of the time" and "sometimes" was recoded into "sometimes" in Figure 6), and to the degree that is the case, they are transit dependent. The most dependent groups of participants were those in the Rhode Island workshops, and the least dependent were in the Ohio workshops.

The workshop participants were asked to estimate how many one-way public transit trips they made in the last 30 days for a variety of purposes including work, school, shopping, personal appointments, medical, and social or recreational trips. As noted earlier, 75% said they took one or more such trips; that is, 213 out of 282 participants had ridden public transit at least once in the past 30 days. Whether or not an individual uses transit for a particular purpose is less important for this study than understanding the intensity of transit use, which refers to the frequency or number of times in the 30 day period the workshop participants reported using public transit. Figure 7 shows the number of one-way transit person-trips by workshop location. This is the total number of one-way trips taken by all the participants at each location. As can be seen in Figure 7, the transit users in the Rhode Island workshops reported taking almost twice as many trips overall compared with the participants in Utah or Washington; however, more people reported taking trips in Rhode Island. This may reflect the higher level of transit dependence among the Rhode Island workshop participants.

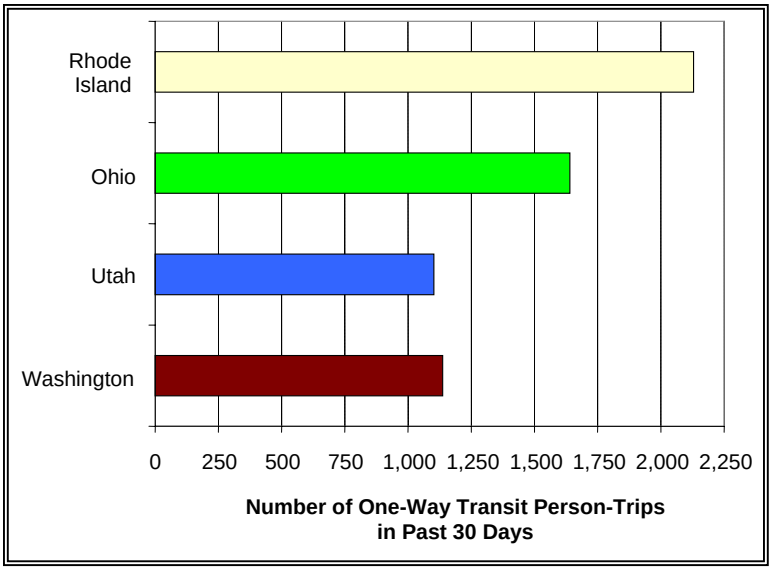


Figure 7. Number of one-way transit person-trips in the past 30 days by workshop participants in each workshop location.

The average number of one-way transit trips per transit rider in the past 30 days also was calculated. Rhode Island averaged 36.1 transit trips per rider, Ohio averaged 31.0 trips per rider, Utah averaged 26.2 trips per rider, and Washington averaged 19.3 trips per rider. Although Washington riders averaged the fewest trips per rider, they had the same number of transit riders (59) as Rhode Island. Clearly, Rhode Island participants were taking many more trips per rider to yield a total number of person-trips of 2,129 in this one-month period, versus 1,137 person-trips for Washington.

Figure 8 shows the average percent of one-way transit trips in the past 30 days for each of the trip purposes separated by each of the four workshop locations. Work trips and school trips account for most of the transit use in Ohio, Utah, and Washington. Trip purpose is spread out more equally across all the trip types for the Rhode Island participants. The concentration of the work trips in Ohio is clearly evident, however, by comparing the distribution of transit person-trips by trip purpose as a percent of the total person-trips taken by all the riders at each site. Figure 9 is based on the same data and shows that between 49% and 73% of all the trips taken in Washington, Utah and Ohio are work-related, with the rest of the trips distributed among the other trip purposes. In Rhode Island, on the other hand, only 14% of the trips are work-related, and shopping, medical, and social trips account for between 18% and 20% each.

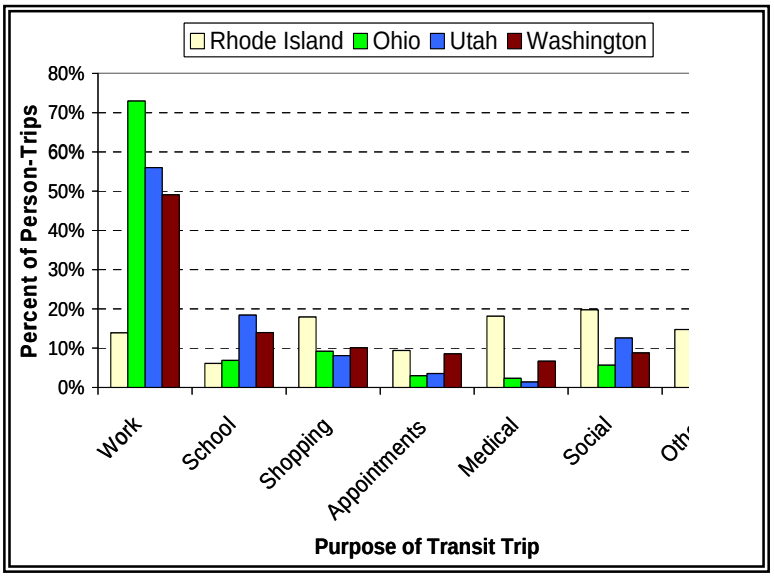


Figure 8. Average percent of one-way transit trips in past 30 days for each trip purpose by workshop location.

Having to transfer from one bus to another or between modes in order to complete a trip is often perceived as time-consuming and confusing for transit users. Information related to the transfer process is well recognized as important to riders, particularly new or infrequent riders who are less familiar with the routes, transfer points, and timing associated with the trip they need to make. The workshop participants were asked whether they have to transfer to another bus, train or ferry on the public transit trip they take most often. Among the 213 transit riders, 110 (52%) said that they have to transfer on their primary transit trip. Washington and Ohio participants reported fewer, and equal portions, of riders who need to transfer (36%), Utah had 62% and Rhode Island had the largest portion at 75%.

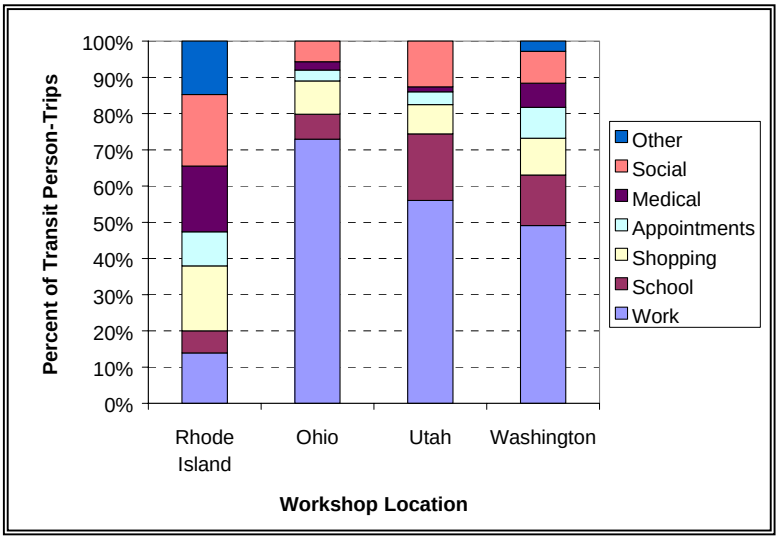


Figure 9. Distribution of one-way transit person-trips taken by workshop participants by workshop location.

The participants were asked how many days, if any, in a typical week they telecommute (i.e., work at home) rather than commuting to work. Seventeen percent of the participants said they do that at least one day a week, and the average number of days a week they telecommute was 1.8. This ranged between 1.4 days a week for 18.5% of the Utah participants, to 3.8 days a week for 17.4% of the Washington participants. Figure 10 shows the number of person-days of telecommuting in a typical week by each of the individual workshop participants in the four metropolitan locations. This is a measure of the intensity of telecommuting among these groups. Both the most intense telecommuting (29 person-days for the Seattle, WA participants) and least intense telecommuting (1 person-day for the Bellevue, WA participants) occurred within the same transit jurisdiction in Washington State. Telecommuting was much more prevalent among two of the Ohio sites and much less at the third site. Telecommuting was evenly distributed across the participants at each of the three workshops in Utah.

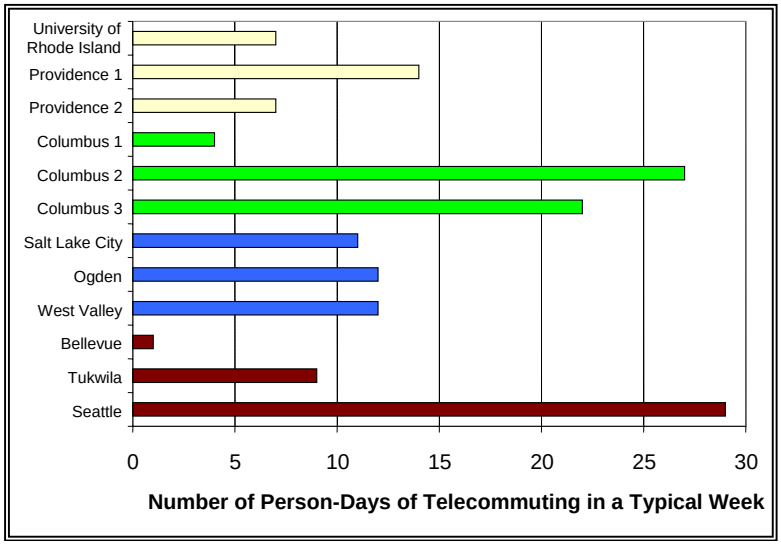


Figure 10. Number of person-days of telecommuting in a typical week by workshop location.

The workshop participants were asked to indicate the different kinds of portable communication devices available to them. These include cellular telephones, WAP phones (cell phone with Internet connectivity), personal digital assistant (PDA) with wireless Internet connectivity, portable computer that has wireless communications, or an alpha-numeric pager. Devices such as these offer ways for transit agencies to make travel information available to travelers, especially real-time information. Conversely, transit users who do not have, do not want, or cannot afford such technologies will find themselves somewhat at a dis-advantage when using trans-portation systems that provide information that can only be accessed with such technologies. Agencies should consider this when making decisions about ATIS systems. Figure 11 shows

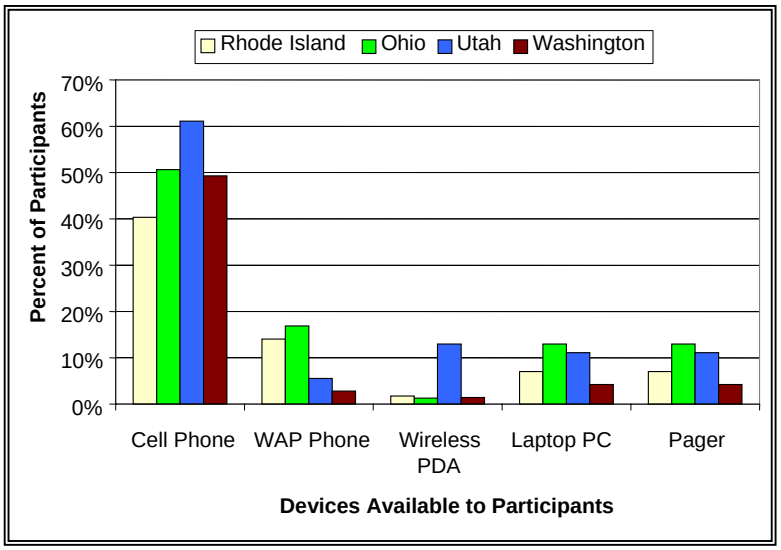


Figure 11. Portable communication devices in use by participants by workshop location.

the percent of participants in each of the four workshop locations who indicated they have one or more of these portable devices. On average, cell phones are available to about half of all the participants, with the fewest in Rhode Island and the most in Utah. Overall, 10% report having access to WAP phones, 9% to a portable computer that has wireless communications, 9% to a pager, and 4% to wireless PDAs. Some participants are more "wired" than others, with 2.8% saying they have two or more of these devices. Access to remote communications capabilities could influence the participants' preferred information delivery systems.

The questionnaire also asked whether any of the workshop participants had any characteristics or impairments that might affect their transit information needs, or their ability to access and use some kinds of information. While the workshop recruitment process did not specifically target transit riders who have a disability, the participants included 43 individuals (15% of those who responded to this question) who indicated they had one or more special needs that affect their use of transit information, including visual, hearing, mobility, or language (non-English speaker). Figure 12 shows how reported disabilities were distributed across the participants at the four workshop locations. The percent of participants reporting disabilities ranged from 34% in Rhode Island to 8% in the Ohio workshops. Due to the low number of participants with disabilities, additional analyses based on their needs are not reported.

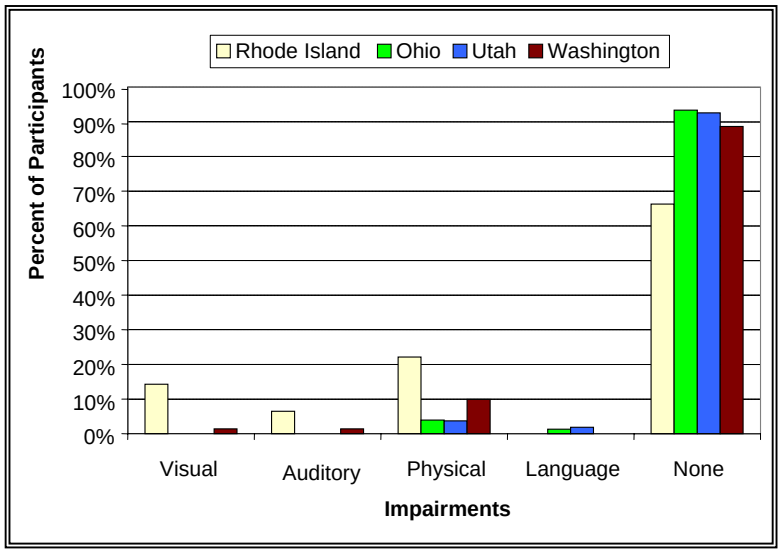


Figure 12. Impairments that affect participants' ability to access or use transit information.

Finally, the participants were asked to answer a set of questions that focused on attitudes towards technology in general and more specific questions that addressed participants' experiences and feelings associated with transit riding and the use of transit information. In all, 17 questions were posed that offered the respondent a scaled set of responses ranging from "disagree completely" at one extreme to "agree completely" at the other. There were seven response options from –3 to +3, with "0" representing a neutral position on the particular question. The detailed wording of each question is shown in Appendix F, and paraphrased versions of the questions are displayed in the four charts on the following pages (Figures 13 through 16). The charts show the average response (mean) over the group of participants in each of the four workshop locations. The average is represented by a small colored circle, and a vertical line through the circle illustrates the variation in responses above and below the mean. The shorter this line, the more the participants' responses were clustered close to the mean, implying greater consensus on that question. The longer the line, the more variation there was in responses to the question, and hence less consensus. The responses to each question are shown in the four figures in the order in which they were asked of the participants.

Figure 13 shows the summarized results of the first five questions. The first question was, “I’m comfortable using high-tech devices at home or at work,” and the participants were asked to rate how much they personally disagreed or agreed with that statement on a scale from -3 (disagree completely) to +3 (agree completely). The average rating of the Rhode Island participants, for example, was 2.0 on this scale, indicating that the participants were in fairly strong agreement. This question elicited the highest level of agreement overall compared with all the other attitudinal questions.

For most of these questions the participants have responded similarly across the four workshop sites. That is, the mean values of their responses tend to be clustered fairly closely together. There are, however, some differences between the workshop groups. For example, the participants’ responses to the statement “It is important for me to be able to use the Internet to get public transit information” are summarized in Figure 16. The Utah participants expressed strong agreement with this question, much stronger than participants at the other three sites. These participants also reported that they were more comfortable using high-tech devices compared with the other participants, and we also know that the Utah participants were recruited from a list of transit riders who had asked the Utah Transit Authority to keep them informed by Internet with information that might affect their use of the transit system. So this is a self-selected group of transit riders who are already active users of the Internet for transit information. This was not the case with most of the participants at the other workshop sites.

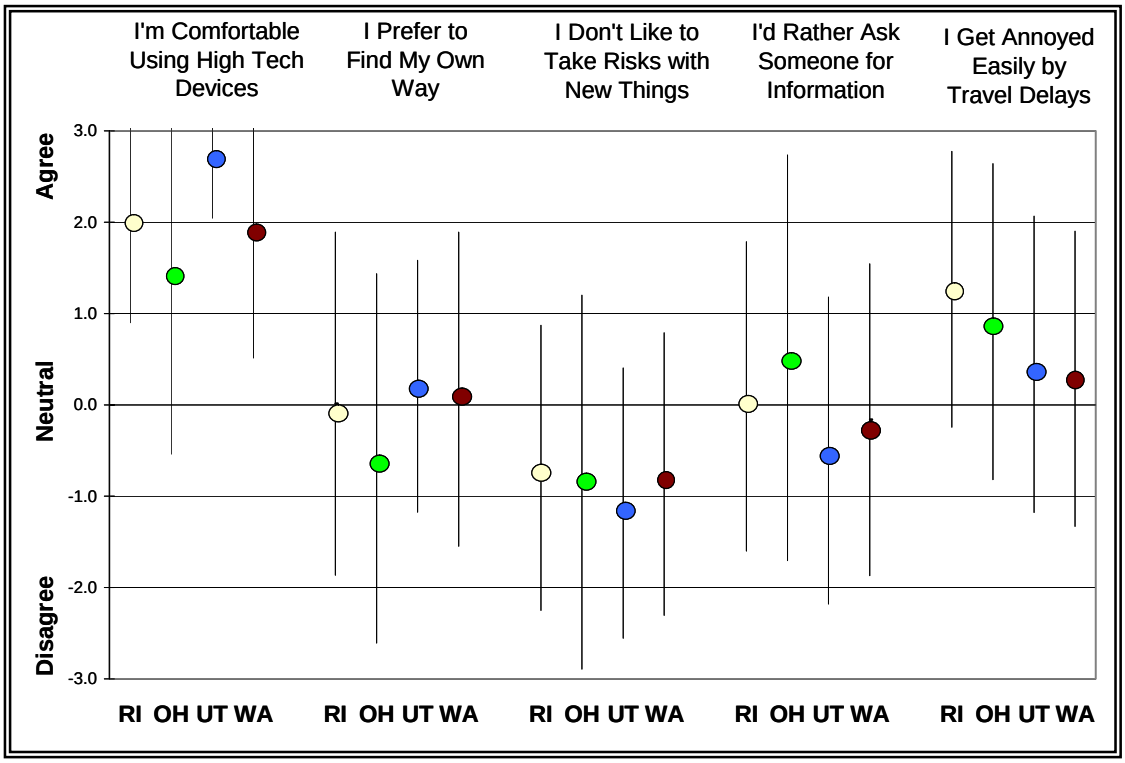


Figure 13. Agreement/disagreement with selected attitudinal statements: Average (mean) responses ± one standard deviation.

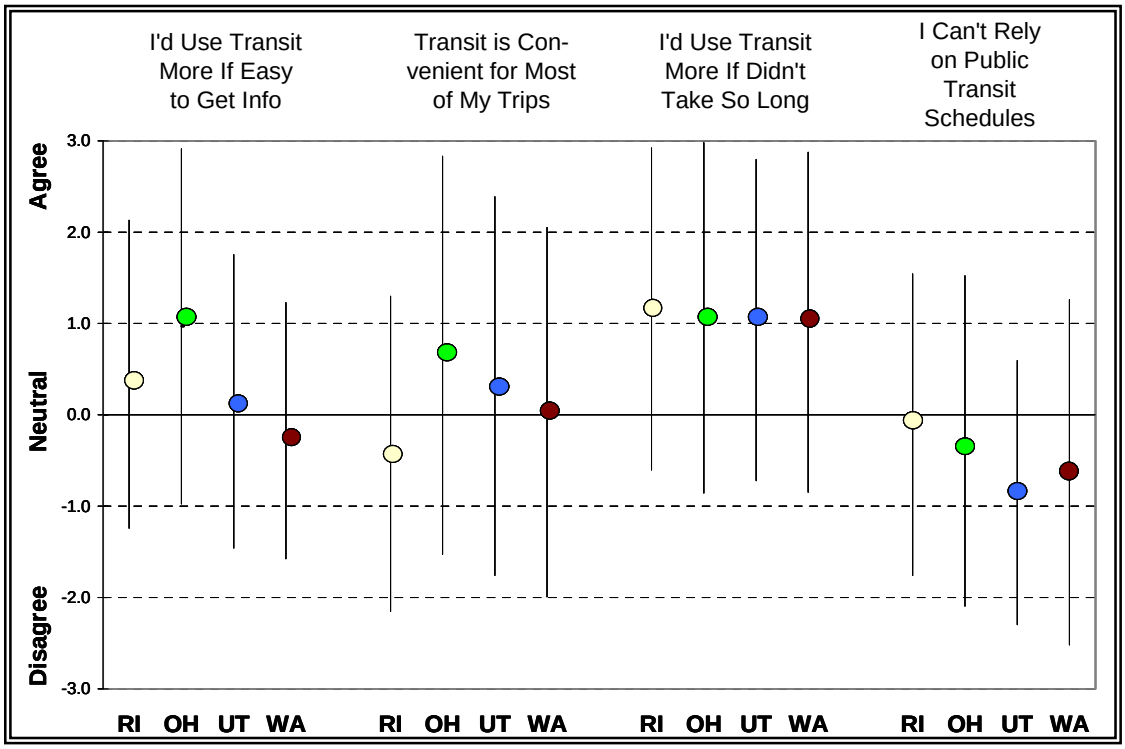


Figure 14. Agreement/disagreement with selected attitudinal statements: Average (mean) responses ± one standard deviation.

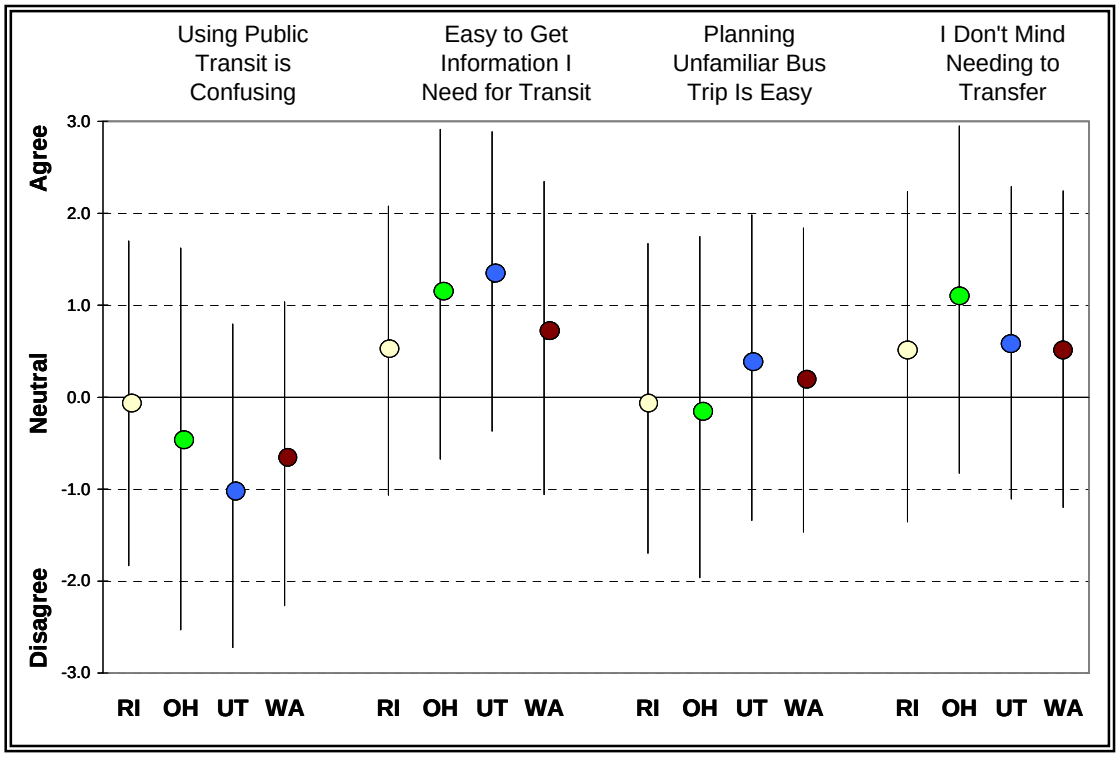


Figure 15. Agreement/disagreement with selected attitudinal statements: Average (mean) responses ± one standard deviation.

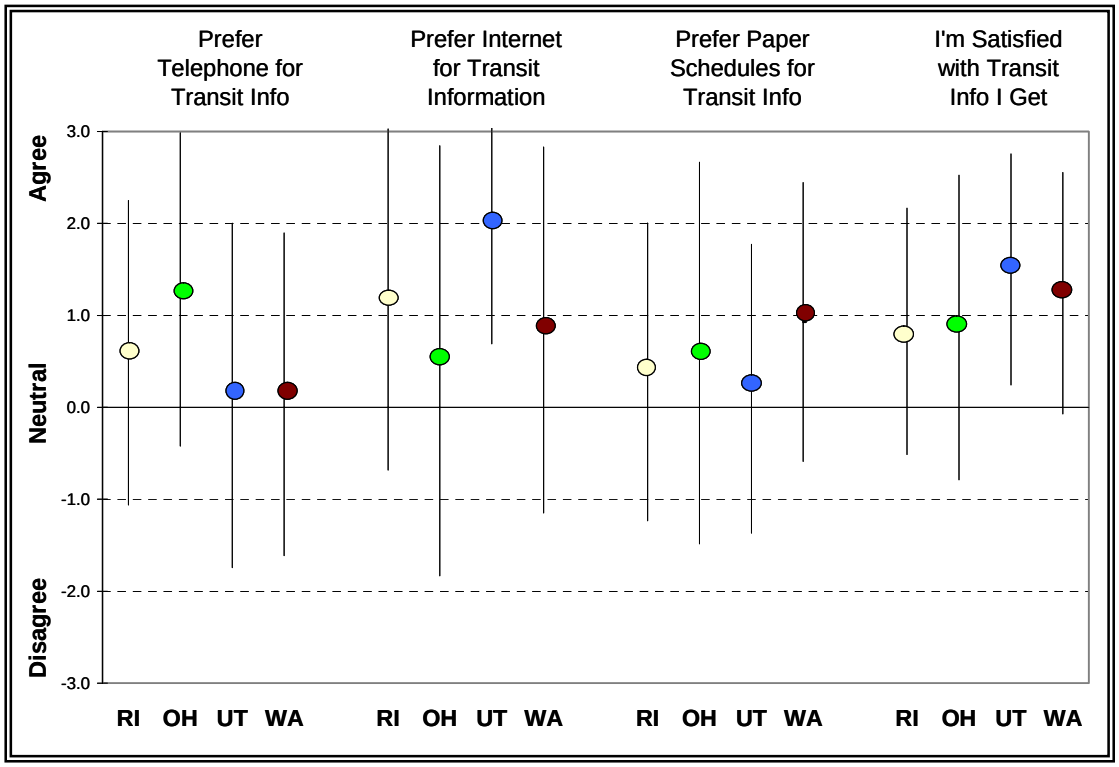


Figure 16. Agreement/disagreement with selected attitudinal statements: Average (mean) responses ± one standard deviation.

4.3 Patterns of Use of and Preferences for Information: Survey Findings

From the perspective of a transit agency, there is a desire to understand what kinds of information are most useful and preferred by their ridership. But answering this question almost immediately leads to needing to clarify where riders want to get that information and how they would like to get it. Answering these questions is a matter of considerable practical importance to transit agencies that need to prioritize the provision of information within their operations to focus on the greatest needs in the face of limited resources. So the question becomes how the transit agency can provide needed information at a manageable cost that will benefit the most riders across as many trips as possible, including meeting the needs of specialized users.

In addition to asking the workshop participants *what* information they needed, *where* in their trips they needed to have access to this information, and *how* they wanted to get the information, we also asked participants to think in terms of information that they considered essential to their trip-making versus information that was not essential but would be nice to have. Then, recognizing that information needs are likely to vary considerably by how familiar they are with the transit system and the particulars of their trip, we asked these questions in the context of a usual, familiar trip as well as for an unusual or unfamiliar trip. The presumption is that information needs in general will be greater for unfamiliar trips or for riders who have less experience on the transit system.

Thus, the complexities of the data collected at the 12 workshops are self-evident. The total number of combinations for information preferences can be characterized by the following calculation:

What Information	(**16** categories)
How to Get It	(**9** categories)
Where to Get It	(**4** categories)
Familiarity of Trip	(**2** categories)
How ***Essential*** Information Is	(**2** categories)

Total Possible Combinations of Preferences: (**16**) x (**9**) x (**4**) x (**2**) x (**2**) = **2,304**

However, not all of these combinations make logical or practical sense. For example, access to transit information while going to a bus stop or while traveling on a bus is unlikely to be available to riders via a video monitor or kiosk. Furthermore, while it is possible to obtain information wirelessly over the Internet, few in the general population, let alone transit riders, have wireless communication devices they carry with them. In spite of the fact that some of these combinations are unlikely to occur, most are at least technically plausible and therefore could be chosen by any of these participants in this study. It is important to keep in mind, however, that transit agencies are looking for the significant information needs of their customers to guide their investment decisions. Therefore, to deal with all the many possible combinations of information needs and situations described above, we approached the description of the data collected in a step-wise fashion. The basic objective of this analysis is to identify clear and significant patterns of information preferences that can offer useful, practical guidance to transit agencies; that is, to focus on the highlights and not on the small nuances.

The first step is to identify the overall kinds of information (the *what* question) that customers say are essential to their trip making, then to examine the *where* and the *how* questions for the most important of those preferences. The second step is to examine how these preferences vary depending on where the customer is in his or her trip-making process—from pre-trip planning to en-route information preferences. This kind of information will be important for transit agencies trying to decide where to provide information and will have an obvious bearing on how to best communicate that information. The third step will be to look for variation in the expressed information preferences under these various circumstances by characteristics of the customers. For example, the preferences of younger travelers may be different from older transit riders, and the preferences of seasoned travelers may be expected to be different from those who are relatively new to public transit or who ride infrequently. This kind of knowledge of the preferences of different segments of transit ridership will aid the transit agencies in tailoring their provision of information to the known characteristics of their own ridership or help direct more focused information programs to different parts of their service area.

4.3.1 What Information Is Preferred?

Figure 17 shows the percent of all workshop participants who indicated each of the 16 information types was essential for their trips, both for their familiar trip and for an unfamiliar trip. Respondents had been asked to think of their usual trip in terms of the particular transit trip they take most often, and the unusual trip in terms of leaving their home to visit a friend in a part of their town to which they had never before taken public transportation. In Figure 17 the results are arrayed from the type of information most often selected as essential (timetables and scheduled service changes) to the least selected information type (real-time information on parking availability at selected locations). The ranking criterion was the percentage of responses, from highest to lowest, regardless of whether for a familiar or unfamiliar trip. The rational for this ranking approach is that transit agencies need to serve their customers' most pressing information needs, regardless of the type of trip the customer is making. Further, static information is grouped on the left side of the chart, and real-time information grouped on the right. Descriptions of these 16 information types are included in Table B-1.

Some general observations can be made based on the data shown in Figure 17. First, for every type of transit information, whether static or real-time, there is a greater expressed preference for information for the unusual or unfamiliar trip compared with the usual or familiar trip. This is what one would expect to be the case. These differences are substantial for the static information. Furthermore, the need for timetables exceeds all other types of information for both the familiar and the unfamiliar trip types.

Second, the expressed preference for static information is greater than for real-time information, though this is more prominently the case for the unusual trip than for the usual trip. Static information constitutes the more traditional form and content of information provided by transit agencies to their customers, including information on schedules, fares, and maps. Participants in this study might have had limited experience with real-time information systems, and although an effort was made in the workshops to inform all participants about these newer kinds of information services, it is plausible that those who lacked experience with them would be less likely to view them as essential for their transit use. This is one area where awareness-building and education will be needed to promote these modern information systems.

Finally, for many of the static types of information services, the perceived need is much greater for the unusual trip than for the usual trip. For most of the real-time information types, there is no significant difference in preference between these two kinds of trips. Information about the "closest stop or station on my route" is a good example. Only 58.3% of the participants said this was essential for them to have for their usual trip, while 85.4% said they preferred it for an unusual trip. Most transit users know where to board transit and where to get off on the trip they make frequently, but this kind of information becomes much more important to transit riders when they are making a trip they have not taken before. The same argument applies to the other static information types.

The order of static and real-time information as shown in Figure 17, ranked from highest preference to lowest, is maintained in all the remaining data charts shown in this report for comparative purposes.

Figure 18 provides transit rider preferences for the different types of information that they judge to be nice to have. Note that the percent of participants who classified an item as *essential* in Figure 17 and the percent for the same item in Figure 18 are not additive – the combination of the two percentages might be greater than 100%. This is due to the multiple response survey design. A participant can classify a particular combination of information type (*what*), location (*where*), and delivery system (*how*) as *essential*, and another combination as *nice to have*. Figures 17 and 18 only reflect the percentage of responses that classified a particular information type as *essential* or *nice to have*, respectively, regardless of where or how the participants want access to the item. These responses are examined in more detail later in the analysis. Figure 18 indicates three primary points.

First, generally fewer transit users identify any of these different types of information as nice to have, compared with the percent of users judging the information types to be essential. We anticipated that essential information preferences would be fewer than shown here, if for no other reason than people are making these trips day after day without benefit of some of the information types, especially the real-time information types. The report looks more closely later in this section at each of the four sites and assess these response patterns in light of the actual current information availability of the different information types at these sites. Regardless, transit agencies are actively seeking ways to make transit riding more comfortable for their current customers as well as more attractive for both riders and non-riders, and therefore they are interested in understanding which types of information are likely to enhance the overall transit experience. For that reason, taking account of both essential and non-essential information preferences will be important from the agencies' perspective.

Second, in Figure 18 both static and real-time information types are judged by these participants as more or less equally nice to have, with somewhat higher percentages of respondents saying real-time information would be nice to have. This is understandable, both given that there is currently limited availability of this kind of useful information in these transit operations and given that fewer participants selected real-time as essential compared with the static information, leaving more chances for respondents to select these types as nice to have.

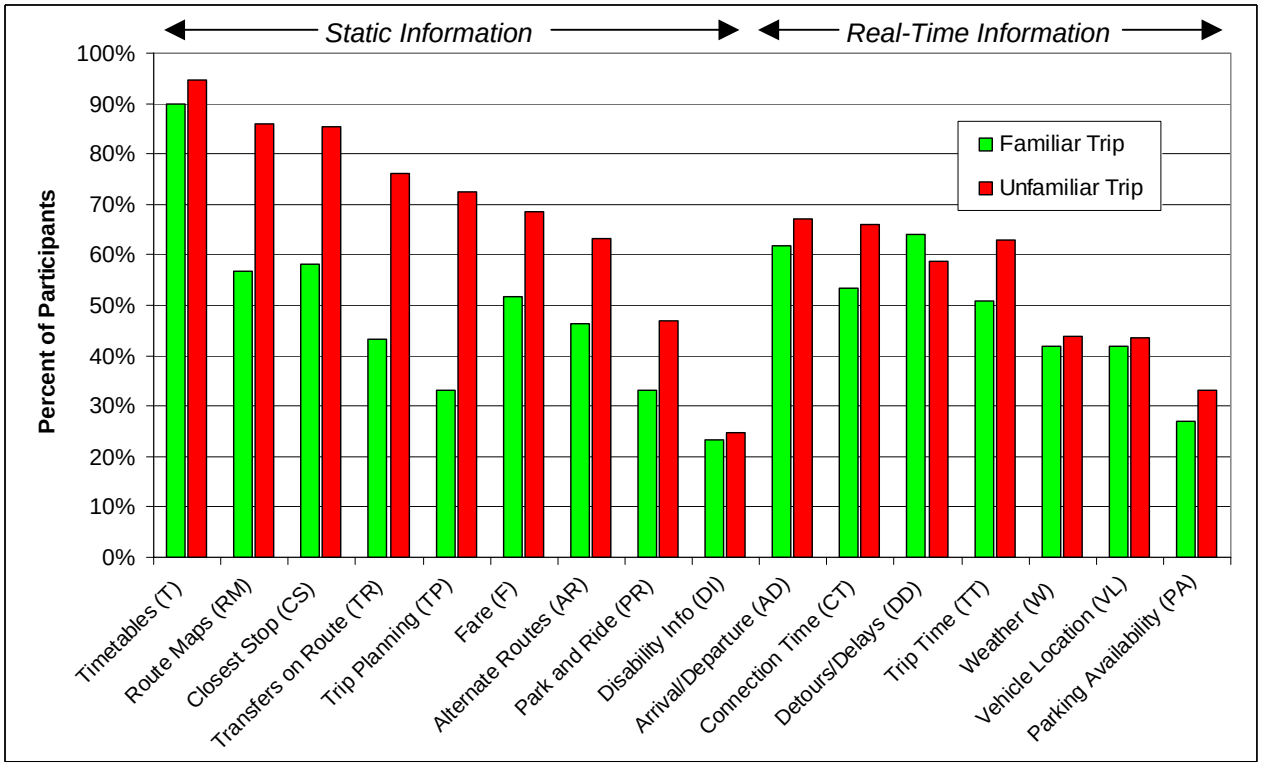


Figure 17. Percent of workshop participants who classified each type of information as Essential, for familiar and unfamiliar transit trips.

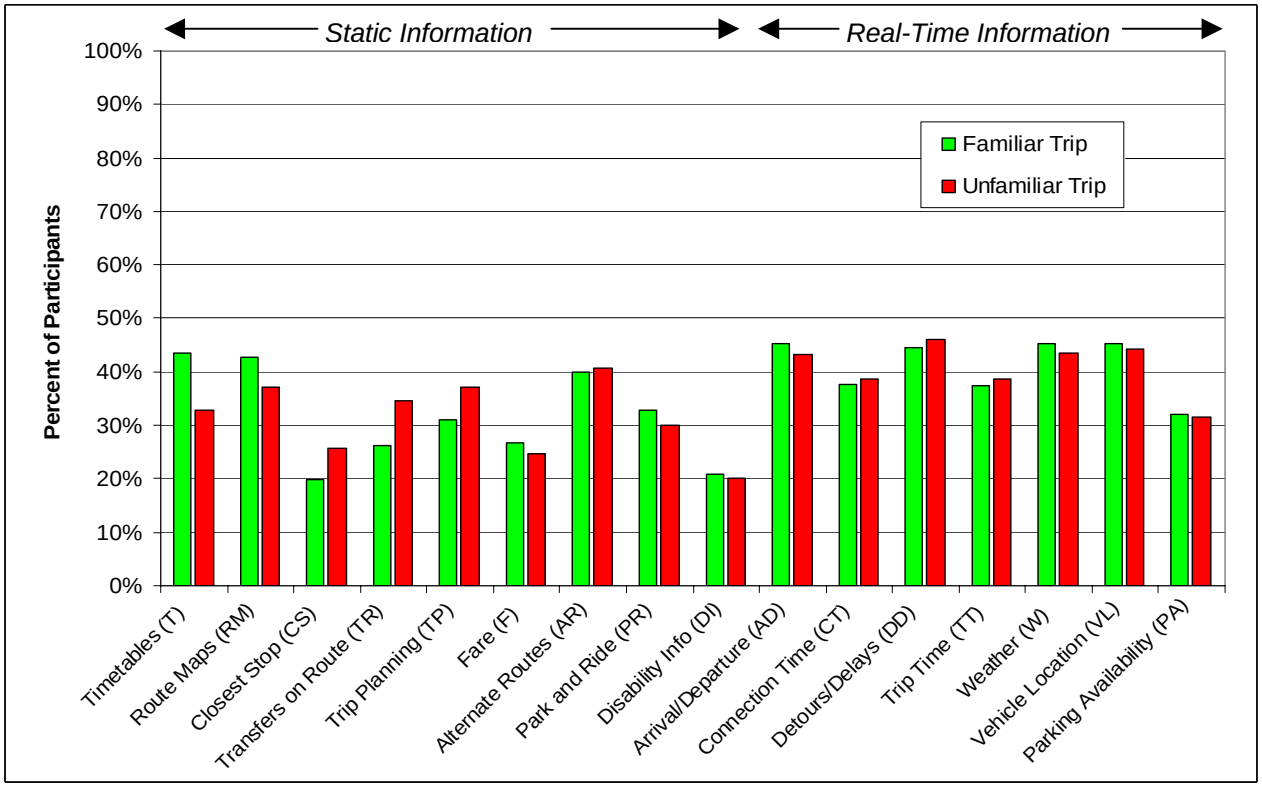


Figure 18. Percent of workshop participants who classified each type of information as Nice to Have, for familiar and unfamiliar transit trips.

Finally, there are only a few information types classified as nice to have for which preferences differ between the familiar trip and the unfamiliar trip, and these differences are very small. Interest in each of the real-time information types is similar, but there is variability in the static information types, with information on closest stop, fares, and services for the disabled preferred less than other types.

The next set of four figures (Figures 19, 20, 21, and 22) show the overall preference for essential information according to *where* the information is wanted or expected to be used. These four information locations include:

- Pre-trip (at home, work, or other place where you plan your trip)
- Going to a stop or station (bus stop, rail station, ferry dock, transit center, or park & ride)
- Wayside (at a bus stop, rail station, ferry dock, transit center, or park & ride)
- On board (on a bus, train, ferry or other transit vehicle)

Transit information of most types is considered to be essential primarily for pre-trip planning (Figure 19) and at the wayside (Figure 21) compared with the other two locations. Figure 19 shows the importance of having access to many of the standard, static types of information primarily to help with planning unfamiliar transit trips. Over half the participants in the 12 workshops said it was essential for them to have all the static information types on an unfamiliar trip except for park & ride and disability services information. These two are primarily relevant only for transit users who have access to an automobile or for disabled riders. For the familiar trip, the only type of information considered essential for pre-trip planning by more than about 40% of the participants was timetables, and twice as many participants selected timetables compared with any other information type. Various types of real-time information are considered just as essential as some of the static information types for use in planning familiar trips, but generally as non-essential for the unfamiliar trips. Evidently, transit riders are saying that the traditional kinds of information are of primary importance for trip planning.

Figure 20 shows the percent of participants who indicate that the various information types are essential for their trip-making while going to a stop or station, both for familiar and unfamiliar trips. In every instance, less than 20% of respondents have indicated a preference for transit information under these circumstances. Because these expressed preferences are so low across all information types, the subsequent more detailed analyses of these data will focus only on pre-trip, wayside, and on-board information preferences. Figure 22 shows comparable results for information available while traveling on the transit vehicle. Among the static information types, information on timetables, route maps, closest stop, and transfers on route are more important than the remaining static information types, and logically so. The greatest preference across all the information types considered essential while on board the transit vehicle is for information on detours or delays, but even this is only 22.6% for the familiar trip.

Figure 21 shows similar preferences for information considered essential while at a transit wayside (a bus stop or transit station for example). Here the importance of these information types at the wayside is a lot less than for pre-trip planning, particularly with regard to the traditional, static kinds of information. Some of the real-time information, however, is considered even more important for use at a wayside than for pre-trip planning and also more

important than the static information available at a wayside. For example, real-time arrival and departure information is as important as static timetables for both familiar and unfamiliar trips.

As expected, participants classified more information types as essential for their unfamiliar trip (mean = 7.8 types) than their familiar trip (9.9 types). This result is consistent with our hypothesis that transit riders generally need more information when traveling to an unknown area than for a trip they usually take. On average, participants considered 5.7 types essential for both the familiar and unfamiliar trips.

4.3.2 How Do Travelers Want to Get the Information?

Up to this point in the analysis, the results have been presented in the form of two-dimensional charts that show the transit customers' information preferences for their familiar and unfamiliar trips at different key locations during their trip. The remaining dimension of interest in this study is the preferred delivery system, or *how* these transit customers want to get the information. Three-dimensional charts are used to illustrate participant responses for each combination of information type and delivery system. These charts were designed for identifying general patterns that emerge from the data. Each chart is supplemented by a table showing the percentage value at every data point illustrated by a bar in the chart. Six of these charts reflect information types perceived as essential for transit trips, and four for information types perceived as nice to have. The first group contains charts that cover the three important locations, including pre-trip, wayside, and on-board the transit vehicle. The second group only contains charts for pre-trip and wayside locations. Charts for on-board the transit vehicle were not included due to the low response rate in the categories (only two combinations exceeded 5%). For each trip location, data are shown on separate charts for the familiar and unfamiliar trips. All 10 charts indicate the percent of participants who prefer each combination of information type and delivery system, ranging between 5% and 65%. The origin for all charts was set at 5% to eliminate much of the "noise" in the data and allow the significant patterns to emerge more clearly. Displaying the upper range at 65% for every chart accommodates the highest percentage figure encountered in the analysis and makes the data in all 10 charts comparable at the same scale. Descriptions of these nine information delivery systems are included in Table B-3.

Figures 23 and 26 illustrate the participants' preferences for essential pre-trip planning information for their familiar trip (Figure 23) and their unfamiliar trip (Figure 26). The main pattern visible in these two charts is that pre-trip information is preferred in printed paper form and on a computer. As previously noted, there are more participants indicating their preference for various types of essential transit pre-trip planning information for an unfamiliar trip (Figure 26) compared with their usual or familiar trip (Figure 23). Real-time pre-trip planning information is wanted via a computer (typically over the Internet), as one would expect for such dynamic information. The mode for getting the more traditional, static pre-trip information is roughly equal between computers and printed form, such as paper schedules, maps, and the like. The telephone is an important way for some of the participants to acquire this information and more so for unfamiliar trips than for familiar trips and to some degree for both static and real-time information. Also, there is some interest in obtaining this pre-trip information via printed signs, especially timetables.

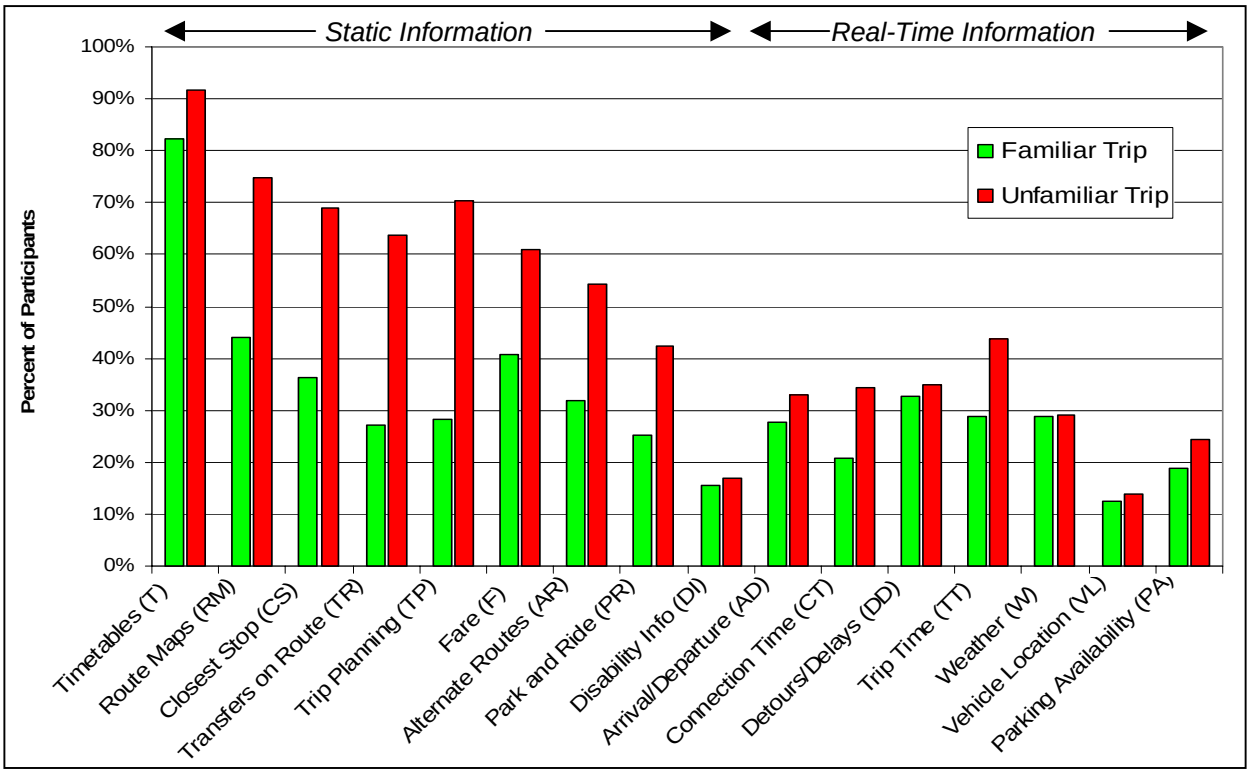


Figure 19. Percent who classified information types as Essential for Familiar and Unfamiliar transit trips: Pre-trip.

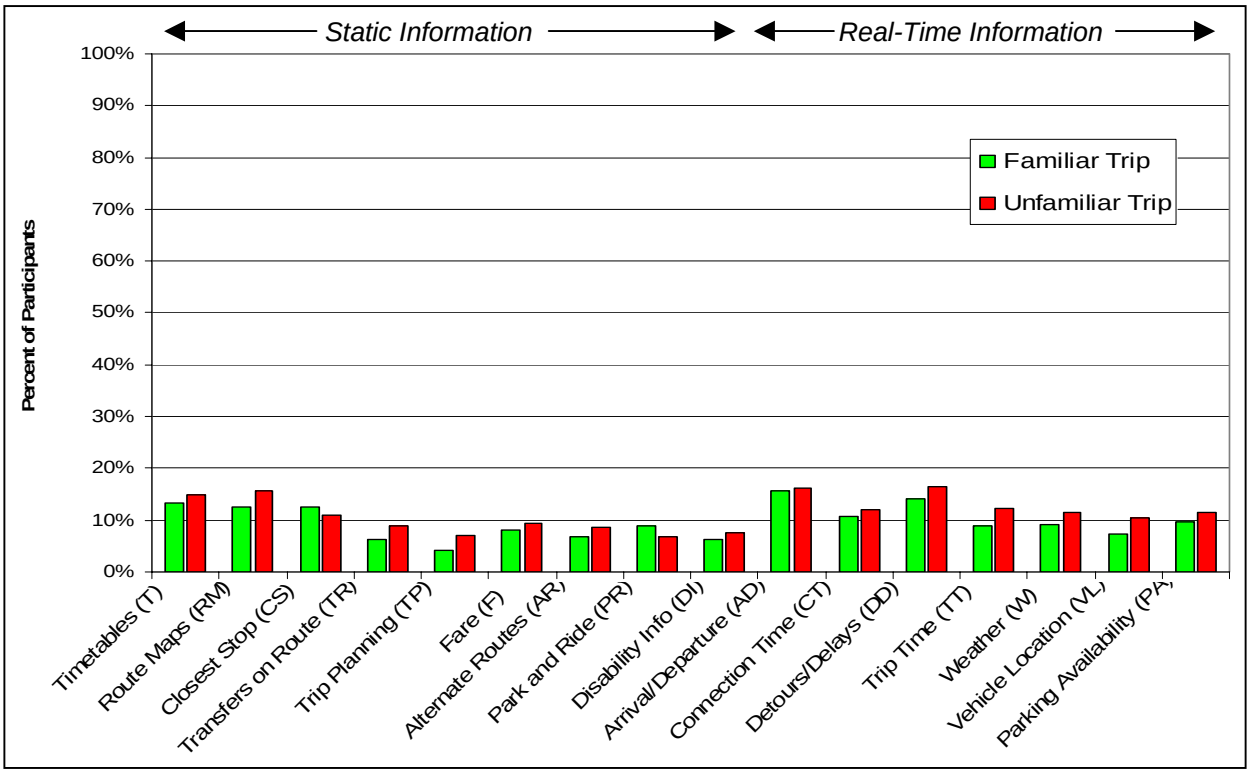


Figure 20. Percent who classified information types as Essential for Familiar and Unfamiliar transit trips: Going to the Stop or Station.

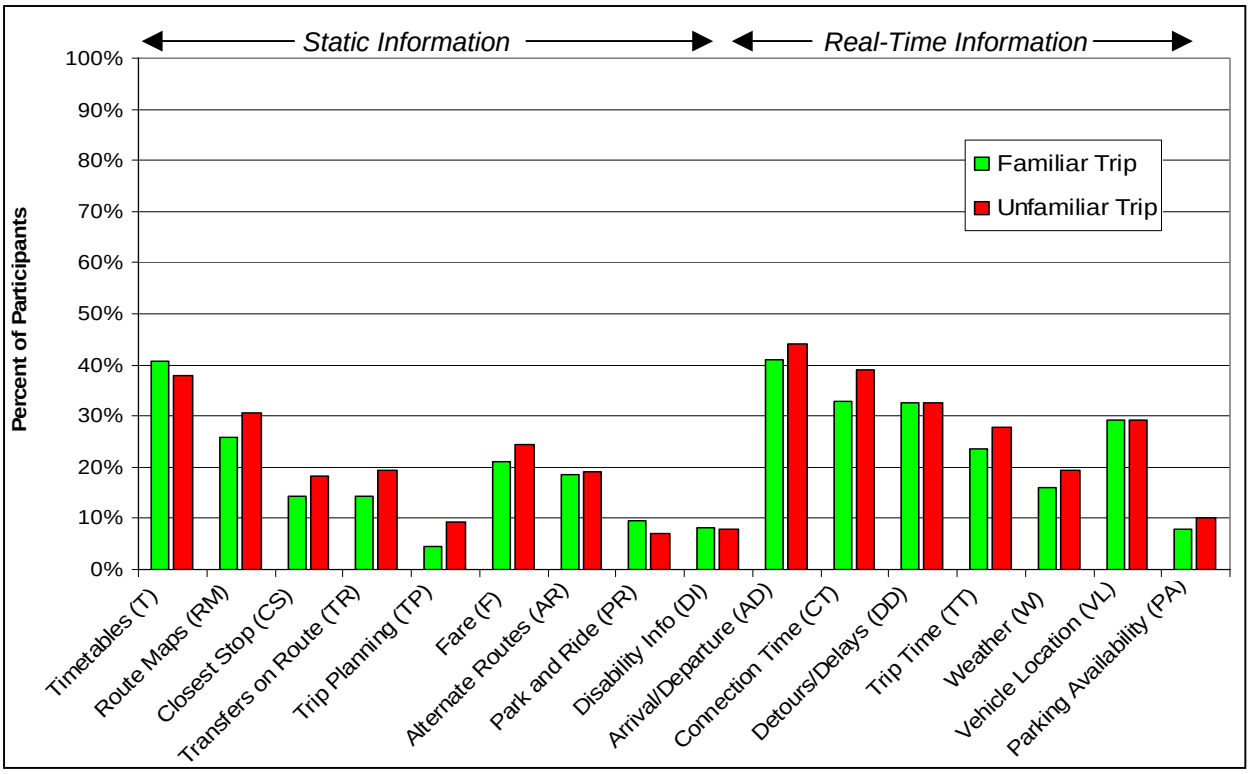


Figure 21. Percent who classified information types as Essential for Familiar and Unfamiliar transit trips: Wayside.

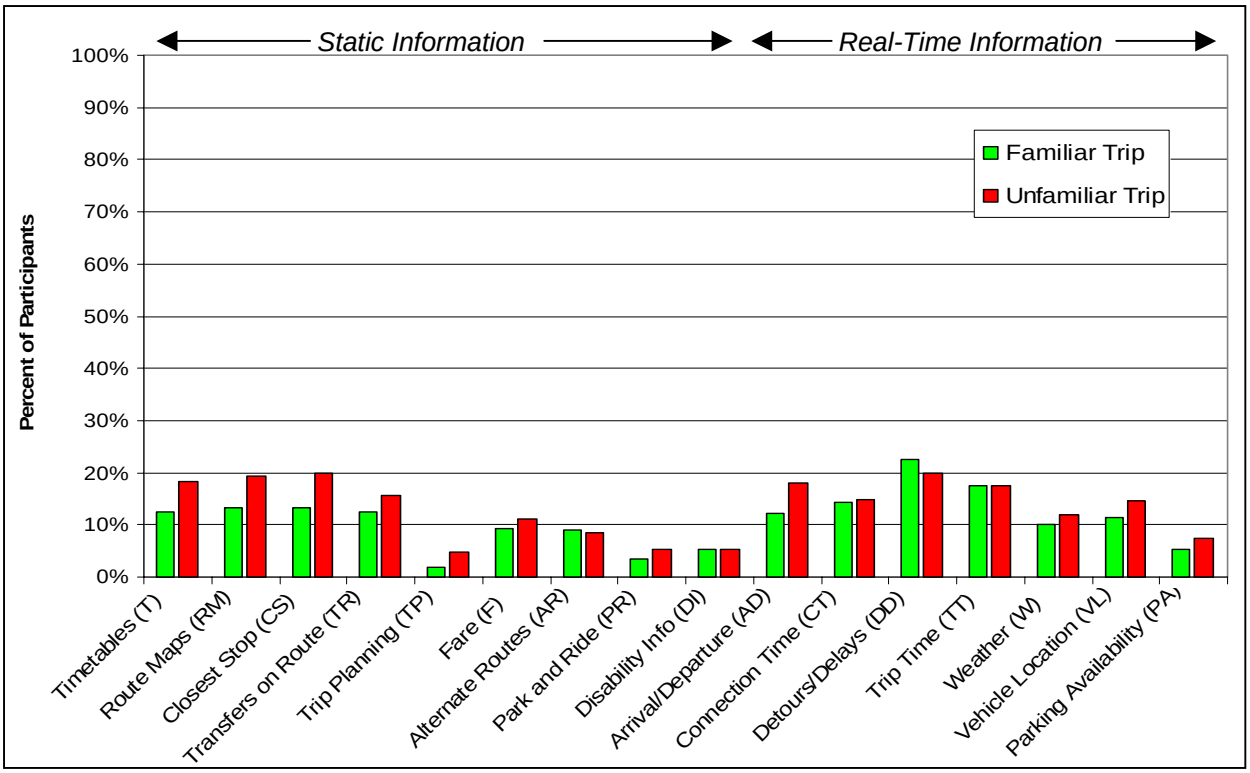


Figure 22. Percent who classified information types as Essential for Familiar and Unfamiliar transit trips: On board.

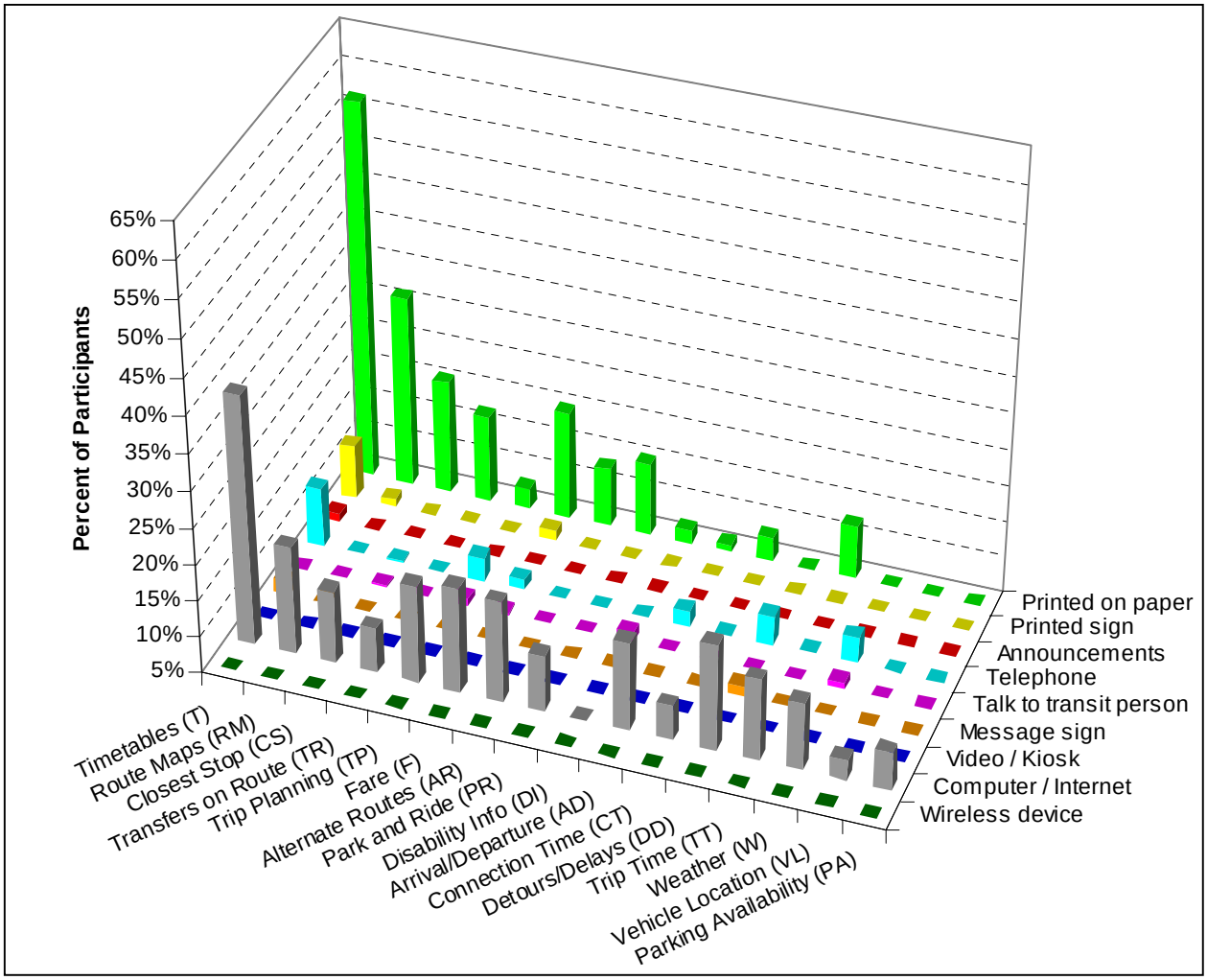
These charts show how the ways of obtaining information differ for the different types of information. For example, in Figure 23 the participants have a much greater preference for getting static trip planning information on a computer rather than in printed form. Noteworthy by their conspicuous absence are preferences for pre-trip information obtained with wireless communication devices, on video monitors (or kiosks), or on message signs. This is understandable given the lack of widespread wireless device ownership and the presumed desire for trip planning information to be dynamically interactive to be useful. Also, it indicates that customers might not want to use public kiosks for everyday trip planning. This report seeks to explain some of these pattern differences in Section 3.5 by examining differences by individual and contextual characteristics (e.g., rider age, riding frequency, access to a car, technology ownership, user attitudes toward information technology, and provision of real-time information by transit agencies).

The next pair of three dimensional graphs (Figures 24 and 27) also show preferences for essential transit information by ways to get that information, but in this case for use at a transit wayside (e.g., bus stop, park & ride, transit center). As a generalization, it seems plausible to assume that once a rider has initiated a trip, information requirements are reduced. Most trip planning has taken place, a route and time has likely been selected, and now, either at the wayside or on board the transit vehicle (Figures 25 and 28), information preferences should be fewer and more focused. This is clearly the case here. As one would expect, the patterns of information preferences at the wayside are strikingly different from pre-trip information preferences. First, one can see from the chart pattern that the type of information considered essential for both familiar and unfamiliar trips is predominantly real-time. The real-time information that transit users most want to know about are arrival/departure status, connection time, detours or delays, and vehicle location. The way they most prefer to get this kind of information is on an electronic message sign. Getting that same kind of information via a video monitor or kiosk is also preferred but less so compared to message signs and much more for unfamiliar trips than for familiar trips. Arguably, travelers are looking for a variety of optional ways to get real-time information at the wayside, especially when they are in unfamiliar territory. For the traditional or static kinds of information, the preferred way is on printed signs at the wayside, especially for timetables and less so for route maps, fares and alternative routes. These participants report that they also want to get static timetable information on dynamic message signs in addition to real-time information. For example, they would want to see on a message sign the scheduled arrival time for a bus and the actual arrival time, or more preferably the actual time remaining to arrival (countdown format). These more detailed nuances of information preferences were revealed in the breakout discussions held in each workshop, and these qualitative findings are discussed separately in this report (see Section 4.5).

The next set of charts (Figures 29 through 32) also show the participants' preferences for transit information for both their familiar and unfamiliar trips for pre-trip and wayside but these reflect information preferences considered non-essential or just nice to have. Charts for on-board the transit vehicle are not presented because very few of the information types were selected by more than 5% of the participants. The pattern differences are also striking. The first thing that is apparent is that fewer non-essential information types are selected compared with the essential types, especially for pre-trip planning. Those who feel that selected types of pre-trip information are non-essential but nice to have are thinking of accessing these information types almost

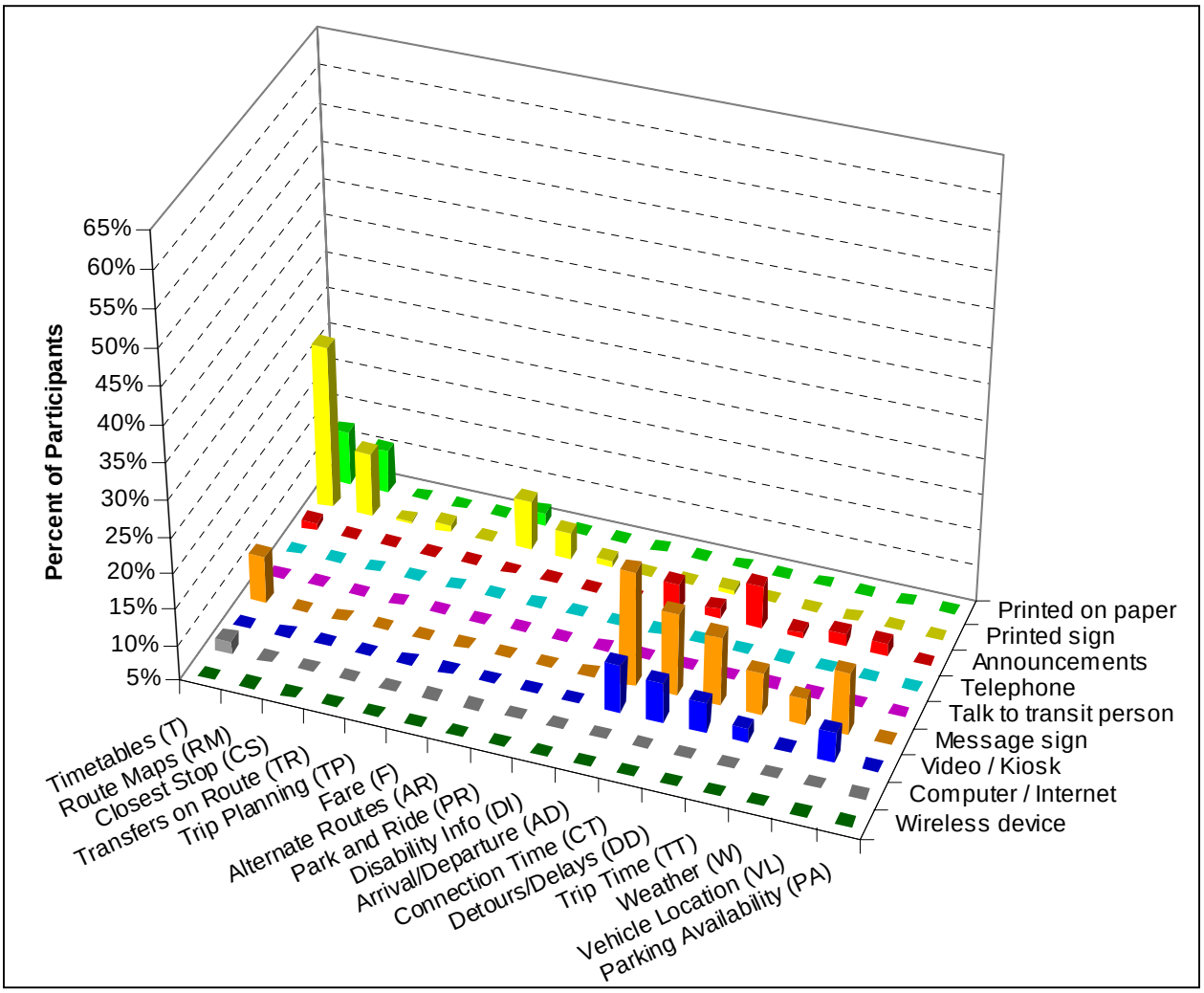
exclusively using a computer. The preferences are similar whether for their familiar trip or an unfamiliar trip (Figures 29 and 31). Information on alternate routes and weather conditions on their route are the two that the participants felt would be nice to have available via the computer or Internet.

Information at the wayside that participants say would be nice to have primarily includes most of the real-time information that is wanted either on electronic message signs or on video monitors (Figures 30 and 32). But the percent of participants expressing these preferences is relatively low, though not a lot different from the proportion of participants who indicate that this same information, presented in the same ways, is essential.



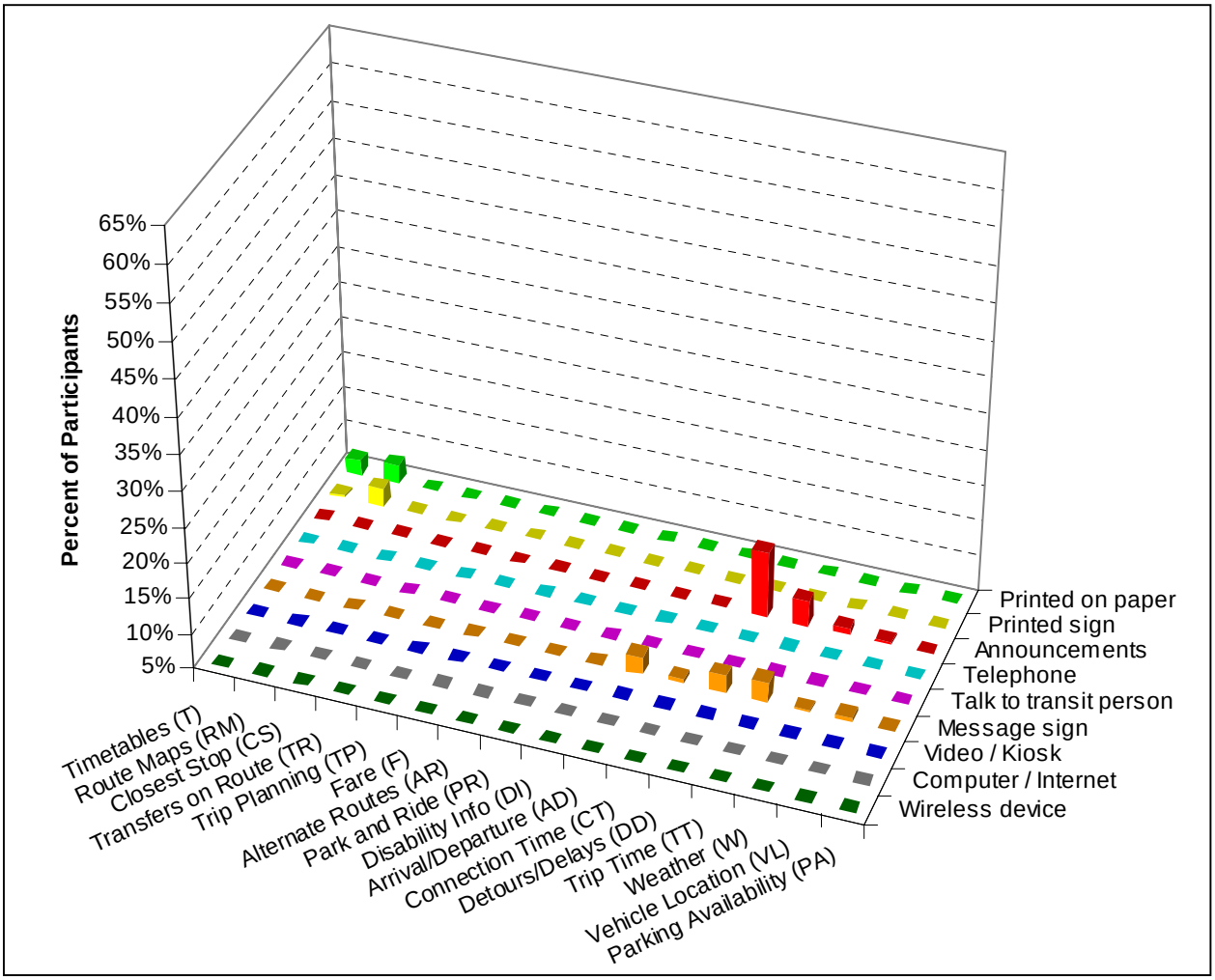
	T	RM	CS	TR	TP	F	AR	PR	DI	AD	CT	DD	TT	W	VL	PA
Printed on paper	56.6	31.1	20.6	16.9	7.9	19.9	13.1	15.0	6.7	6.0	8.2	4.9	12.4	3.4	1.1	2.2
Printed sign	12.4	6.0	2.6	3.7	2.2	6.4	3.4	2.6	2.6	2.2	1.9	2.2	4.1	1.5	1.1	1.5
Announce-ments	6.0	0.7	0.4	1.1	0.4	1.5	1.5	1.1	1.1	2.2	2.2	4.5	2.6	4.1	0.7	2.6
Telephone	13.1	3.0	5.2	3.7	8.2	6.4	4.9	3.0	4.1	7.1	4.1	9.0	5.2	8.6	2.6	4.9
Talk to transit person	3.4	1.5	5.2	4.1	6.0	5.2	4.9	3.7	6.4	3.4	3.0	4.1	2.2	6.0	0.7	2.2
Message sign	6.7	2.6	1.1	1.5	0.7	3.0	2.2	1.1	1.9	3.7	2.6	6.4	2.6	4.9	2.2	3.7
Video / Kiosk	2.2	2.2	1.1	1.5	1.1	1.5	0.0	1.1	0.7	2.6	3.0	2.2	1.9	1.1	1.9	0.4
Computer / Internet	39.3	19.9	15.0	11.2	18.4	19.5	18.7	12.7	4.5	17.2	9.7	19.5	16.1	14.2	7.9	10.1
Wireless device	3.7	1.5	1.1	1.1	0.7	1.1	1.1	0.7	1.1	3.0	1.9	3.0	1.9	2.2	1.9	0.7

Figure 23. Percent of participants who classified information types as Essential, by preferred delivery system for each type, for Familiar transit trips: Pre-trip.



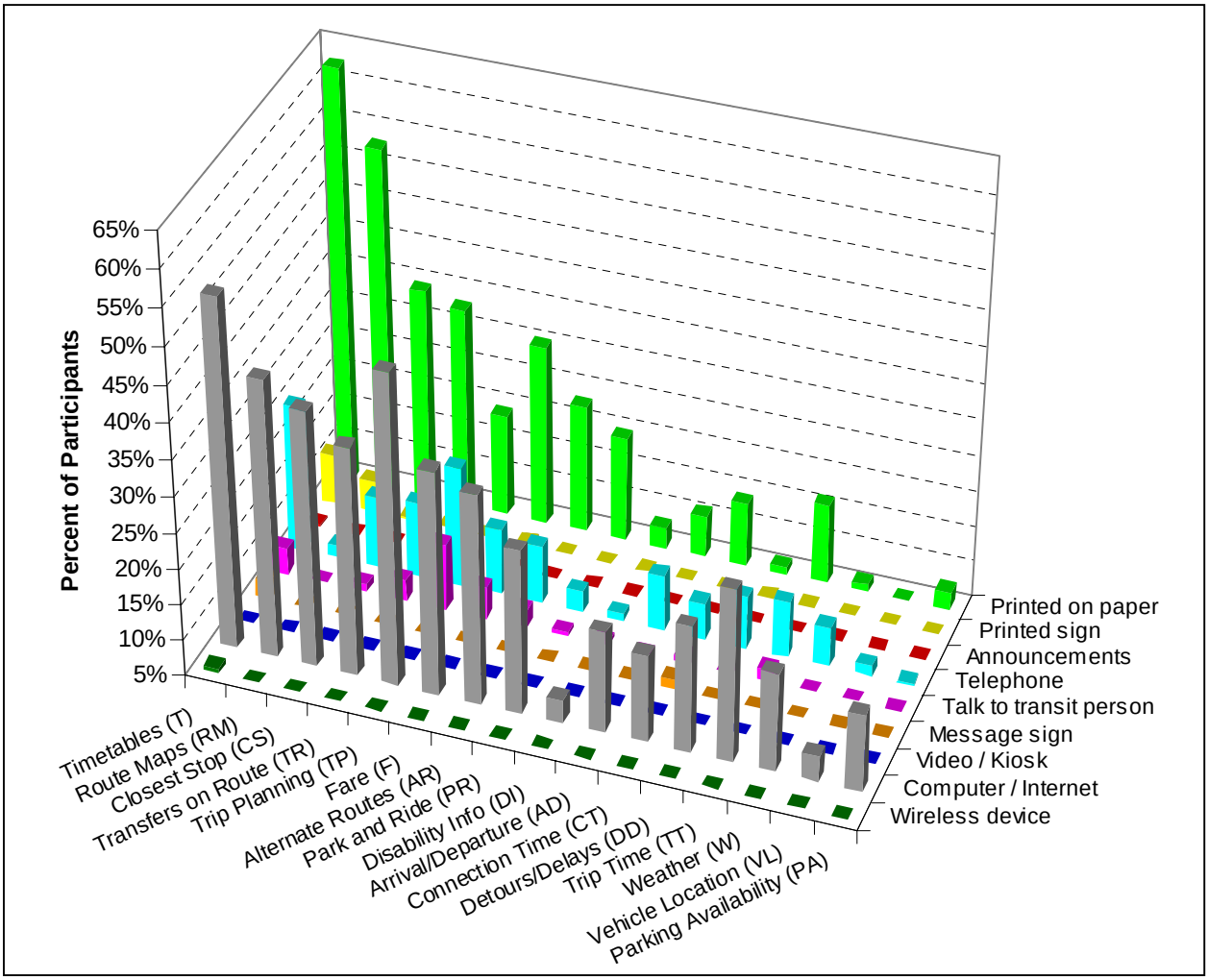
	T	RM	CS	TR	TP	F	AR	PR	DI	AD	CT	DD	TT	W	VL	PA
Printed on paper	12.4	10.9	4.1	3.4	0.4	6.7	3.7	2.6	2.2	1.1	1.9	1.5	3.0	1.1	0.7	1.5
Printed sign	27.7	13.9	5.2	6.0	1.1	12.0	8.6	6.0	4.9	4.5	5.6	4.1	4.5	1.1	2.2	1.1
Announce-ments	6.0	1.5	2.6	2.2	0.7	2.2	2.2	1.9	2.6	8.6	6.4	10.9	5.6	6.7	6.7	1.9
Telephone	4.5	0.4	0.7	0.4	0.0	1.9	1.9	0.7	1.1	4.1	4.1	4.5	3.7	2.6	3.7	0.7
Talk to transit person	2.2	1.1	1.1	1.1	1.1	1.9	1.5	1.5	2.6	3.7	3.4	3.0	1.9	2.2	1.9	0.4
Message sign	11.6	4.5	2.2	3.0	1.1	3.0	3.7	3.4	1.9	21.0	16.5	14.6	10.9	8.6	13.5	3.7
Video / Kiosk	3.7	2.6	1.9	1.1	0.7	2.2	3.4	1.5	0.7	11.6	10.5	9.0	6.7	4.9	9.0	0.7
Computer / Internet	6.7	2.6	1.5	2.6	0.4	3.4	2.2	0.7	1.5	3.4	3.4	3.7	3.4	1.9	2.6	0.7
Wireless device	1.5	0.0	0.4	0.4	0.0	0.7	1.5	0.4	1.1	3.0	2.2	1.9	2.6	2.6	3.0	0.4

Figure 24. Percent of participants who classified information types as Essential, by preferred delivery system for each type, for Familiar transit trips: Wayside.



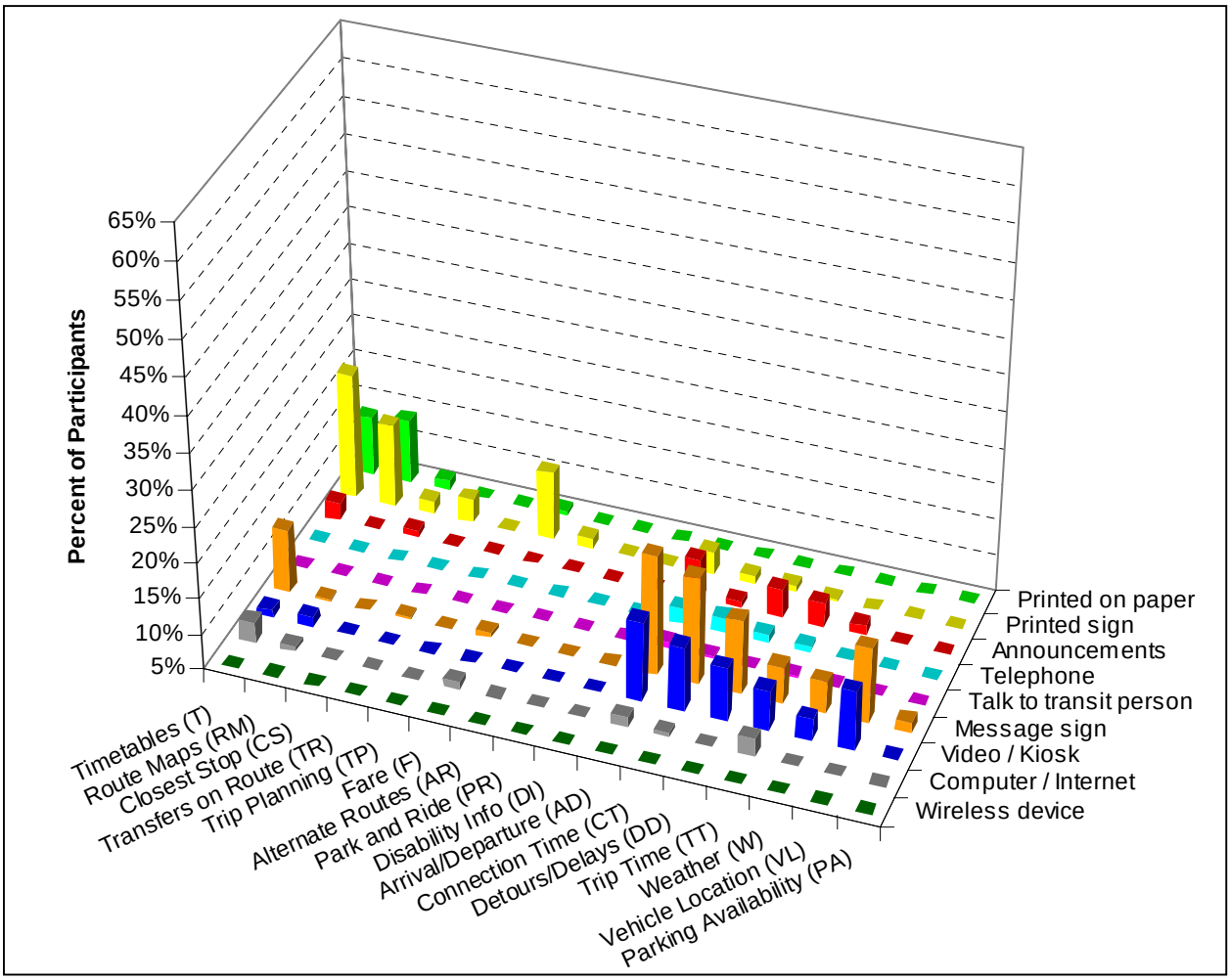
	T	RM	CS	TR	TP	F	AR	PR	DI	AD	CT	DD	TT	W	VL	PA
Printed on paper	7.1	7.5	3.0	4.5	0.7	4.9	3.7	1.5	2.2	0.7	2.6	1.9	3.0	1.1	0.4	0.7
Printed sign	5.2	7.5	3.0	3.4	0.4	4.5	2.2	1.5	2.2	1.9	2.6	2.6	1.5	0.7	0.7	0.4
Announce-ments	3.7	1.5	4.5	3.4	0.4	0.7	2.6	1.1	1.9	4.5	4.5	14.2	8.6	6.0	5.2	1.5
Telephone	2.6	0.7	0.7	0.7	0.0	1.5	0.7	0.7	1.1	1.9	3.4	2.6	2.6	2.2	2.2	1.1
Talk to transit person	2.6	1.1	3.4	3.0	0.0	1.5	1.1	1.1	1.9	0.7	1.9	3.7	0.4	2.2	1.5	0.4
Message sign	4.1	1.5	3.0	2.6	0.0	1.5	1.9	0.7	2.2	7.5	5.6	7.5	7.9	5.2	5.6	1.9
Video / Kiosk	1.1	1.5	0.0	0.4	0.0	0.4	0.0	0.4	0.7	0.7	1.9	1.5	0.7	1.1	1.5	0.7
Computer / Internet	3.7	2.6	1.1	2.6	0.4	2.2	3.0	0.7	1.5	2.2	3.0	3.0	1.9	1.9	2.6	1.1
Wireless device	1.1	0.4	0.7	1.1	0.0	0.4	1.1	0.7	1.5	1.5	1.9	1.5	2.2	2.2	2.2	1.1

Figure 25. Percent of participants who classified information types as Essential, by preferred delivery system for each type, for Familiar transit trips: On Board.



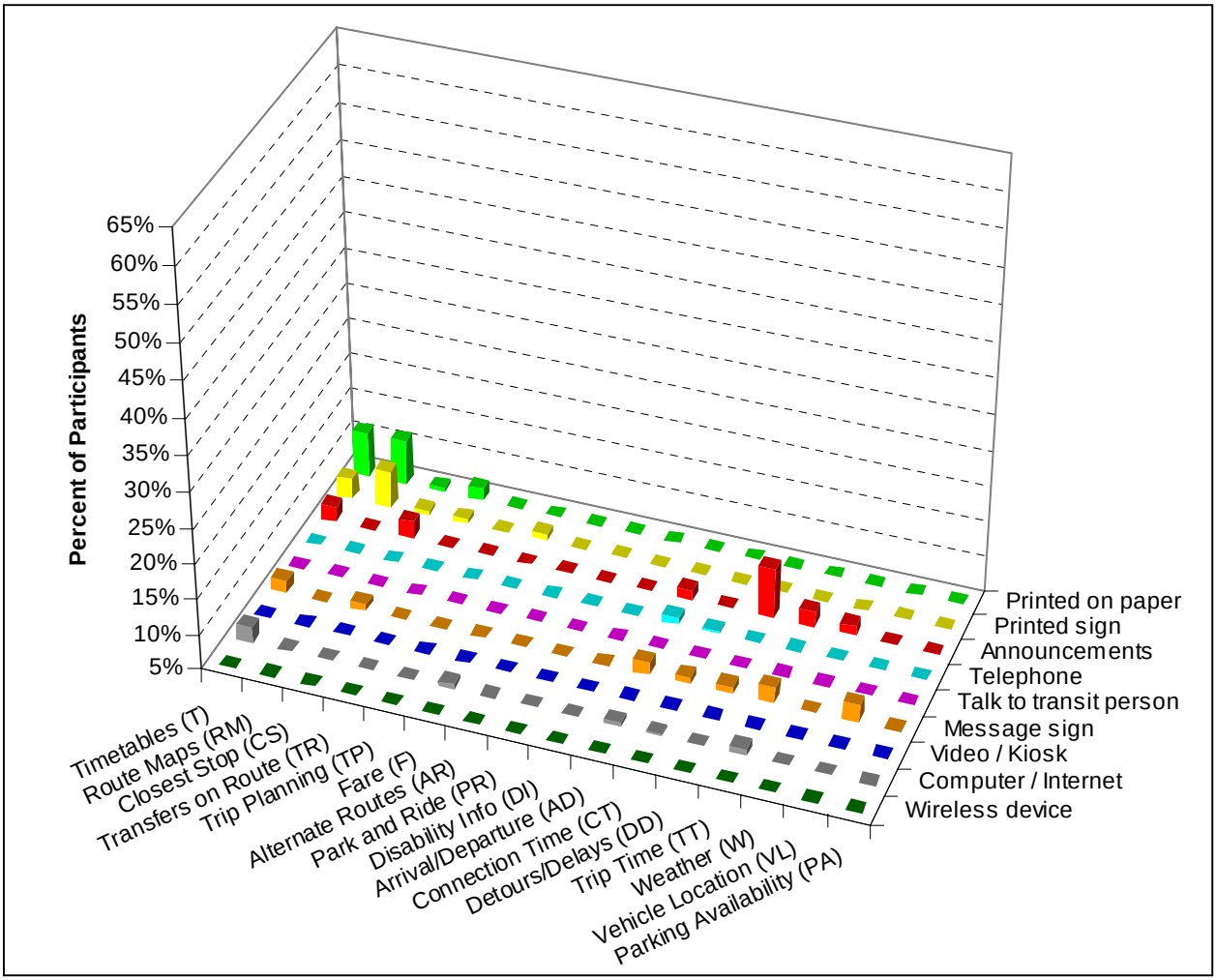
	T	RM	CS	TR	TP	F	AR	PR	DI	AD	CT	DD	TT	W	VL	PA
Printed on paper	62.5	52.8	34.5	33.0	19.1	30.0	22.8	19.5	7.9	10.9	13.9	6.0	16.1	6.0	2.6	7.5
Printed sign	12.0	9.4	5.2	4.9	1.9	5.2	4.1	4.5	4.1	4.1	3.0	2.6	3.7	1.9	1.9	2.2
Announce-ments	5.2	1.5	1.1	1.9	0.7	1.5	0.4	2.2	0.7	3.7	2.6	3.7	3.4	2.2	1.5	1.5
Telephone	25.5	6.7	15.0	15.4	21.7	14.2	13.1	7.9	6.0	12.7	10.1	12.4	12.7	10.5	6.4	5.2
Talk to transit person	8.6	4.5	6.0	7.9	14.2	9.4	7.5	5.6	5.6	4.1	6.0	3.7	6.7	4.9	3.0	3.4
Message sign	7.5	3.7	4.1	3.0	1.9	2.6	2.2	2.2	2.6	4.9	6.4	4.9	4.9	3.4	3.7	3.4
Video / Kiosk	4.1	4.5	0.7	1.1	1.5	3.0	1.5	1.1	1.9	3.7	4.5	4.5	3.4	2.6	2.2	1.9
Computer / Internet	53.2	43.4	40.4	36.7	47.9	36.0	34.1	27.7	8.2	19.1	17.2	22.5	28.8	18.7	8.6	15.7
Wireless device	5.6	3.4	2.2	1.9	1.9	3.0	2.2	2.6	1.5	3.7	2.6	3.7	3.7	3.7	1.9	1.9

Figure 26. Percent of participants who classified information types as Essential, by preferred delivery system for each type, for Unfamiliar transit trips: Pre-trip.



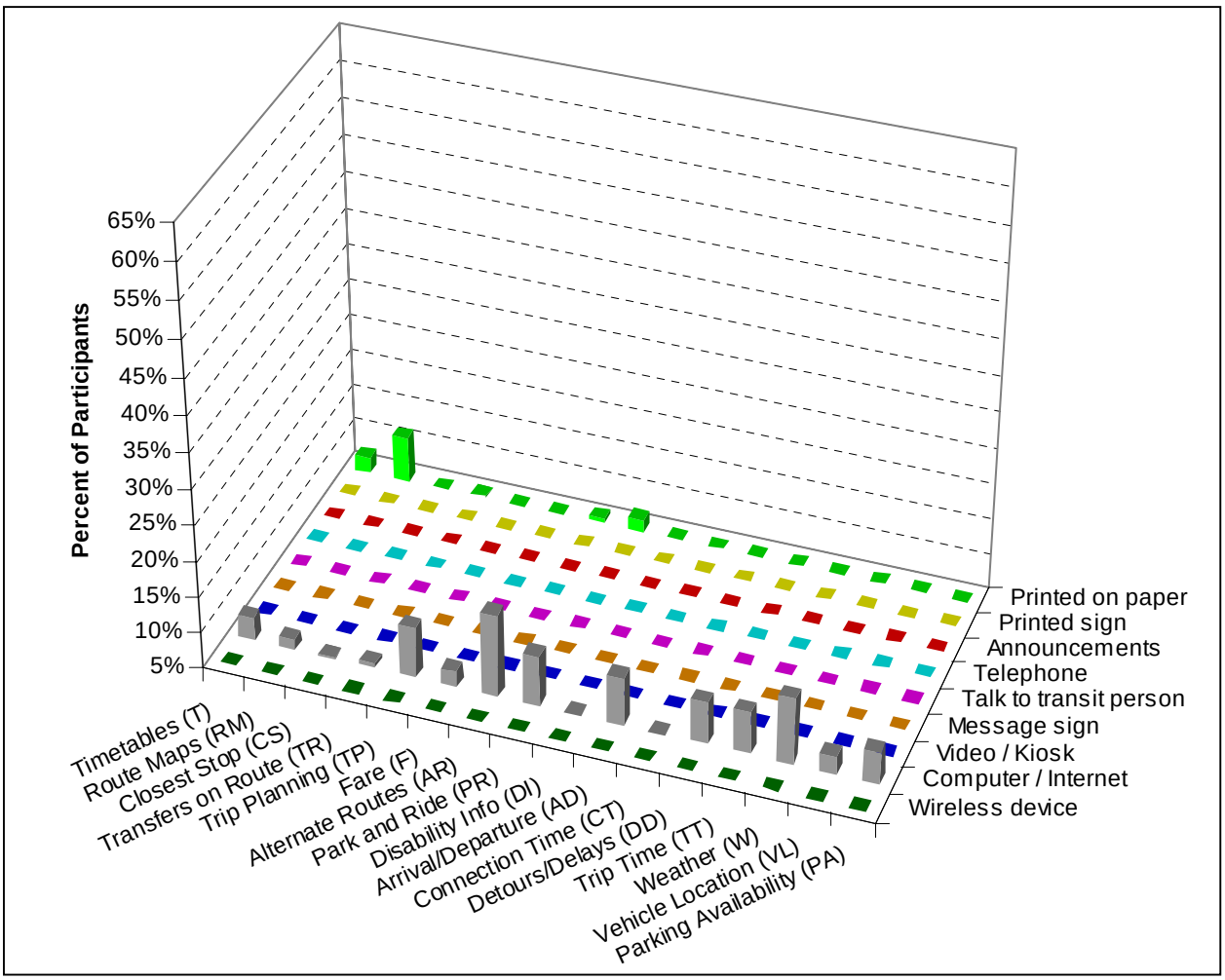
	T	RM	CS	TR	TP	F	AR	PR	DI	AD	CT	DD	TT	W	VL	PA
Printed on paper	13.1	13.9	6.4	4.9	1.1	5.6	4.9	2.6	2.2	3.7	3.7	2.2	4.5	1.9	2.2	2.2
Printed sign	22.5	16.5	6.7	8.2	1.5	14.6	6.4	3.0	3.7	8.2	6.0	6.0	5.2	2.2	3.0	2.2
Announce-ments	7.5	3.7	6.0	4.9	1.9	2.6	3.4	2.6	2.2	10.5	6.0	9.0	8.2	6.4	4.5	2.2
Telephone	5.2	1.1	3.0	3.7	2.6	1.9	2.2	1.9	2.2	7.1	7.1	6.0	5.6	3.4	4.9	2.2
Talk to transit person	3.0	2.2	1.9	3.0	1.9	1.5	2.6	1.5	2.6	6.0	5.2	3.7	5.2	2.6	3.4	2.2
Message sign	13.9	5.2	4.9	5.2	1.5	5.6	4.5	3.4	3.0	21.7	19.9	15.4	10.1	9.4	15.4	6.4
Video / Kiosk	6.0	6.4	2.2	2.6	3.4	3.4	4.5	1.1	1.9	16.1	13.9	12.4	10.5	7.9	13.1	2.2
Computer / Internet	7.9	5.6	3.4	2.6	3.0	6.0	4.1	1.9	1.9	6.4	5.6	4.9	7.5	4.1	3.4	3.4
Wireless device	3.7	1.9	2.2	1.5	1.9	1.5	1.9	1.1	1.1	4.5	3.0	4.1	3.7	3.7	3.4	1.9

Figure 27. Percent of participants who classified information types as Essential, by preferred delivery system for each type, for Unfamiliar transit trips: Wayside.



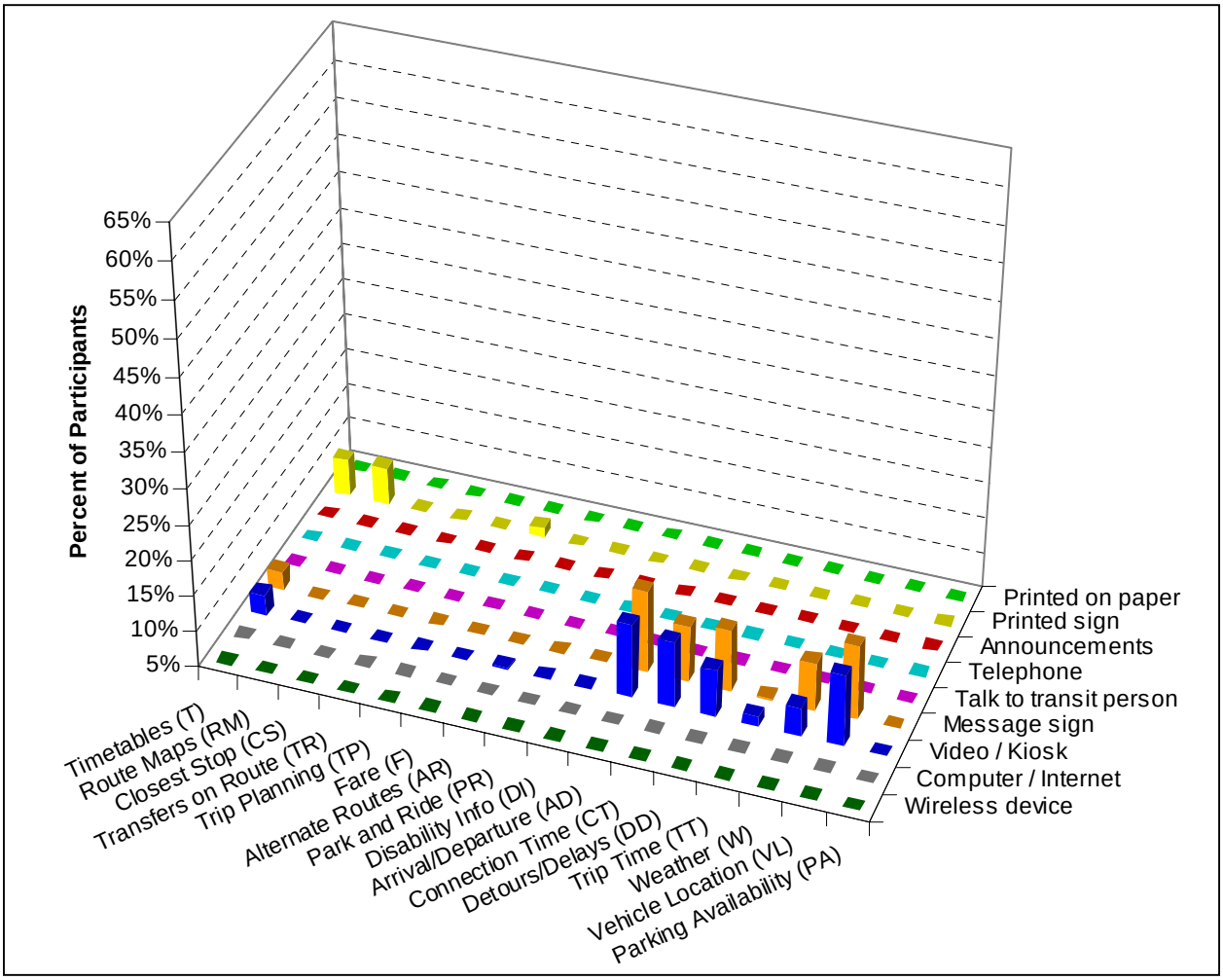
	T	RM	CS	TR	TP	F	AR	PR	DI	AD	CT	DD	TT	W	VL	PA
Printed on paper	11.2	11.2	5.6	6.7	1.1	4.1	3.7	3.4	2.2	3.4	2.6	2.2	3.7	1.5	1.5	2.2
Printed sign	7.9	10.1	5.6	5.6	1.1	6.0	2.2	2.6	2.2	3.0	2.6	2.2	3.0	1.5	2.6	1.9
Announce-ments	7.1	2.6	7.5	4.5	1.1	1.9	2.6	1.5	1.9	6.4	4.5	12.0	7.1	6.4	4.9	3.4
Telephone	4.1	1.1	3.0	3.0	1.5	1.9	1.5	1.9	2.2	6.0	5.2	4.5	4.9	2.6	3.7	2.2
Talk to transit person	3.4	1.9	4.5	4.5	1.1	1.5	1.9	1.5	2.2	3.7	3.0	3.0	3.7	1.9	3.4	1.9
Message sign	6.7	3.4	6.0	4.1	0.7	1.5	1.9	1.1	2.2	6.7	6.0	6.0	7.1	4.5	7.5	2.6
Video / Kiosk	2.6	1.9	0.7	0.7	0.7	1.5	1.5	0.7	1.5	4.1	3.4	3.0	3.0	2.6	3.4	1.9
Computer / Internet	7.1	4.9	3.7	3.0	2.2	5.6	3.7	2.2	1.9	5.6	5.2	4.5	6.0	4.1	3.4	3.0
Wireless device	3.7	1.9	1.5	1.1	1.5	1.9	1.1	1.9	1.5	3.4	3.4	2.6	3.7	3.0	3.0	2.2

Figure 28. Percent of participants who classified information types as Essential, by preferred delivery system for each type, for Unfamiliar transit trips: On Board.



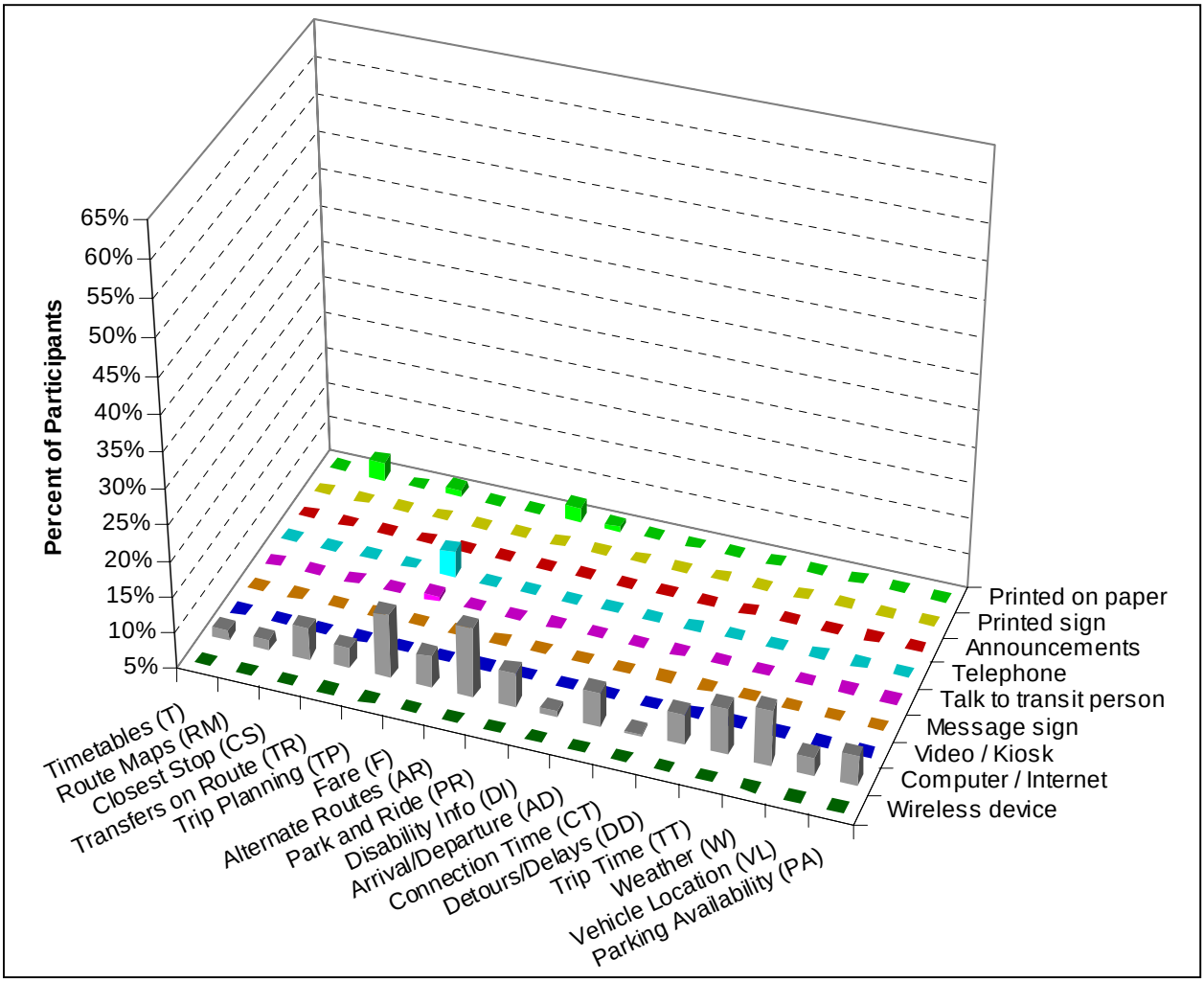
	T	RM	CS	TR	TP	F	AR	PR	DI	AD	CT	DD	TT	W	VL	PA
Printed on paper	7.1	11.2	3.4	5.2	3.7	4.5	5.6	6.7	3.0	1.1	1.1	0.0	1.5	0.7	0.0	1.5
Printed sign	1.9	0.7	0.0	0.4	0.4	1.1	2.2	1.1	1.9	0.0	0.7	0.4	0.0	0.7	0.4	1.1
Announce-ments	0.0	0.0	0.4	0.0	0.0	0.4	0.0	0.4	0.4	0.7	0.7	1.1	0.0	1.1	0.7	0.0
Telephone	4.5	0.7	0.4	0.7	4.9	2.2	4.5	1.9	1.9	1.1	0.7	2.2	1.5	1.5	1.5	2.6
Talk to transit person	1.9	0.4	0.0	0.4	3.0	1.1	1.1	1.9	1.9	0.4	0.4	1.5	0.4	0.7	0.4	0.4
Message sign	1.1	0.0	0.7	0.0	0.0	0.4	0.0	0.0	0.7	1.5	0.7	2.2	0.4	1.1	1.5	1.9
Video / Kiosk	1.5	0.7	0.0	0.4	0.7	0.0	1.1	0.4	0.7	0.7	0.7	0.7	0.7	0.4	1.5	1.1
Computer / Internet	8.2	6.4	5.2	5.6	12.0	7.1	16.5	12.0	4.1	11.6	3.4	10.9	10.9	14.2	7.5	9.4
Wireless device	4.1	1.5	1.5	1.5	3.0	1.5	2.2	3.4	0.0	1.9	1.1	1.5	1.9	2.6	1.5	3.0

Figure 29. Percent of participants who classified information types as Nice to Have, by preferred delivery system for each type, for Familiar transit trips: Pre-trip.



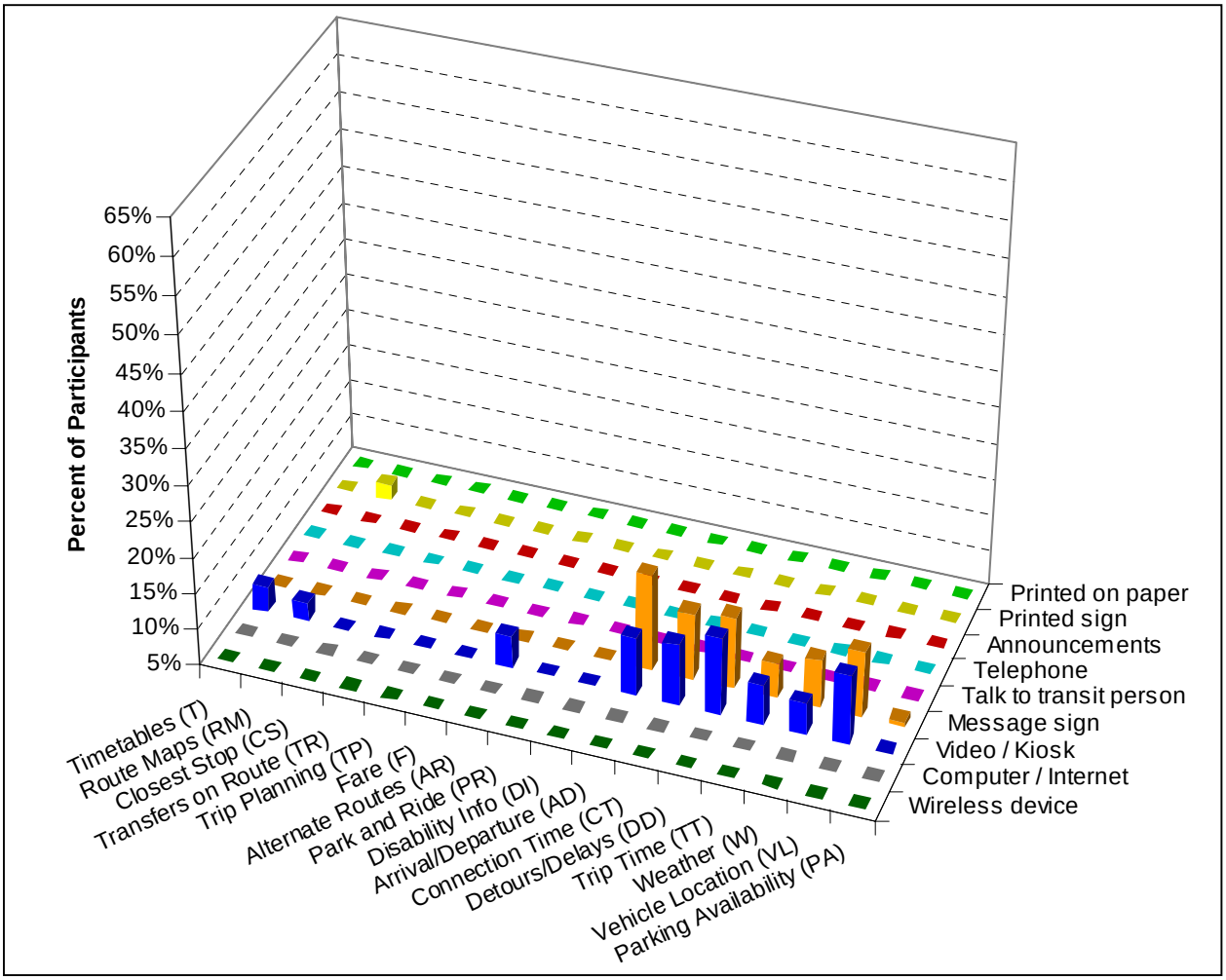
	T	RM	CS	TR	TP	F	AR	PR	DI	AD	CT	DD	TT	W	VL	PA
Printed on paper	2.2	3.7	0.7	1.9	0.0	2.6	1.1	2.2	2.2	0.4	0.4	0.0	0.0	0.0	0.0	0.7
Printed sign	10.1	10.1	1.1	2.2	0.4	6.4	3.7	1.9	3.4	1.1	1.5	1.1	1.1	1.5	1.1	0.7
Announce-ments	1.9	0.7	0.4	0.7	0.0	0.0	0.7	0.7	1.5	2.6	2.2	4.5	0.4	3.0	2.2	0.0
Telephone	0.7	0.0	0.0	0.0	0.4	0.4	1.9	0.4	0.7	1.9	2.2	2.2	1.5	2.2	3.4	0.4
Talk to transit person	2.2	0.7	2.6	1.5	0.4	1.1	2.2	0.0	0.7	1.1	2.6	2.2	1.1	0.7	2.2	0.4
Message sign	7.5	1.1	0.7	0.4	0.7	1.5	2.2	1.5	2.6	16.5	12.7	13.5	5.2	11.6	15.4	4.5
Video / Kiosk	7.9	4.5	1.1	1.1	1.9	1.9	5.2	1.9	1.9	15.4	14.2	11.6	6.4	9.0	15.0	1.9
Computer / Internet	1.1	0.7	0.7	0.7	0.4	1.5	1.9	1.9	1.1	1.9	1.9	3.4	0.7	1.5	2.2	0.0
Wireless device	3.0	1.1	0.7	1.5	1.5	0.7	3.0	1.1	0.4	4.9	2.6	2.6	1.9	1.1	3.7	0.7

Figure 30. Percent of participants who classified information types as Nice to Have, by preferred delivery system for each type, for Familiar transit trips: Wayside.



	T	RM	CS	TR	TP	F	AR	PR	DI	AD	CT	DD	TT	W	VL	PA
Printed on paper	5.2	7.5	2.6	6.0	3.4	4.1	7.1	5.6	3.4	0.7	1.1	0.7	1.9	0.4	0.7	0.7
Printed sign	1.9	1.1	0.0	1.1	0.4	0.7	2.6	1.1	1.1	0.7	0.7	0.0	0.4	0.4	0.4	0.0
Announce-ments	0.0	0.4	0.0	0.0	0.0	0.4	0.4	0.0	0.4	0.0	0.7	0.4	0.0	0.0	0.4	0.0
Telephone	3.7	0.7	3.7	3.4	8.6	2.6	4.1	2.6	1.5	3.0	1.1	3.4	2.6	3.7	3.0	1.9
Talk to transit person	3.0	0.7	2.6	1.9	5.6	1.1	3.0	3.0	3.0	1.9	0.0	0.4	1.5	0.4	0.4	0.4
Message sign	0.7	0.4	0.0	0.7	0.0	0.7	0.4	0.0	0.4	0.7	0.7	2.2	0.0	0.4	1.5	1.1
Video / Kiosk	1.1	0.7	1.5	0.0	1.1	0.7	1.1	0.4	0.7	0.7	0.4	1.1	0.4	1.1	0.7	1.9
Computer / Internet	6.4	6.4	9.4	7.9	13.9	9.4	14.6	9.7	5.6	9.7	5.2	9.4	11.6	12.7	7.5	9.0
Wireless device	3.7	3.0	1.5	1.5	3.0	1.1	1.1	0.7	0.4	0.7	1.1	1.5	1.5	1.9	0.7	1.9

Figure 31. Percent of participants who classified information types as Nice to Have, by preferred delivery system for each type, for Unfamiliar transit trips: Pre-trip.



	T	RM	CS	TR	TP	F	AR	PR	DI	AD	CT	DD	TT	W	VL	PA
Printed on paper	2.2	4.1	0.4	2.2	0.0	2.2	1.9	1.9	2.2	0.4	0.7	0.0	0.4	0.0	0.4	0.4
Printed sign	4.1	7.1	0.4	2.2	0.4	3.7	4.1	1.5	3.0	1.5	2.6	1.9	0.7	1.5	1.1	0.7
Announce-ments	0.7	0.0	0.0	1.1	0.0	0.4	0.4	0.0	1.5	3.0	3.7	4.1	1.9	2.2	4.5	0.0
Telephone	1.1	0.0	0.0	0.0	1.1	1.1	1.5	1.1	0.7	3.0	1.9	1.5	1.1	1.9	1.9	0.4
Talk to transit person	1.5	0.0	1.1	0.7	1.1	0.7	1.1	0.0	1.9	1.1	1.1	0.7	0.4	1.1	1.5	0.7
Message sign	4.5	2.2	0.0	0.7	0.7	1.9	2.6	1.9	1.9	18.4	14.2	15.0	9.7	11.6	14.2	5.6
Video / Kiosk	8.6	7.5	4.9	4.9	4.5	3.0	9.4	1.9	3.0	13.1	13.5	15.7	10.5	9.4	14.6	3.4
Computer / Internet	0.7	0.4	1.1	1.1	1.5	1.5	2.2	2.2	3.0	2.6	1.9	1.5	1.5	2.2	2.6	1.9
Wireless device	1.5	1.1	0.4	0.7	1.1	0.7	1.1	0.0	0.7	2.6	3.0	2.6	2.2	2.6	3.0	1.1

Figure 32. Percent of participants who classified information types as Nice to Have, by preferred delivery system for each type, for Unfamiliar transit trips: Wayside.

4.4 Effects of Participant Characteristics and Contextual Factors on Information Preferences

The previous analysis has described how the workshop participants expressed their preferences for information needed to facilitate their transit trip making. This section explores the extent to which the information needs vary for different groups (or segments) of the participants.

Figure 33 shows a simple model of some of the factors that are expected to influence transit information needs. It is well known that use of ATIS varies by the demographic characteristics of the user, as well as travel frequency (a proxy for familiarity with the transit system), and access to and use of the communication technologies that are being adopted by DOTs and transit agencies to facilitate information dissemination. Some generalizations include the following:

- Younger persons and those in a higher socioeconomic group tend to be more comfortable with new technologies such as computers, cell phones, wireless communication devices, and the Internet. Younger participants in the workshops were expected to express greater preference for these high tech approaches to transit information than older participants.
- More frequent transit travelers might want less information, especially for their familiar trips but also perhaps for their unfamiliar trips, compared with infrequent transit travelers.
- Persons who currently have and use high technology communication devices are likely to be those who most want to access transit information using those technologies.

Individual attitudes toward such things as the use of technology and value of time are also known to be related to some of the individual characteristics discussed above, as well as to influence how, when and where a person might be expected to need information associated with a transit trip. For example:

- Comfort with technology in general is expected to be related to preference for high technology approaches to accessing transit information.
- Attitudes toward transit use and the availability of good information are expected to be related to the amount and frequency of needing information.
- Attitudes toward preferred ways of getting information (e.g., paper versus the Internet) should be related in obvious ways with how these participants say they want to get their transit information.

A third set of factors fall under the heading of transit agency context. The idea here is that individuals who are exposed to a particular transit environment, and have some experience with a particular set of transit information services that are routinely available to them will express preferences for transit information that are influenced by that context. It is more difficult to hypothesize outcomes in this regard, but an expectation would be that transit riders whose agencies currently provide real-time travel information are likely to express a higher preference for that type of information due to their familiarity with it and their direct experience of the benefits it offers. These hypotheses are explored further in this section with the data from the workshop surveys.

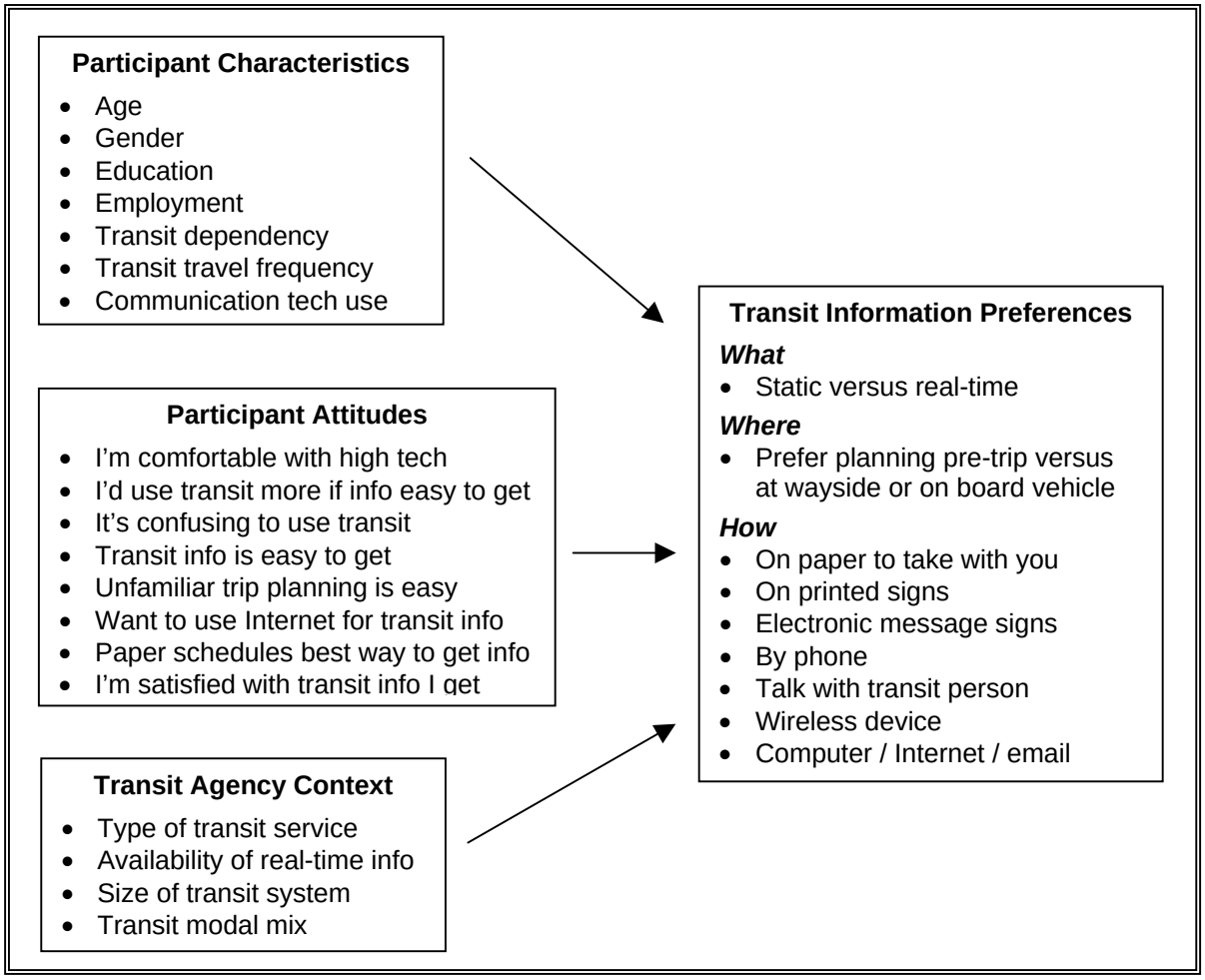


Figure 33. Conceptual model of factors influencing transit information preferences.

4.4.1 Gender

A total of 141 female and 118 male participants were included in an analysis of gender. Seven participants were not included due to lack of data on gender. Gender was first cross tabulated with responses to general attitudinal questions. Three of the 16 attitudinal questions revealed the largest differences between males and females. Figure 34 shows that males are generally more comfortable using high tech devices, are more easily annoyed when their travel is delayed, and they are less likely than females to say they can rely on published transit schedules.

Considering preferences across all the trip-making components (pre-trip planning, wayside, and on-board), the survey revealed that the male participants were generally more interested in static information than the females, especially for route maps, closest stop information, and fares (Figure 35). The difference between female and male interest in disability information is likely due in part to the larger number of disabled females than males in the sample. Males also indicated a larger interest in more types of real-time information. The only real-time information that the females were much more interested in than males was information on current weather.

The survey found differences in where and how males and females want to get different types of transit information. Females indicated that they use the telephone primarily for acquiring static timetables and real-time information on arrivals/departures, detours and delays, and weather, while males use the phone primarily for timetables and the trip planning service. Males were more likely than females to say that static and real-time information would be nice to have via telephone.

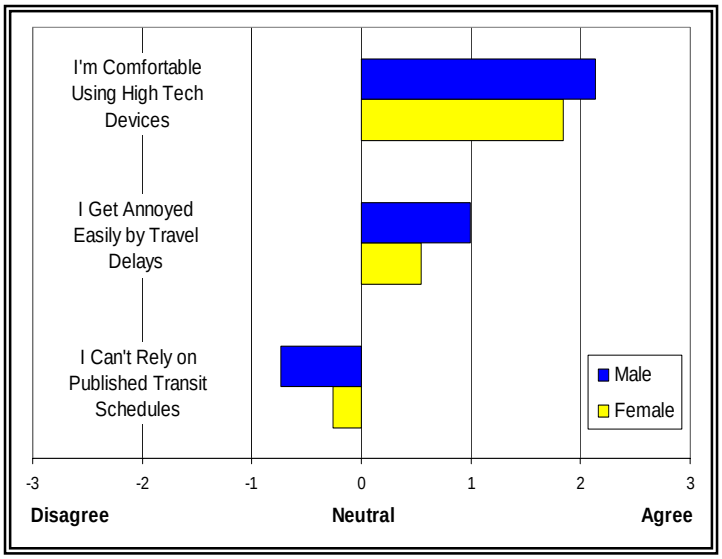


Figure 34. Differences in attitudes between males and females.

For the wayside, females indicated a greater preference for real-time information than males for every real-time information type (Figure 36), though these gender differences were not large. Females were more likely to report that the presentation of static information on video monitors/kiosk at the wayside is essential for them, while males were more likely to say that video is simply nice to have.

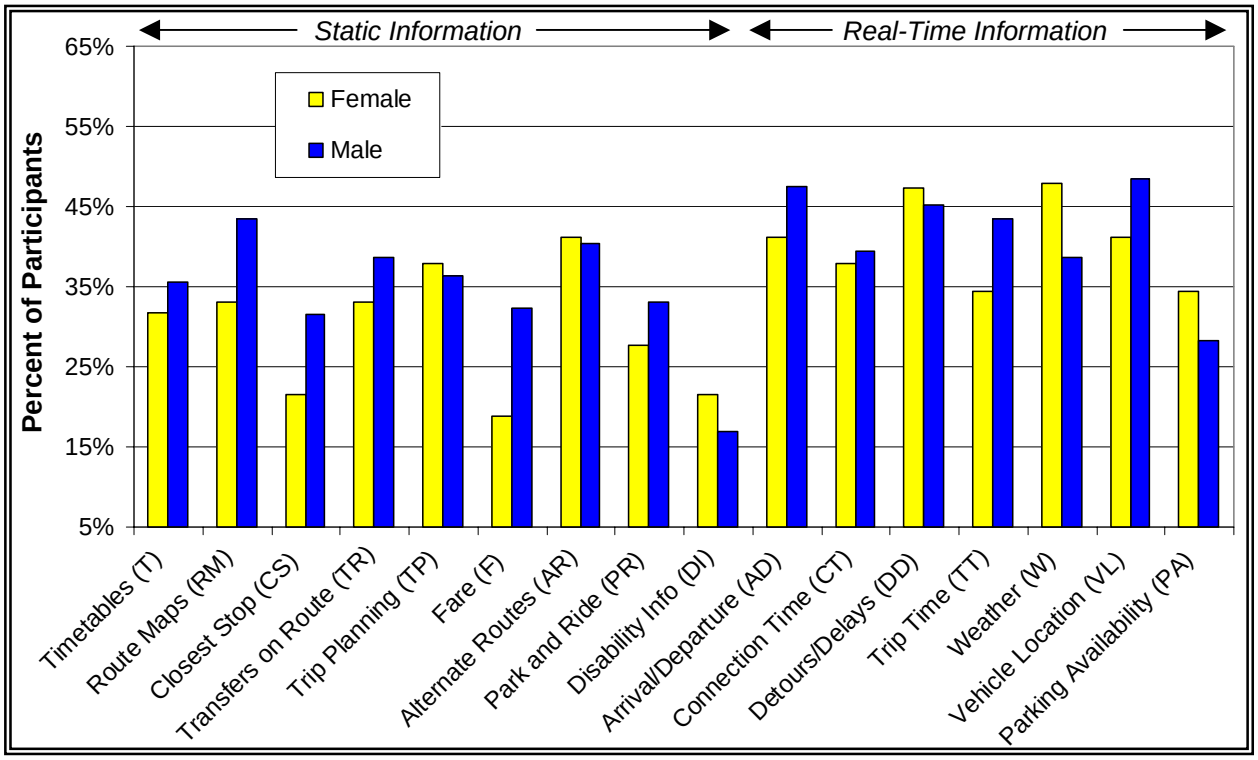


Figure 35. Information preferences by gender.

4.4.2 Age

The participants were divided into four separate age groups: 18-24 (N=81), 25-44 (N=81), 45-64 (N=82), and 65 and over (N=22). It is expected that younger persons are more comfortable with high technology devices, and therefore more likely to use them when gathering information on and during their transit trips. The data generally support this hypothesis. Those in the 65 and older group reported less dependency on computers for pre-trip planning and more dependency on printed paper. The youngest (18-24) age group reported a heavier reliance on using a telephone to get information for familiar trips, both for static and real-time information. While one would expect that this is due to a larger popularity of cellular phones in this age group, cellular phones are popular in all four age groups in this sample (Figure 37). Hence, it might be a difference in the patterns of use in younger cellular phone users, who might use them more often and for different purposes than older cell phone users.

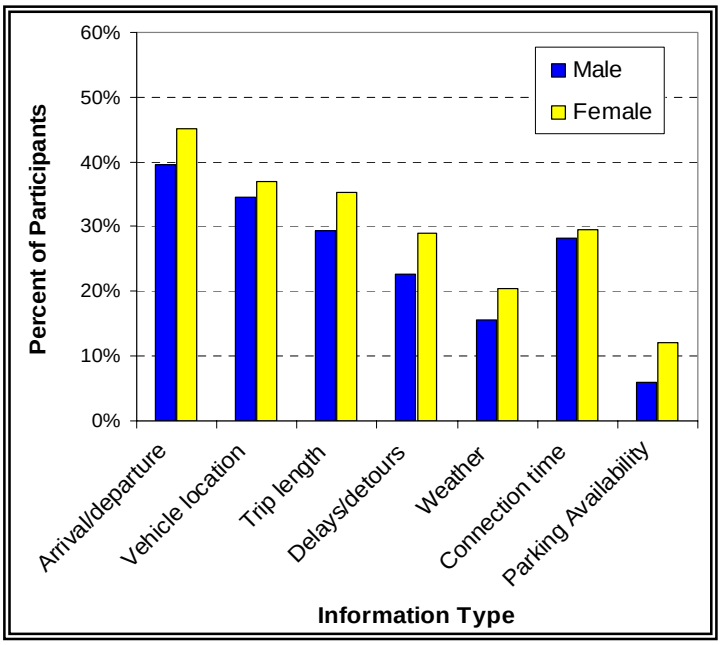


Figure 36. Differences in preferences for real-time information at the Wayside for males and females.

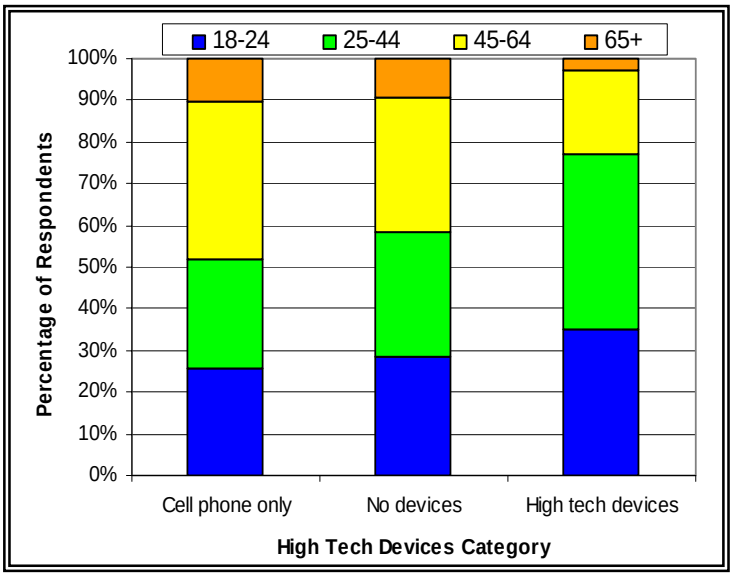


Figure 37. Distribution of high tech device access by age group.

At the transit stops and stations senior citizens express less preference for information overall while the youngest age group wanted the most. Generally, the desire for information presented on video monitors or kiosks decreased with age. The respondents aged 25-64 consistently wanted real-time information via video and message signs.

Preferences for information while on-board the transit vehicle differed by age group. General pattern analysis by percentage of respondents in each age group indicated an inverse relationship by age group in technology acceptance, comfort, and, as expected, preference. However, the 24-44 and 45-64 age groups showed little differences in this analysis, so they were combined. Persons 65 and older indicated greater preferences for traditional ways of gathering information, including talking to a transit

person (likely the bus driver) and auditory announcements for information on the closest stop and real-time information about delays and detours. Like the 65 and older participants, those in the 24-44 and 45-64 age groups wanted real-time information via announcements, but they also wanted the same information displayed on message signs. The younger group was more diverse with regard to their information preferences. These participants felt that is was important to have low-technology items such as timetables and route maps printed on paper and signs and real-time information via announcements and message signs. However, a large number of them indicated that it would be nice to have all types of information available on a computer, such as a laptop or PDA. Consistent with their preference for pre-trip information over the phone, participants in the youngest group indicated that it would be nice to have access to real-time information on their cell phone while on-board the transit vehicle.

4.4.3 Education Level

Participants reported their completed education levels in terms of five categories: high school, trade or vocational school, some college, college graduate, and post-graduate degree. Frequency of ridership was generally similar across these categories, with the exception of trade school, that was likely due to the small number of participants in this category (N=11). Overall, there was an inverse relationship between education level and level of preference for information types, most notably with information related to trip planning. Those who only completed high school or trade school indicated a greater preference for trip planning services, alternate routes, and the location of the closest stop or station on their route. Higher educated participants expressed a greater preference for accessing transit information on the Internet as well as by video or kiosks. Less educated participants indicated a greater preference for talking to a transit person.

4.4.4 Frequency of Ridership

Respondents were classified into four ridership frequency groups based on the number of one-way trips taken in the past 30 days. Frequent riders tend to report higher levels of comfort and confidence when riding transit, though high riding frequency may simply be associated with a necessary daily commute. Commuters are typically familiar with a single route, which they can ride with great confidence (Higgins, et al., 1999). Non-riders (N=59) were defined as being participants who reported zero transit trips.[2] These riders were primarily middle-aged (74% aged 25-64), had access to a personal vehicle most or all of the time (93%), and were employed at least part time (76%). Infrequent riders (N=53) reported 1-4 transit trips. These riders were also primarily aged 25-64 (74%) and had access to a vehicle (89%), but were less likely to be employed (58%). Mid-frequency riders (N=102) reported 5-35 transit trips. These riders tended to be equally distributed across age groups (from 31% to 45% of the total in each age group) and employment status (36% of full-time, 31% of part-time, and 41% of unemployed), and they had moderate access to a vehicle (67%). High-frequency riders (N=58) reported greater than 35 trips. These riders included mostly younger and late middle-age persons (41% and 33%, respectively), had the lowest vehicle availability (34%), and were generally employed (88%).

Pre-trip Information. As expected, information requirements for mid- and high-frequency riders are less than for non- and infrequent riders for a familiar trip. All four groups want information both printed on paper and computer. Infrequent riders expressed the greatest interest in static information on a computer and the least desire for information on a telephone. Non-

riders want to talk to a transit person for both their familiar and unfamiliar trips, infrequent riders reported no need, and frequent riders prefer to talk to transit representatives only for their unfamiliar trip. This last point could be due to the more frequent rider knowing how to travel a familiar trip (e.g., daily commute), and having less confidence planning a trip on a different route. Non-riders were the only group that indicated a clear desire for information (timetables, route maps, and alternative routes) on a wireless device. This finding is inconsistent with participant reports of device ownership other than a cellular phone, as only 20% of non-riders report having such devices compared with 45% of the mid-frequency riders.

All riders showed an interest in all types of real-time pre-trip information. Non- and mid-frequent riders wanted to access this information using a computer or telephone. Infrequent riders wanted this information solely via computer. High-frequency riders showed interest in an assortment of different ways to get the information, including telephone, talking to a transit person, computer, and wireless device (the latter for detours/delays, trip time, and weather).

Wayside Information. While all types of riders were interested in some type of electronic signage for the presentation of real-time information, the strongest preferences were held by non- and high-frequency riders, who generally preferred message signs and announcements rather than video terminals. The reason why non-riders would be more interested in announcements and message signs than higher-frequency riders may be due to less confidence in their ability to find the correct transit vehicle at the wayside. Only non-riders were interested in information on parking availability. As seen in the description of pre-trip information above, high-frequency riders did not agree upon a preferred delivery system for real-time information. While most indicated a preference for message signs and announcements, others expressed a desire to get information via telephone, talking to a transit person, and wireless device.

On-board Information. Large variation in preferences for on-board information is related to riding frequency. As expected, non- and infrequent riders report more dependence on timetables, route maps, and other static information on paper and in-vehicle signs than more regular transit riders. Similar to wayside information, non- and high-frequency riders had the greatest desire for real-time information on board the transit vehicle. However, while both non-riders and high-frequency riders wanted information by announcements, high-frequency riders tended to rely more on talking to a transit person and non-riders on message signs. Mid-frequency riders expressed little preference for any kind of on-board information. Interestingly, transit riders more often classified real-time information as nice to have, rather than essential, compared with non-riders. This finding may reflect an artifact of the survey's design. Specifically, in the categorization of information items into essential vs. nice to have, participants were instructed to classify an item as essential only if they felt it would be difficult to make the trip without that type of information. Therefore, users might have indicated real-time information as something that would be helpful to have, though they could make their transit trip without it.

4.4.5 Vehicle Availability

Three different levels of vehicle availability were identified: persons who always, sometimes, or never have a vehicle available to use. Vehicle availability is an indicator of transit dependency – those who do not have access to a vehicle are more likely to rely on transit for their mobility needs. Vehicle availability also tends to be associated with income level. The survey results

indicated that vehicle availability is related to the preferred information delivery method. Participants who had more access to a vehicle indicated more of a desire for information available on a computer, wireless device, electronic message sign, and video monitor. In contrast, those who did not have a vehicle available showed a preference for more traditional information sources, such as telephone, talking to a transit person, announcements, and information printed on signs. It is logical to expect that persons who have a vehicle available to them would be more likely to need parking information. This was in fact the case – persons who always had a vehicle were the most interested in park & ride information. Those who sometimes had access to a vehicle were slightly interested, and those who never had a vehicle were never interested in park & ride information. In addition, the need for real-time parking information via video monitor/kiosk and message sign increased with the availability of a vehicle.

4.4.6 Access to High-Technology Devices

Another possible indicator of socio-economic level is access to high-technology devices. These devices tend to be expensive and those with a continuous service plan, such as a cell phone or Internet service, usually require long-term commitments. Three different segments were used to identify differences in transit riders' preferences according to their access to high-technology devices, such as cell phones, internet-enabled cell phones, personal digital assistants (PDA), internet-enabled laptops, and pagers. These segments included those with no devices (N=120), those with a cell phone only (N=118), and those with other high-tech devices (N=29). Not surprisingly, cell phone and other high-tech device users rely more on telephone and computers than those with no devices (Figure 38). Some of the high-tech device users indicate that the ability to access a trip planning service on a wireless device would be nice to have, while those with no devices or just a cell phone indicated that it is nice to have trip planning via telephone.

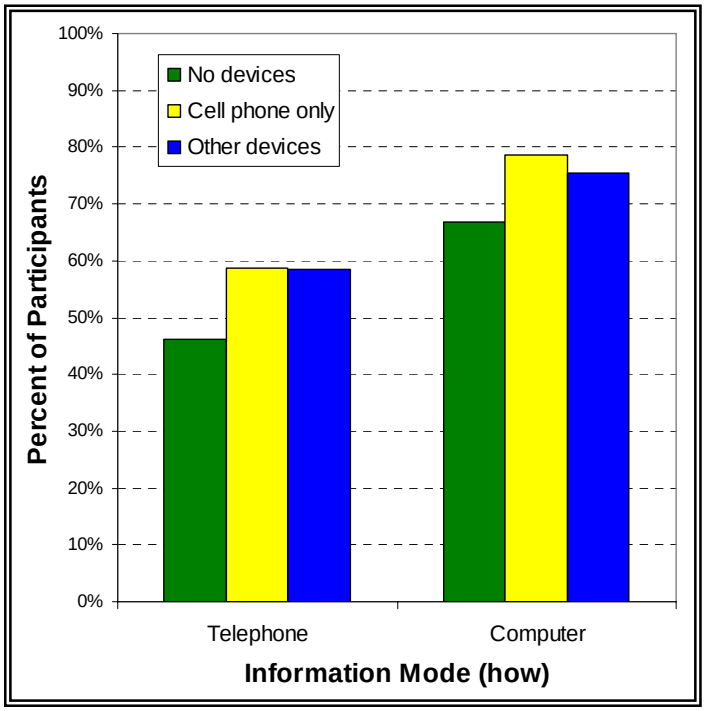


Figure 38. Distribution of telephone and computer preference by type of high-tech device availability.

4.4.7 Attitudinal Questions

It was hypothesized that participant responses would vary according to their responses to the attitudinal and behavioral questions asked in the background questionnaire. Most of the attitudinal questions yielded little variation in participant information preferences. As expected, participants who indicated that it is important for them to be able to gather transit information via telephone preferred information by that delivery method. However, they also showed the highest preferences for information printed on paper and signs, as well as talking to a transit person. They showed the

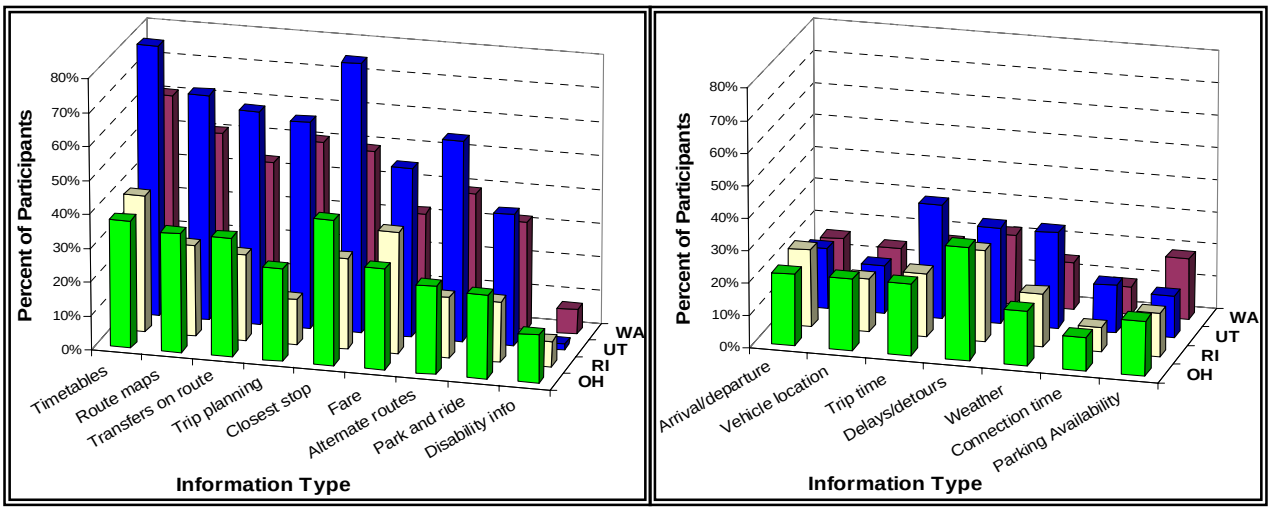


Figure 39. Essential static (left) and real-time (right) information types preferred to be accessed via computer by workshop location.

least interest in the Internet, video sources, or wireless devices. In contrast, those who indicated that it is important for them to gather transit information on the Internet showed the greatest interest in the Internet and video sources.

4.4.8 Geographic Location

In addition to differences in types of transit services, the information offerings that differ across the four workshop sites could influence information preferences. The transit systems in Rhode Island and Ohio had fewer ATIS applications than those in Utah and Washington (for more details about ATIS deployment in each of the four workshop locations see Appendix A). Rhode Island and Ohio participants indicated a large variety of information preferences and ways of getting the information, gathering it from paper, printed signage, computer, telephone, and talking to a transit person. Though Washington respondents have the most current availability of real-time information about arrivals/departures and vehicle location via computer (refer to Table 1), they reported the lowest preferences for such information. This trend is consistent with comments offered by participants during the workshop discussion groups that some of them were not aware of the presence of these high-tech online tools. Because the Utah participants were recruited from an Internet mailing list, it was predicted that they would be more “tech-savvy” than participants from the other workshop locations. This characteristic is reflected in the results from the Utah respondents: they have the most consistent preference for static information via computer for pre-trip information (Figure 39).

Utah respondents clearly indicated a preference for getting real-time en-route vehicle timing information from message signs, very likely because the UTA TRAX information system uses dynamic message signs to display this type of information throughout its service area. Both Washington and Utah participants reported a preference for auditory announcements on the vehicle informing them of delays and detours.

4.5 Patterns of Use of and Preferences for Information: Discussion Group Findings

The breakout discussion groups that were held in the second half of each workshop encouraged a free-flowing discussion among the participants to explore in some detail how the participants used transit information and how they thought access to transit information could be improved. A discussion moderator's guide was used to provide consistency between groups (see Appendix I). This section presents the key issues and ideas from these discussions, organized around the three key components of a public transportation trip where customers are likely to want information:

- Pre-trip planning preferences
- Wayside information preferences
- Onboard information preferences

The findings under each of these three situational topics are organized in terms of *what* information is important and *how* transit customers want to access that information. The discussion then addresses a variety of special circumstances that condition the information preferences of these workshop participants in each of the three components of their trips.

4.5.1 Pre-Trip Information

What Kind of Information Do Travelers Want? While some workshop participants chose not to plan their transit trips in detail, most individuals sought service information for some of their trips. At a minimum, transit riders wanted to know what route to take to reach their destination on time. Transfer details were also important to participants – route, schedule, transfer location, and fare information. Several individuals asked for schedule information at every stop along the route, not just the major time points.

> *"I'd like to have information on the Internet that would tell you in real time, if something was running on time, so you could just check before you walk out to the bus stop, see if everything's going on schedule."*

When planning a trip, transit riders wanted to obtain information about travel time, walking distance at origin and destination, required transfers, and alternate routes. In some systems, passengers also cited the importance of distinguishing among route variations or between express and local routes that served the same corridor. Passengers using park-and-ride facilities considered information about parking capacity helpful.

A few workshop participants wanted to know where the bus was before leaving for the bus stop. Others looked primarily for information about travel delays or detours. Some focused on long-term changes, possibly from construction-related detours or special events; others were more interested in one-time delays associated with weather or traffic incidents. Passengers who used wheelchairs wanted to learn whether the lift was available and working on a specific bus trip or whether the bus could accommodate several wheelchairs.

How Do Travelers Want to Access This Information? Preferred information sources ranged from the ad hoc to the high tech. Some participants chose to ask friends and family for transit information. Even those who did not plan their trip in any formal way went to the bus stop or rail

station and asked fellow passengers or the driver for information. One individual said that he knew the bus would be along soon if he saw other people waiting at the stop.

Many passengers simply wanted basic transit schedules and maps. Some liked the convenience of paper schedules – they could pick one and refer to it any time – and others liked the simplicity of the information presentation. Some workshop participants wanted booklets that included multiple schedules, so they could plan several segments of their trip or make changes en-route. Others appreciated having a system map so they could see individual routes in relation to one another.

> *"You push a wrong button and you get re-routed. You think it's where you're going, and then you have to go through five other buttons to get where you actually need to go. Pound here, star there. By that time your bus is gone."*

Many workshop participants had experience using the telephone to access information, both from an interactive voice response (IVR) system and from an operator. In general, telephone systems can be a convenient way of accessing information; as one participant said, it can be easier to locate a telephone than a computer. But quite a few individuals expressed frustration with the automated systems and preferred to speak with a customer service agent or operator. They believed that an operator could answer their questions more quickly and more accurately than the automated system. Some felt it took too long to get the information they needed; others hit several dead ends before they received the information they sought. A few participants noted that the IVR prompts asked for too much detail. One transit rider tried to use the system to find a bus route in an unfamiliar area; because she did not know her location or the buses that served it, she was at a loss when the IVR asked her to input a bus route number or street name. A few participants were frustrated because they could not easily find the telephone number to call for customer information. Although the information was listed on the schedules, it did not appear on bus stop signs and they could not find it in the telephone book. This frustration with complex automated telephone information systems is consistent with previous research findings (Charles River Associates, Inc., January 1997).

> *"And that's the thing with the Internet — you get on and it looks all nice and wonderful, but in reality it does not always work that well."*

Many workshop participants use the Internet to access transit information, especially schedules. Some read them on-line, others printed them out, and a few downloaded them to their personal digital assistants (PDAs) for later reference. Some also had experimented with on-line trip planners, although others did not know that their transit operator offered this feature. Those who used the system generally considered the itinerary planners quite helpful, but expressed some specific concerns. Some had received inaccurate or outdated information; others found that the system could not recognize certain addresses or recommended stops too far from origin or destination. Consequently, a few participants considered the itinerary planner as a good starting point; they would then use printed schedules to confirm the information or work out the details. In Ohio, the system required participants to submit a request for information using an on-line form; they received a response several hours later via e-mail. Some users were comfortable with this approach (which is

> *"If I have my PDA and I'm in a meeting — and then I can see the routes that I wanna take, and, Wow, that bus is coming down here pretty fast. I need to get outside."*

scheduled for replacement); others deemed it too slow. Asked what features they considered most important for itinerary planners, participants requested overall travel time, alternate routes, transfer information, and walking distance/directions at origin and destination.

> *"I've always used the trip planner to cross check. It says, "Take these two buses, and they transfer at this point, and your time is this." And then I go out and look at the routes themselves on route maps. And route maps usually have listings of where other buses cross the routes and the transfer points. And very often I'll get a better idea of a better bus, based on my own research on those maps. But the trip planner is the starting point."*

Internet use was not universal, however. Whereas many workshop participants were extremely comfortable with on-line services, some participants did not have Internet access at all. This was especially common among participants who said they were transit-dependent. This finding is also reflected in the survey data analyses – those who never had access to a personal vehicle had the smallest preference for Internet-based information. Others were like the college student who believed that people like her mother would have an easier time using a printed schedule than a computerized itinerary planner.

Very few workshop participants sought to use wireless technology for trip planning. Many expressed their strong belief that the typical bus passenger could not afford this technology. Moreover, they were not interested in spending several hundred dollars for a device just to get information that they could otherwise access free of charge. Those who did have a PDA generally used it to download static schedules instead of to access real-time information. Similarly, some participants with wireless telephones did not want to use their allocation of minutes to call the transit agency; they strongly believed that the agency should provide that information to them, a common finding in previous research (Hobeika, et al., 1996; Lappin, February 2000). A few suggested that the agency should create a telephone number that would allow subscribers of particular wireless plans to call the transit agency at no charge.

***Do Information Needs Depend On Any Special Circumstances*?** A handful of workshop participants planned every transit trip they took, but the majority took a more flexible approach. In general, participants did not plan a familiar trip, such as a daily trip to work or school, especially on a high-frequency service. These trips, as one participant said, they could do "blindfolded." Circumstances where many workshop participants considered it important to plan their trip included the following:

- **Time-sensitivity** – Some participants considered work trips to be time-sensitive, but most identified time-sensitive trips as those requiring transfers or those with destinations like an airport.
- **Frequency** – On routes with high frequency, say 10 minutes or less, most participants were willing to walk to the bus stop or train station and wait. On less frequent routes they wanted schedule information before they went to the stop, especially in isolated areas.
- **Familiarity** – Participants generally sought more information for trips where they did not know the area, either in their own city or when traveling out of town. This finding is the same as the results of the survey.

- **Mode** – Some participants believed that trains were easier to use than buses without advance planning. They could arrive at the train station and easily determine how to get to their destination.
- **Weather** – Some workshop participants wanted service details during bad weather (especially real-time information about delays or implementation of snow routes) so they could minimize their waiting time in the rain or snow.
- **Last trip** – On routes with infrequent service or those serving areas with limited service, participants wanted to make sure they knew when the last trip of the evening was scheduled.
- **Return trip** – For some trips, participants knew generally how to get to their destination, but needed to access information about routes or schedules for their return trip.
- **Special needs** – A number of participants wanted to plan trips that addressed specific concerns. For example, those traveling with children or returning from shopping trips with multiple bundles wanted to plan trips that avoided transfers. Individuals traveling through unsafe neighborhoods wanted to minimize walking distance. Similarly, those with mobility impairments wanted to ensure that their trip could accommodate a wheelchair.
- **Special events** – Transit riders wanted to access information about service changes during special events. Participants in Salt Lake City, for example, described the need to get updates for the service changes associated with the 2000 Winter Olympic Games.

4.5.2 Wayside Information

What Kind of Information Do Travelers Want? Wayside information needs fell into two broad categories. At one end of the information technology spectrum, passengers asked for basic transit service information. For example, they wanted to know where and when the bus stopped. Once they knew what bus they were waiting for – and when it was supposed to be there – they wanted to confirm that information in real time. Specifically, they wanted to answer questions like these: *Where is the bus? Did I miss it? When is the next one expected?* Between these two extremes, passengers also wanted to have access to a transit agency representative to obtain service information or to check on apparent problems.

> *"Just knowing how long I have to wait seems to be the thing that puts me at ease, and I guess I just do not stress out, and, like, 'Where's the bus at?'"*

The strong interest in static service information suggested not only the widespread use and value associated with the various standard kinds of informational materials, but also the perception that some riders were often unable to obtain even the basic service information they wanted. Many transit customers wanted to have access to a printed schedule and, possibly, a route map at the stop or station. Bus passengers, in particular, wanted wayside information about the route(s) serving the bus stop and a telephone number to call if they encountered a service problem. In systems where different bus stops had different purposes (e.g., express only, temporary, drop-off only), passengers requested this information as well. Some specifically asked for information about the last bus of the evening, so they would know if they arrived too late to reach their final destination. A number of patrons also asked for better clarification of route variations or direction; many

> *"You do not have to wonder how long you're gonna be cooling your heels. You know exactly how much time you have. You know. If you've only got a couple of minutes, then you stand on the line and you wait. If you're gonna have ten minutes, you sit down, read a book."*

reported the experience of boarding the wrong bus because the route description was confusing or insufficient.

Many customers saw tremendous advantage in accessing real-time information from the bus stop or train station. Most wanted to know when they could expect the bus to arrive; others wanted to know whether they had just missed it. Almost universally, passengers wanted to know the correct time of day. Passengers with special access requirements wanted real-time status reports. For example, one passenger wanted to determine whether the bus could accommodate her bicycle; another wanted to know if the arriving vehicle had room for more than one wheelchair. A few wanted to get information about capacity at park & ride lots, while some wanted to access real-time information about bus crowding, especially during peak usage periods. Passengers boarding at transit centers or rail stations wanted to know what bus bay or track an arriving vehicle would use. Some also asked for a station area map that would identify key landmarks around the stop.

How Do Travelers Want to Access This Information? Passengers generally wanted to see static route and schedule information incorporated into bus stop signs. In one workshop, bus passengers defined the details that the ideal bus stop sign should provide: (1) the words *bus stop*; (2) drawing of a bus; (3) route number(s) serving the stop; (4) telephone number for more information. Schedules would be mounted on the sign pole in a frame or box; Braille information would be available for visually impaired riders. Other features that participants thought would be desirable at bus stops included a light that would let bus drivers know that someone was waiting, especially after dark or during bad weather. A handful of workshop participants wanted their transit agency to assign "transit ambassadors" at major stops to provide service planning and status information.

While many participants wanted the option of calling the transit agency from stations or stops, opinions about the best way to provide telephone access varied greatly. For customers with mobile telephones and generous calling plans, displaying the transit agency's phone number was enough. These individuals had no problem calling the transit agency with a service question or complaint; one transit rider programmed the transit agency's phone number into his cell phone for exactly this purpose. However, some transit riders did not have access to mobile telephones. Others did not want to use the limited minutes on their calling plans to call a transit agency, particularly since they believed it was the agency's responsibility to disseminate service information. Customers with limited or no access to wireless telephones proposed other options for reaching their transit agency. Some suggested developing a public-private partnership between transit agency and local wireless service provider for free telephone calls (* B-U-S). Others suggested a telephone "hot-line" or intercom at each bus stop (or major ones) that would provide a direct connection to customer service. This strongly held belief that the transit agency should disseminate service information freely – just as airlines distribute service updates – was also observed in prior research (Charles River Associates, Inc., January 1997).

Workshop participants were extremely interested in getting real-time information about transit performance, primarily when the bus or train would arrive. Some bus passengers considered a simplified system, whereby a signal light would indicate the status of the bus. Hypothetically, a green light could indicate that the bus was on time, and a red light could indicate a delay. While this approach had the virtue of simplicity, some passengers believed it would create frustration

and confusion when they encountered a red light. In the absence of any other service details – anticipated arrival time, the nature of the delay or the anticipated arrival time – passengers would not know what to do with the information. Moreover, simply knowing that the bus was running on time was helpful only if passengers knew the schedule. Otherwise the information was without context.

> *"You know what would be a simple fix for a lot of this stuff, though? Just a simple clock on each of the bus signs. 'Cause I know a lot of times you get to the bus stop and you do not know what time it is, and if you do not have your watch on you … You got a schedule there, but it does no good if you do not know what time it is."*

Questions about arrival time generated lively discussion. Many workshop participants suggested that transit agencies should provide a clock showing the current time used by the transit system at every bus stop (irrespective of other information systems). Several participants pointed out that having a schedule did them no good if they did not know what time it was and many participants had experiences with lost, broken, inaccessible, or inaccurate watches.

In several workshops, participants were asked to compare two types of real-time information systems that were under consideration by Seattle's King County Metro Transit. One alternative displayed current time of day and anticipated arrival time; the other showed minutes until arrival in a countdown format. These two display alternatives were shown in full wording on larger electronic message signs, or on a smaller unit in abbreviated text form (see Figure 40 for images of the alternatives that were shown to the participants in the Washington and Utah workshop discussion groups). Both the large and small versions cycled through four message sets each, with the time of day and other non-scheduling information appearing on the fourth message only. The majority of participants preferred the countdown signage, because the system did not require them to know the current time. As above, some did not carry a watch, others did not know if their watch would match the current time used by the transit system, and a few did not want to calculate the arrival time themselves. For some, it did not matter whether the bus was on time as long as they knew when it would arrive. The smaller sign, using abbreviated text display, was acceptable to most of the participants, though some thought the abbreviated, somewhat cryptic references to Seattle locations could be confusing to newcomers or infrequent transit users. Most of the participants believed that because smaller signs would be less expensive to produce, they could be installed at more transit facilities. Other real-time display formats were discussed. Several transit riders wanted to receive real-time arrival information in the form of a map display, describing themselves as visually oriented. Others felt reassured when they could watch the image of the bus moving toward their stop.

> *"With the [anticipated arrival] time, you don't know if your watch is five minutes faster or slower than theirs, as well. So the accuracy, looking at the time, is not as great as looking at the minutes."*

Regardless of the form the information came in, the ability to predict vehicle arrival time was very important to workshop participants. Consistent with previous research findings, passengers reported that accurate real-time information reduced stress and provided them with peace of mind (Lappin, December 2000). Such information allowed them to conduct personal business while they were waiting. Transit passengers wanted the opportunity to buy a newspaper, get

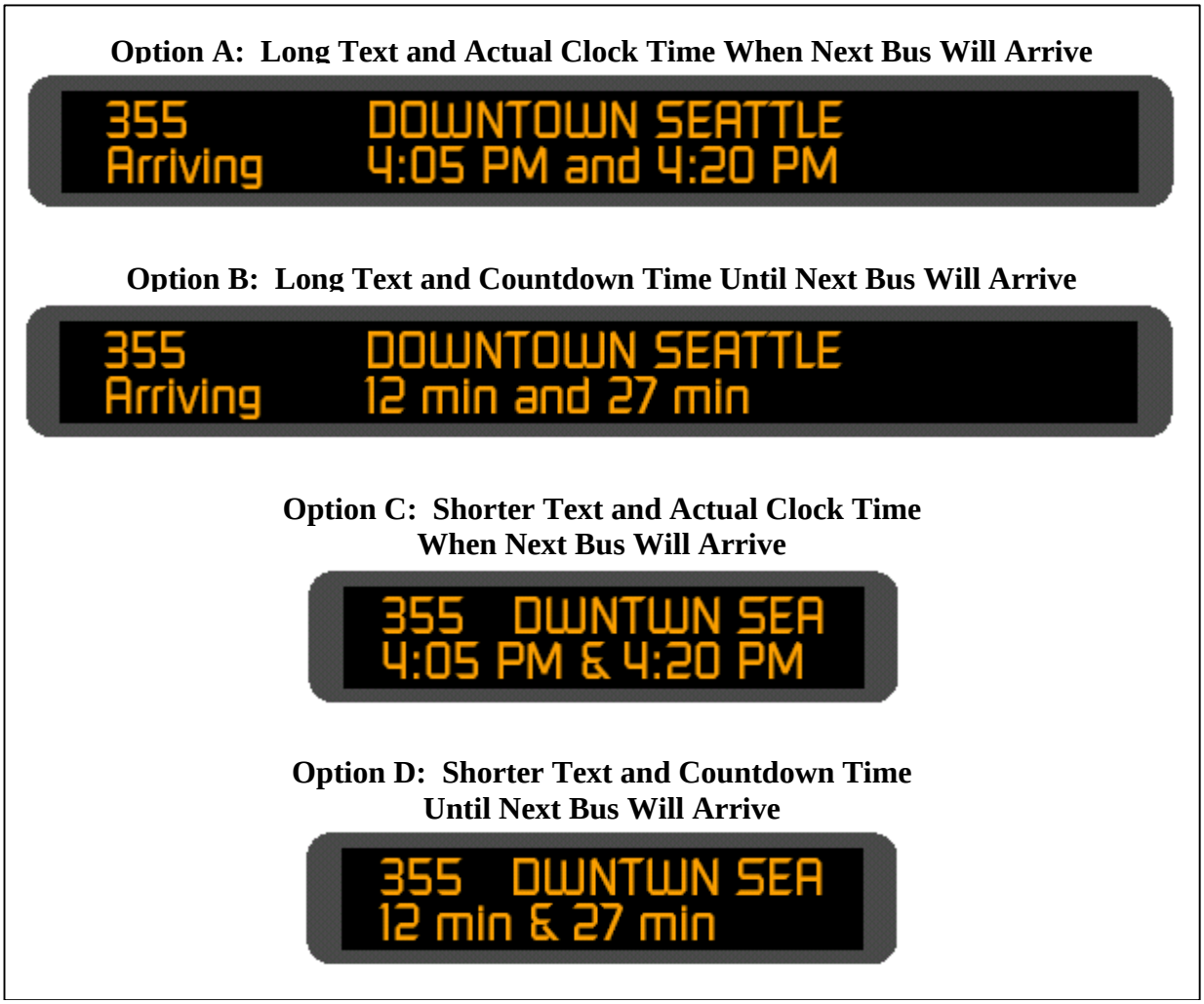


Figure 40. Optional strategies for electronic real-time transit station signage under testing by King County Metro Transit division, Seattle, WA.

something to eat, or use the rest room without worrying about missing the bus or train. Generally, passengers wanted to see arrival information for the next two buses. This information would allow them to make informed travel decisions.

> *"You could have multiple people looking at this [kiosk] screen at one time. "Hey! Get outta here! I'm operating this thing." You know?"*

Some workshop participants liked the convenience of kiosks at bus stops or train stations, but they disagreed about the features they preferred. Some liked the idea of using the kiosk to print out information (or even fare tickets), but others thought this would generate litter. To solve that problem, some suggested using biodegradable paper and others proposed charging a nominal fee for a printout. Several participants raised concerns about gaining access to kiosks. Because only one person could view the screen at a time, users might have to queue up to access the information they wanted. As an alternative, video monitors could provide real-time arrival and departure information in a format that multiple users could access simultaneously.

A few workshop participants were interested in using real-time wireless applications to obtain wayside information, but most preferred to access information through electronic message signs at the stop. In fact, many participants believed it was the responsibility of the transit agency to disseminate such information to all passengers, free of charge, and not just to the few who had wireless devices.

Throughout the discussions of advanced information features, some participants remained skeptical of a transit agency's ability to implement new systems. Such skepticism about ATIS services among members of the general public has been reported in previous research (Mehndiratta, et al., 2000). Others noted the potential for vandalizing the equipment, including kiosks and electronic message signs. Participants also expressed concerns about the tradeoffs that an agency might have to make between providing better information and maintaining affordable fares. Finally, some transit patrons pointed out the need for transit agencies to make people aware of the information alternatives currently available.

Do Information Needs Depend on Any Special Circumstances? Transit riders wanted a basic level of information at a transit stop. The desire for baseline information did not vary with service conditions or geographic features, although it was primarily a concern of bus riders. The widespread interest in real-time information, on the other hand, did vary substantially with operating conditions and system features. Situations where information would be especially desirable included the following:

> *"I think that the main responsibility for the bus station is dependability and accuracy of their information. I'm not saying how much or through what medium they give it. If it's low-tech – you know, posted and dependable – it's just as good as something that flashes."*

- **Time sensitivity** – Real-time information was particularly important for time-sensitive trips, such as trips from home to work.
- **Severity of delay** – Passengers were not overly concerned about minor delays, but they wanted information about service cancellations or "catastrophic" delays.
- **Service frequency** – Passengers believed it was especially important to have real-time service updates on routes that ran infrequently. For routes with service every 10 minutes or less, updates were less critical.
- **Stop location** – Some passengers wanted to see real-time information at major bus stops, rail stations, and transit centers. However, several noted the importance of having real-time information at isolated locations, when few service alternatives are available. Park & ride facilities were highlighted as an important location for real-time transit information to benefit those passengers who were dropped off and had no transportation alternatives if the bus they were waiting for was delayed.
- **Special needs** – Participants noted the importance of providing wayside information in formats accessible to those with visual or auditory impairments.
- **Security –** Passengers traveling in unsafe areas or at certain times of day believed that real-time service information contributed to their security.
- **Weather –** Service updates were particularly important when the weather was bad.

Clearly, workshop participants wanted to receive updates about transit service while waiting at the stop or station. But it was also noteworthy that many transit riders – especially bus riders – wanted a basic level of static information at the bus stop before they would even consider seeking real-time updates. In either case, transit passengers placed a high premium on receiving accurate information. For some, that meant access to current schedules posted at the bus stop. For others, it meant being able to get real-time information that they could depend on. In fact, accuracy and reliability of ATIS information have been cited consistently as customer priorities throughout the literature (Charles River Associates, Inc., January 1997).

4.5.3 On-Board Information

What Kind of Information Do Travelers Want? Transit riders thought in-vehicle information was extremely important. Some considered it more important than wayside information. Most passengers wanted to know one thing: *Where do I get off the bus?* Other information, while desirable, was not as critical.

Generally, passengers wanted to know where they were along the route and asked for information about cross streets, bus stops, and landmarks. Most asked for information about one or more upcoming stops and some asked for an estimated travel or arrival time. Several also wanted the bus to display the time of day. Several wanted a visual representation of the route so they could track their progress and determine where to get off the bus.

Some passengers wanted to confirm the route they were on; this was often a concern with express and local variations of the same route. In a similar vein, some wanted to know what street the bus was on.

Passengers also expressed interest in obtaining details about transfer opportunities. At a minimum they sought information about transfer locations, including route number and specific stop location (e.g., north side of intersection). Some asked for real-time information about transfer status, including the possibility of notifying the bus driver that a transferring passenger was arriving.

Some passengers asked for updates on detours or delays, although opinion was mixed. Some considered this helpful information, if only for peace of mind, and some were glad to have the opportunity to notify others via mobile phone that they would be late. As one participant noted, having information on delays may not affect travel time, but it can reduce stress. But several workshop participants said that real-time information about delays would only make passengers angry or frustrated since there was nothing they could do about it once they were on the bus.

> *"On the bus, of course, you always have a representative – that's the driver. So if I'm going someplace I have not gone before, I always ask the driver, "Where's the nearest stop?" and so forth."*

How Do Travelers Want to Access This Information? Workshop participants currently relied on a variety of low-tech strategies to obtain basic location information on the bus. They asked the driver, listened to on-board announcements, checked with fellow passengers, consulted a paper map or schedule, counted stops, and looked out the window. None of these strategies was ideal. While many drivers offered excellent customer information, sometimes they had inaccurate

information and other times were "grumpy." On-board announcements were not consistently available and sometimes difficult to hear or understand. Other passengers were often happy to share information, but again this approach had the same potential failings as consulting the driver. Paper schedules were not always available, were not drawn to scale, and did not list every stop. Counting stops did not work when the driver skipped one or more boarding locations. Looking out the window did not work at night, when it was too dark to see landmarks, or when the view was otherwise obstructed.

Most workshop participants wanted automated information about their current location and upcoming stops. They appreciated this information on trains and wanted something similar on the bus. Some preferred audio announcements, while others wanted visual information. Many noted that information should be provided in both formats. Not only would this accommodate passengers with disabilities, but it would also enable people to access information from any location on even the most crowded bus. Participants further noted that information should be provided in multiple languages to accommodate those who did not speak English.

Many participants wanted the bus to display the name of the next stop using an electronic sign. Many wanted to know two stops in advance (upcoming stop plus one), and a few wanted three (upcoming plus two). Some suggested using video monitors strategically located throughout the bus, but this approach raised concerns about safety (passengers could bump into the monitors) and convenience (monitors may be difficult to read from some locations on the vehicle). Most preferred a dynamic message sign near the front of the vehicle.

Several bus passengers asked for a map of the bus route. While some simply wanted to be able to pick up a paper schedule on the bus for the route they were riding, others wanted to see their current location displayed in real time on a map. Many suggested a schematic linear representation, similar to a rail map, with a light to indicate progress along the route in real time. This would help passengers who were unfamiliar with the route, letting them know when their stop was coming up. While some participants wanted the progress indicator to show every stop (especially in areas where stops were widely spaced), others thought that landmarks and major intersections would suffice.

> *"The drivers that I ride with are pretty good at announcing stops. But a lot of times the PA system is not working, or there is other background noise with people around you – you can't hear. So, to me, something visual would be better than an audible notice."*

Some workshop participants wanted audio announcements of each bus stop. They preferred automated annunciators to driver announcements because the former were consistent and easy to understand. In addition, the automated system would let the driver concentrate on driving. As with the visual announcements, passengers wanted information on the upcoming stop and at least one more in advance. One participant suggested providing an audio announcement of the current stop along with a visual display of the two following stops. Some of the participants commented on the sound quality from on-board audio systems, reporting that understanding the announcements was often difficult, especially when the bus was crowded.

A few participants showed interest in using hand-held devices to access information, but they were in the minority. Some suggested developing a specialized device that would provide only

transit information, presumably at a lower cost than a full-service PDA, but most did not want to contend with yet another gadget.

Do Information Needs Depend on Any Special Circumstances? While workshop participants generally agreed that in-vehicle information would be desirable, they highlighted some circumstances where the information would be especially welcome. These circumstances included the following:

- **Familiarity** – Participants believed that stop announcements would be particularly beneficial for passengers who were not familiar with the route, either because they were new to the city or traveling in an unfamiliar neighborhood.
- **Mode** – Information systems commonly used for rail trips – such as annunciators and schematic route maps – could provide substantial benefits to bus passengers as well.
- **Time of day** – Bus passengers had a more difficult time relying on visual cues at night.
- **Special needs** – Participants noted the importance of providing in-vehicle information in auditory and visual formats as well as in multiple languages.
- **Crowding** – Information should be provided in a format that passengers can easily access, even on the most crowded route.
- **Stop spacing** – When stops are closely spaced, information about major stops may be sufficient. When stops are farther apart, it would be desirable to provide information about every bus stop.

By the time passengers boarded a vehicle, their information needs were substantially simplified. As they indicated throughout the workshops, regardless of location, they wanted to know where they were and when they had to get off the bus. Very few focused on rail-related information preferences, although it was not known whether this was because of the high proportion of bus passengers in the workshops or the greater availability of traveler information for rail travelers.

4.6 Wireless Devices

Are Passengers Interested in Using Wireless Devices to Access Transit Information? Passengers expressed only moderate interest in using wireless devices to access transit information. Interest was stronger in the Washington and Utah workshops, where the local transit agencies use the Internet and e-mail to disseminate service information and people are more apt to have and use wireless devices. But in many workshops participants believed that bus passengers, in particular, could not afford this technology. Some believed that focusing on a technology that served only a subset of riders was a waste of scarce resources and that transit agencies had a responsibility to communicate information to as wide an audience as possible. One participant believed that real-time information, in general, was not valuable. If the delay or service interruption were big enough, information would be available on radio or television. Otherwise, agencies were spending time and money disseminating information about delays that would be cleared up in a few minutes.

> *"I'd almost prefer to be able to just call on the phone. I know that I could find out the location of a route or whether it's late. I'd almost rather have that than to pay for a wireless service and be able to look at it as I'm walking to the station."*

4.6.1 What technology do customers prefer?

Among those passengers interested in discussing wireless devices, discussions centered on use of PDAs and mobile telephones for voice and text messages. A few transit passengers were enthusiastic about the potential for accessing real-time information about service changes or delays, and anticipated using such information while walking to the bus stop. Others preferred to use their mobile telephones to access such information. Others suggested using a mobile phone to call the transit agency where they could talk to someone accessing real-time information. Armed with information about the status of their bus or train, they could share updates with others waiting at the stop. Some transit riders liked the idea of receiving electronic alerts from the transit agency regarding real-time delays or periodic schedule changes. These alerts could take the form of e-mail, text messages, or voice messages. (One minority opinion, however, was that frequent e-mail alerts could become annoying.)

Does This Depend on Any Special Circumstances? The difference of opinion observed regarding use of wireless devices appeared to reflect both the wide variation in socioeconomic status among workshop participants and the varying degrees of familiarity with such systems. Many workshop participants had only limited access to wireless devices. Cell phones were by far most readily available, but a sizable number of transit riders had restrictive calling plans and did not want to use limited minutes to access transit information. Far fewer workshop participants had access to PDAs, and even some of these participants expressed concern about the cost of using these devices to access real-time transit information. Generally, the passengers who were already familiar with the capabilities of wireless communications devices were those most likely to appreciate real-time transit applications.

> *"They need to consider the fact that not everybody has these technological advantages, like a PDA or cell phone connected to the Internet."*

Customers saw the greatest value in using wireless devices while walking to the transit stop. Accurate real-time information about arrival times would let them know how quickly they had to walk – or run – to catch the bus or train. Before leaving work or home, most preferred Internet- or telephone-based information. Once at the transit stop, they preferred to receive real-time information from electronic signs. By the time they were on the vehicle, many participants thought that the primary value of wireless devices was to let people know they would be late.

ENDNOTES

1. Note that two participants did not fill out the background survey, so no background data are available for them.

2. Note that although these individuals were defined as non-riders in this study, some had ridden transit before. But for the purpose of this study only transit trips in the past 30 days were considered.

5.0 CONCLUSIONS

Transit customers are willing and eager to share their point of view when invited to discuss their transit riding experiences and how information fits in with their trip making decisions and practices. The surveys and qualitative discussions with 284 individuals from the four workshop sites have yielded valuable insights into the questions raised at the outset of this research project. To review briefly, FTA's objectives for this research were to gain insight into answers to the following questions:

- *What* types of information do transit customers want?
- *Where* and *when* in the course of their total trip do they want the information?
- *How* do they want to be able to access that information?
- What are the critical *human factors* issues in presenting transit information?

Findings from the workshops are organized around these four main objectives.

5.1 What Transit Information Do Customers Prefer?

Transit customers' desire for timetables exceeded all other information preferences for both familiar and unfamiliar trips. The desire for static information of all types also exceeded the preference for real-time information. This is partly explained by the lack of available real-time information for most transit agencies in this study, which is typical of the currently limited national availability. Most participants cited the cost of advanced technologies as the limiting factor when asked whether they would use portable electronic devices. Interestingly, many participants who owned wireless devices were satisfied with simply downloading static transit information, rather than access it in real-time. The implications for transit agencies are that it will take time before the full potential of real-time information can be realized. In the meantime, riders are very interested in accessing information over the Internet for trip planning purposes, on electronic message signs at the transit wayside, or in vehicles through electronic signs or automated announcements.

As was expected, information is desired more for unfamiliar trips than for usual or familiar trips. This is especially true for the traditional, static kinds of information like schedules, fares, and route maps. Infrequent riders want these kinds of information more than regular riders. More participants judged most of the types of transit information as being essential for their trip making versus being nice to have (non-essential). This is particularly true for static information used to inform unfamiliar trips, where two to three times more participants said timetable, route map, closest stop, transfers, trip planning, fare, and alternate route information is essential than nice to have. But these differences were reduced for real-time information, and for some of those types a slightly higher percent of participants considered them non-essential, such as for weather, transit vehicle location and parking availability. This implies that agencies will need to continue to offer reliable static forms of information, and where feasible to invest in the newer forms of real-time information, in order to attract new riders, retain existing riders, and increase overall ridership.

Participants believed that it is the responsibility of the transit agency to disseminate information about service changes and delays as widely as possible; the customer should not be expected to have to access the transit agency to get such information. They expressed that often it was

difficult to determine if the present transit schedules posted at a bus stop were current, citing experiences with out-of-date schedules and the problems that arose when they tried to catch a bus that never arrived. Some suggested simply posting the effective dates of timetables at the stop. This would be most appropriate for timetables that experience scheduled service changes.

5.2 Where and When Do Customers Want Transit Information?

Transit information needs were examined for four key trip stages, including pre-trip, going to a transit stop, at the stop (wayside), and on board the transit vehicle. By far the most participants indicated that static information types were essential for their pre-trip planning more than for any other location or time in the course of their total trip. The differences between the desires for static information compared with real-time information during pre-trip planning were much more pronounced for planning unfamiliar trips. While timetables were essential for 82% of participants for planning their familiar trip, all other types were selected as essential by less than 45% of the participants.

Information needs once the trip was initiated were dramatically less than for pre-trip planning. Because only around 10% of the participants indicated that information of any type was essential while they were on their way to a transit stop or station, these results are not presented in this report. Once at the wayside, real-time information assumed more importance than all the traditional sources of information except timetables. Information on vehicle arrival and departure from wayside locations was the most dominant preference among real-time information types, equivalent to the preference for most pre-trip information for a familiar trip other than timetables. In the breakout discussions, participants indicated a desire for clear signage indicating the location of their bus both within transit stations and at bus stops, especially where multiple routes converge. Some suggested the use of video monitors with a pictorial showing the location of different bus routes within a transfer station.

Information preferences while on board the transit vehicle tended to be under 20% for each type, but here too some real-time information was considered more essential compared with the traditional information types. The most prominent type on board was information about detours and delays. However, during the breakout discussions in the workshops, participants emphasized that they want to know where to get off the bus, especially when traveling on an unfamiliar route.

Preference for information delivery technologies was strongly related to trip phase. Customers seeking pre-trip information preferred paper schedules, telephone guidance, and Internet-based planning. Wayside information needs focused on better signage, posted schedules/maps, and electronic signs providing real-time vehicle arrival information. Once passengers were on board the bus or train they wanted stop announcements in visual and audio formats. Non-riders reported a greater preference for real-time information at the wayside, compared with riders, who typically indicated that it would be nice to have but not essential. This suggests that non-riders (those in our workshops who said they had not taken any transit trips in the past 30 days), who are likely to have the least experience and confidence in transit riding, tend to value real-time information the most.

5.3 How Do Customers Want to Access Transit Information?

It is quite clear that the participants wanted pre-trip information printed on paper and/or available on a computer, typically via the Internet. This preference is strong, especially for information deemed essential for planning unfamiliar trips. While not at the level of paper and computer-based information, many indicated that the telephone is an essential means for them to obtain the different information types, followed by speaking directly with a transit representative.

At the wayside, some of the real-time delivery systems were preferred over the traditional, static sources. For both familiar and unfamiliar trips, about one-quarter of the participants indicated they wanted information provided on electronic message signs, especially covering vehicle arrival and departure times, connection times, detours and delays, and vehicle location. The preference was somewhat greater for this kind of information for their unfamiliar trips. As for the static information preferences at the wayside, having timetables and routes maps printed on paper was still useful for some, but having this information posted at the wayside on signs was even more desirable.

Transit users generally liked Internet-based itinerary planners, but some were concerned about the accuracy of the information and whether they could be confident using it for trip planning. Participants with mobility impairments expressed a need for an itinerary planner that could help them select stops based on physical or geographic characteristics, such as curb cuts, terrain, or similar features. Many older participants, while not disabled, still had problems navigating hills and requested the ability to select routes based travel requirements once they have exited the transit vehicle.

Passengers showed some interest in public kiosks but expressed concerns. Because only one person at a time can access a kiosk, customers anticipated crowding or queuing, resulting in uncertainty about their ability to get the information they wanted when they wanted it. For these customers, a video monitor would be a better solution. Opinions were mixed about printing information from a kiosk or monitor. While it could be desirable to obtain printouts, some customers worried about litter and suggested charging a nominal fee to those who wanted to receive information on paper.

As expected, the preferred mode of information retrieval is affected by a person's age. Older participants (age 65+) reported a lower overall preference for transit information at all stages of the trip, and primarily depended upon lower-technology means, such as printed on paper or static signage. Participants aged 25 to 64 had the highest preference for Internet access to transit information as well as real-time information at the wayside via message signs and video sources. The youngest group of participants (18-24), while also reporting heavy use of the Internet and printed materials, exhibited the highest demand for telephone- and wireless device-based information both for pre-trip and en-route static and dynamic information.

Even though this sample of participants is over-representative of high-tech transit riders, there is still not a large preference for high technology ways of accessing transit information. This is likely because the availability of real-time information is still quite limited. Yet at the site with the most currently available real-time information, the Seattle area, the indicated preference was less than at the other sites. Not surprisingly, only those who currently have high-tech devices,

such as a PDA or Internet-enabled cell phone (e.g., WAP phone), are interested in trip planning on a wireless device.

5.4 Human Factors Design Issues

Several issues were raised during the study that revealed both general and specific human factors design implications. These topics include information provision to riders, user selection of preferred information sources, preferences for telephone-based information systems, and design of visual displays.

A common quality discussed throughout the study was that participants felt that transit information should be self-contained. That is, all information necessary to use the system should be included at transit stops and stations. For instance, while bus schedules are usually posted at transit stops, participants advocated installing vandal-proof clocks that show the current official time used by the transit agency bus schedules. These clocks would be helpful for customers who either don't have a watch or are concerned that their watch is inaccurate. Another suggestion was to install dedicated telephones at wayside locations connected to a live transit person and free of charge to transit riders.

Another theme was the importance of having multiple information sources available. While many participants simply want to be able to choose how they want to get information from a variety of sources, some of the participants expressed a desire to use a combination of different information sources when planning transit trips. For instance, transit riders could use a trip planning service on the Internet or telephone to plan their trip and then confirm the trip details with a printed schedule and real-time updates. Similarly, participants wanted to have multiple information sources available to them at any time, as a redundant fail-safe mechanism in case one system was either unavailable or inaccessible. A common example is the desire for both message signs and announcements at the wayside and on board the transit vehicle to transmit the same message. This combination allows for transit riders to access the information in either a visual or auditory format.

In the discussion groups, many passengers expressed frustration with automated telephone systems and complex voice-mail menus and wanted instead to speak with a customer service agent, either over the phone or in person. This preference for interacting with a real person, as opposed to an automated system, was a commonly-held opinion across different transit information sources. Many older and transit-dependent participants preferred to talk to a transit representative, such as a bus driver or transit ambassador, or ask other riders on the transit vehicle for route information. This points out that many transit riders feel more comfortable interacting with people, rather than automated systems, and suggests that traditional, human-operated systems should be available for those who are not as comfortable with newer automated systems.

One of the dilemmas that concerns transit agencies is the preferred configuration of real-time electronic message signs that show vehicle arrival and departure status. In this study, participants overwhelmingly preferred countdown information compared with displays that showed actual arrival times. The countdown signs were particularly helpful for transit riders without access to an accurate timepiece and did not require customers to calculate time until arrival. Generally,

transit riders said they wanted arrival information for the next two transit vehicles, which provides two sources of information. First, it indicates the frequency of transit service, assuming that the vehicles operate on a consistent frequency; second, it allows riders to judge the importance of catching the next bus. Often, during rush hour or special events, transit ridership is especially high and extra buses are allocated to those routes. Knowing that a second bus will arrive shortly allows riders to determine whether it is worth it to get on a densely-packed bus or wait for the next bus that is likely to be less crowded.

5.5 Key Underlying Themes

This research suggests that a transit system should be based on a solid core consisting of high-quality, reliable, and accurate transit vehicle information. For successful operation, this level of basic information should be attained before investing in real-time ITS technology. This study found that transit customers expressed information preferences that mirror this system implementation approach. Participants in the discussion groups said that transit agencies should focus on making the basic, traditional static forms of schedule information more accurate and easier to access before worrying about providing advanced, real-time information. Inaccurate information was perceived as worse than no information – dependability and reliability are more important than flashy high-tech solutions. In addition, many of the transit users indicated that real-time planning information would not be needed as long as they know there is reasonably regular and frequent service available. This reluctance to adopt advanced information technologies was expressed in different forms throughout the study. Most of the reasons revolved around cost – either diverting funds away from projects seen as more important to a greater number of customers, or those costs assumed by the transit riders themselves.

Transit riders recognize that transit agencies have very limited resources. Some of the participants suggested that the projects transit agencies undertake should benefit the largest number of customers to provide better overall service. They believed that focusing on a technology that served only a subset of riders was a waste of scarce resources and that transit agencies had a responsibility to communicate information to as wide an audience as possible. However, participants ideally would like to have both static and real-time information available at all waysides, but they recognize that the costs are likely to be prohibitive. They suggested options that they thought were lower cost, such as using smaller electronic message signs with abbreviated words that would take less space without confusing people, or installing these systems in the most important locations.

The majority of participants were more concerned about their own costs when riding transit rather than transit agency expenses. Introducing new advanced information technologies could result in fare increases or service reductions. This belief was held more often by transit-dependent, lower-income participants. While participants acknowledge the benefits of real-time information and recognize that these technological approaches to disseminating and accessing transit information are likely the wave of the future, they pointed out that many passengers cannot afford computers or PDAs. However, growing numbers of riders are interested in accessing information with such devices. Agencies will have to find a way to balance the preferences of the high tech segment of the population with the majority of their lower tech customers, perhaps by relying on technologies that do not require transit users to carry special receiving devices with them. Some workshop participants even suggested that agencies distribute

devices to their riders who want them at no cost. Finally, participants in this study expressed a common opinion that transit agencies have a responsibility to provide free services, such as public telephones and wireless access, to transit customers.

Some of the transit agencies involved in this study already offer some of the more advanced information services available to transit riders. Often, the workshop participants were not using these services simply because they were unaware that they were available. This suggests that it is important for transit agencies to do more to advertise and promote the information sources they do provide to encourage more widespread use, both for riders and non-riders. Making the information easy to find and use are equally important along with awareness building.

This study has taken a broad step forward toward learning the information preferences of public transit customers. A next step would be to investigate system design issues in more detail to help transit agencies design their information delivery systems according to their customers' preferences. The findings outlined in this report provide a solid foundation for determining the course of future research projects. These issues include, but are not limited to, the design of real-time electronic signage and wireless electronic devices, where customers tend to look for information at the wayside, and information content for announcements and message signs on board the transit vehicle. This continuing research will help the FTA accomplish its goal to better understand the information preferences of its primary customer – the transit rider.

APPENDIX A:
WORKSHOP LOCATION DETAILS

The process of selecting workshop locations began with the identification of four primary sites and several additional alternate sites. This selection was reviewed and approved by FTA. The next step was to contact the FTA regional representatives for the regions in which these sites were located to facilitate contact with the appropriate local transit agency officials. Three of the four originally selected sites had to be replaced with alternate sites, and one of the second choice sites was also replaced, for a variety of reasons, including concerns that the local transit riders were being "over researched" or that the agencies were over-burdened at the time these workshops were scheduled to take place and therefore would be unable to support the effort required to organize and manage the workshops. This selection process unfolded over a period of several months during the late summer and early fall of 2002, and it resulted in agreements with four local transit agencies to hold three workshops in each of four metropolitan areas: Seattle (WA), Salt Lake City (UT), Columbus (OH), and Providence/Kingston (RI).

The goal in selecting the workshop locations was to ensure a balanced combination of the following characteristics:

- **Geography** – Maximize geographic coverage to take into account differences in local culture and transit operating conditions.
- **Modal mix** – Include bus-only systems and multimodal operators to capture differences in information preferences.
- **Operating settings** – Consider urban, suburban, and rural settings to evaluate different travel patterns.
- **Availability of ATIS services** – Include systems with different levels of investment in advanced traveler information systems, including those making minimal use of technology.

These diverse locations allowed the team to identify issues and concerns that are universal and those that were specific to particular modes, demographic characteristics, and operating settings. Table A-1 summarizes the availability of advanced technology applications for each of the four transit operators, and Table A-2 summarizes the service characteristics of these agencies.

Table A-1. Advanced Public Transportation Systems (APTS) deployment in workshop locations.

Agency	City, State	Service Type	Vehicles (2000)	Advanced Communications	Automatic Vehicle Location	Automatic Passenger Counters	Vehicle Component Monitoring	Automated Operations Software	Automated Transit Information	Automated Fare Payment	Traffic Signal Priority
COTA	Columbus, OH	FR	348	TR	X	X	[X]	X	P,[W],[I]	MS,[SC]	[X]
		DR	45		[X]		[X]	X		[SC]	
RIPTA	Providence, RI	FR	236	[TR], [DIG]	[X]	X	[X]	[X]	P,[W],[I]	[SC]	[X]
		DR	104		[X]	[X]	[X]	[X]		[SC]	
		FB	1		[X]	[X]	[X]	[X]		[SC]	
UTA	Salt Lake City, UT	FR	530	[X]	[X]	X		X	P,W,[I]		X
		DR	90		[X]			X			
		LR	23		[X]	[X]		X			X
KC Metro	Seattle, WA	FR	1,213	[TR]	X	X	[X]	X	P,W	MS,[SC]	X
WA State Ferries		FB	29		X		X	X	P	[SC]	

SOURCE: Advanced Public Transportation Systems Deployment in the United States: Year 2000 Update (11/12/02) http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/13680.html

KEY: Service Type: FR=Fixed Route; DR=Demand Response; LR=Light Rail; FB=Ferry Boat
Advanced Communications: TR=Trunked Radio; DIG=Digital Radio
Automated Transit Information: P=Pre-Trip; W=Terminal/Wayside; I=In-Vehicle
Automated Fare Payment: MS=Magnetic Stripe; SC=Smart Card
[Brackets indicate planned implementation]

Table A-2. Selected service characteristics of the four workshop sites (2001).

	COTA (OH)	RIPTA (RI)	UTA (UT)	KC Metro (WA)
Area (square miles)	543	784	1,612	2,134
Population	961,437	750,000	1,513,000	1,758,300
Population density	1,771	957	939	824
Unlinked Trips	18,533,833	14,220,775	25,946,194	101,000,283
Vehicle Revenue Miles	11,523,747	6,708,250	24,679,530	54,890,689
Vehicle Revenue Hours	863,819	417,264	1,347,906	3,886,407
Vehicles Operated in Maximum Service	318	187	838	2,205
Operating Expenses	$71,376,998	$48,496,685	$107,484,201	$347,931,769

Source: *National Transit Database*, 2001. National Transit Database Profiles. (www.ntdprogram.com)

The selected sites are described in more detail below:

Seattle, Washington

The King County Department of Transportation's Metro Transit Division (KC Metro) provides an extensive network of bus, trolleybus, and vanpool services throughout the Seattle metropolitan area. In 2001, KC Metro operated 54.9 million revenue miles of service with a peak vehicle fleet of 2,205 (half of which were buses or trolley-buses); annual ridership was 101 million unlinked trips. The transit service area covers 2,134 square miles with a population of 1.7 million people.

KC Metro offers on-line trip planning services through its web page (transit.metrokc.gov). In addition, the Smart Trek program, created under the Metropolitan Model Deployment Initiative, integrates information about transit, highways, intercity rail, and ferry services. KC Metro offers three innovative Internet-based transit traveler information services: BusView, MyBus, and Transit Alert! BusView allows transit users to see the real-time location of any bus on any route. MyBus provides transit users with route and schedule information and real-time departure status, and is also available via WAP-enabled cell phone. Finally, Transit Alert! provides e-mail notification about emergency changes to bus routes.

Salt Lake City, Utah

The Utah Transit Authority (UTA) provides transit services throughout the Salt Lake area, including Brigham City, Ogden, Salt Lake City, Provo, and access to the local ski areas. UTA's services include fixed-route bus service, light-rail (TRAX), and ADA complementary paratransit. In addition UTA operates a regional vanpool program. Annual ridership was 25.9 million unlinked trips in 2001, with a peak vehicle fleet of 529 buses and 33 light-rail vehicles. UTA operated 24.7 million vehicle revenue miles of service. UTA's service area covers the four counties of Salt Lake, Weber, Davis, and Utah, and contains 1,612 square miles and 1.5 million people.

UTA's web site (www.utabus.com) offers an itinerary planner. In addition, *UTA my way* allows individuals to create a customized web page with selected UTA schedules, weather updates, and selected links. Registered passengers may order transit passes on-line and participate in UTA surveys. UTA also provides e-mail alerts to registered passengers for route changes or detours. Finally, UTA has entered into partnership with a private vendor to allow subscribers to access transit schedules on their PDAs through its *UTA On the Go!* program.

Providence/Kingston, Rhode Island

The Rhode Island Public Transit Authority (RIPTA) provides transit services throughout the State of Rhode Island. RIPTA services include fixed-route bus service, ADA complementary paratransit service, several reservation-based flexible bus routes in low-density areas, and seasonal ferry service. In addition, commuter rail service provides connections between Providence and Boston. In 2001, RIPTA provided 6.7 million vehicle revenue miles of service and carried 14.2 million unlinked trips. Peak vehicle requirements were 187 buses. RIPTA's service area covers 784 square miles, with a population of 750,000. RIPTA's web page has an on-line trip planner at www.ripta.com.

Columbus, Ohio

The Central Ohio Transit Authority (COTA) operates transit services in Columbus, Ohio, and surrounding communities. COTA provides fixed-route bus service, several shuttles, and ADA paratransit service. COTA's service area covers 543 square miles, with a population of 961,000. In 2001, COTA provided 11.5 million vehicle revenue miles of service and carried 18.5 million unlinked trips with a peak-vehicle fleet of 282 buses and 36 demand-response vehicles. COTA provides real-time bus arrival information at several key stations and locations and offers trip planning services on its web page (www.cota.com).

These four sites offered diversity along several key dimensions. Locations were geographically varied – with operators in New England, Midwest, Mountain, and Northwest states – and service area population ranged from RIPTA's 750,000 to KC Metro's 1.7 million in King County. UTA offered bus and light-rail service, while COTA was bus-only. Ferry service is available in Washington (Washington State Ferries) and Rhode Island (ferry service), and RIPTA passengers can take advantage of commuter rail service provided by the Massachusetts Bay Transportation Authority (MBTA). Of particular relevance to this study, ATIS applications varied widely among the systems. All four offered on-line trip planners, while Seattle also provided its customers with a range of real-time applications and UTA offered several web-based features. This variation allowed the research team to assess customer information preferences in the context of available ATIS services.

APPENDIX B:
RESEARCH METHODOLOGY: DESIGN AND ADMINISTRATION OF WORKSHOP MATERIALS

B.1 Background Questionnaire

A background questionnaire was used to gather demographic, transit ridership behavior, and attitudinal information to segment the preference data collected later in the survey. Demographic questions included age, educational level, employment status, and sensory and mobility impairments that could affect transit information needs. Transit-related questions included availability of a personal vehicle as a measure of transit dependency, the nature and frequency of transit trips in the past 30 days (e.g., work, school, shopping, socializing), frequency of telecommuting, whether their typical transit trip requires a transfer from one transit vehicle to another, and usage of current progressive technology devices (e.g., cellular phone, PDA, pager).

Seventeen attitudinal statements covered such topics as comfort and reliance on technology, personal beliefs, and transit ridership-related attitudes. Respondents rated their agreement to each of the statements on a 7-point scale, ranging from -3 (completely disagree) to 0 (neutral) to +3 (completely agree). Technology usage related items such as "I'm comfortable using high tech devices at home or work" and "When I need information, I like to be able to ask someone, rather than rely on a computer." Personal belief statements included items such as "I like to find my own way rather than ask for directions" and "I do not like to take risks with new products and services." Transit attitude statements included items such as "I would use public transit more if it did not take so long," "It is confusing trying to figure out how to use public transit to get places," and "It is important for me to be able to use the Internet to get transit information." A number of these questions were included here because they have been shown to be reliable predictors of variation in the information needs of segments of travelers (Lappin, Jan. 2000; Mehndiratta, Kemp, Lappin, and Nierenberg, 2000).

B.2 Transit Technology Tutorial

It was assumed that participants in this study had different levels of transit experience as well as exposure to transit information technology. Because these workshops sought to gather transit information preferences, participants needed to be informed of the many available transit information technologies to understand items in the preference survey and provide useful input to the discussions. To ensure that all participants were at least somewhat familiar with the range of emerging transit information technologies, a transit technology tutorial (see Appendix G) was developed and presented early in each workshop to provide a common, informed base for answering questions in the preference survey as well as in the breakout discussions. This multimedia tutorial, designed to be entertaining as well as informative, both provided an overview of the terms used when describing transit information delivery systems, and showed examples of these different types of systems and how they relate to the user experience. The workshop presenters worked closely with the local transit agency personnel to customize wherever possible images and facts regarding local transit vehicles, signage, and information systems to accurately reflect the local transit system in order to increase the participants' familiarity with the information in the tutorial.

The transit technology tutorial consisted of three primary sections: 1) what types of information are available, 2) where the information can be accessed, and 3) the possible methods of providing the information to customers. First, the tutorial reviewed traditional information, such as maps, schedules, and fare information. Less emphasis was placed upon covering these traditional information types because it was assumed that typical transit users are familiar with them. Instead, the focus was placed upon advanced technologies, including automated trip planning and real-time information, with which the participants were generally much less familiar. Automated trip planning was divided into telephone- and Internet-based systems. Local trip planning website screenshots were used where possible to illustrate the technology in a familiar setting. Descriptions of real-time information primarily focused on determining when a transit vehicle will arrive at a particular stop or station, divided into displays showing vehicle timeliness, location, or time until arrival. Other types of real-time information were also briefly introduced, including weather, parking availability, and traffic congestion.

Next, participants were introduced to the terms used to describe segments of a typical transit trip: pre-trip (planning that occurs before departing on a trip), wayside (at the stop or station), and in-vehicle (on board the bus or train). A stylized, animated trip sequence was used to define possible information needs at each of these points in a typical trip. Finally, several types of information delivery methods were presented, outlining basic characteristics of different presentation modes. These included visual displays, auditory displays, portability, interactivity, and customizability. Pictorial representations of example systems using these characteristics were shown for each display method.

B.3 Preference Survey

A survey questionnaire was developed to solicit input from the workshop participants. There were two primary goals for the development of this transit information preference survey: 1) maximize the amount of information on *what* types of information riders need, *where* they need it, and *how* they want to get it, and 2) minimize survey complexity and the time needed for respondents to fill it out – our goal: about one half hour. In addition to the *what, where,* and *how* attributes of transit information needs, the survey also sought to understand from the participants whether each piece of information is essential or non-essential (just nice to have), and include preferences for both their usual or familiar transit trip as well as a trip that is unusual, or less familiar to them. The presumption was that information needs should differ by the familiarity of the trip, and that it is important to try to identify the most essential or trip-critical information needs as a way to help transit agencies prioritize their efforts to improve information delivery. It is assumed that persons riding transit in an unfamiliar part of the system need more reinforcing information throughout their trip, compared to their familiar trip, to remain comfortable and confident that they will reach their destination successfully (Higgins, et al., 1999). The task of designing a survey that gathers comprehensive rider preferences on all of these interrelated attributes is daunting to say the least. Even after reducing the number of entries in each of these categories to the most important items, there were over 2,000 different possible combinations of the organizing attributes of *what, where, how, familiar* and *essential.*

Our solution to reduce the complexity of the survey was to provide letter and number combination codes to indicate where and how people want to get transit trip information they felt necessary for their trips. However, while this coding approach in one sense reduced the

complexity associated with a very large number of possible combinations of choices, it required a very carefully presented explanation of this survey response approach to the participants.

The preference survey included two response sheets that were identical except that one was for the respondent's usual or familiar trip and the other was for an unusual or unfamiliar trip. These two sheets of paper were colored yellow and pink respectively to clearly distinguish them and to provide easier referencing in the tutorial (see Appendices B and C). Sixteen different types of information were included on the survey sheet (the "*what*" dimension of information needs), including nine so-called "traditional" or "static" information items, such as timetables, route maps, trip planner and trip alternatives, and seven different types of "real-time" information. See Table B-1 for detailed descriptions of these sixteen information types. This division into static and real-time information types provides a useful way to analyze and interpret the results. Boxes (spaces) on these two survey forms were provided in two columns next to each type of information where the participants could indicate information they felt was either essential or nice to have but not essential. Essential information was defined as information that is required to make their transit trip – its absence would make the trip impossible to complete. Information that is nice to have but not essential means that the rider could make the trip without it, but it would make them feel more comfortable and confident about their trip. Respondents could also leave an entry blank, indicating that it was not important for the indicated trip.

Each participant was provided with a blue-colored code sheet with letter and number codes to indicate *where* and *how* they want to get information. Letters A, B, C, and D indicated whether the information was needed pre-trip, traveling to the stop or station, at the stop or station, or onboard the vehicle, respectively. Numbers 1 through 9 indicated how to get the information (e.g., 1 = printed on paper, 2 = printed on sign, 3 = message sign, etc.). See Tables B-2 and B-3 for detailed descriptions of these *where* and *how* codes, respectively. Respondents were instructed to combine letter-number codes to indicate where and how they want to get each particular type of information that they considered either essential or nice to have. For example, if a respondent felt that a timetable printed on a piece of paper was essential to have during trip planning for a usual trip, he or she would write "A1" in the "Essential" column on the yellow survey sheet. Participants could write as many code combinations as needed in each answer box, but were instructed to write each individual code combination separately to reduce data entry confusion (i.e., "A1 through 4" should be written as "A1 A2 A3 A4"). Step by step, animated instructions for filling out the survey sheet were included as part of the multimedia presentation at the end of the technology tutorial and right before the respondents were asked to fill out the yellow and pink survey sheets. Also, while they were filling out these survey response sheets, the workshop presenters were available to answer any questions the participants might have regarding the survey.

Table B-1. Description of sixteen information types as presented to participants.

Chart Label	Description
Timetables (T)	Timetables, scheduled services changes (not temporary detours, delays, alternate routes)
Route Maps (RM)	Graphical displays of individual transit vehicle routes
Closest Stop (CS)	Closest stop or station on a particular route, including the stop near rider's origin and destination
Transfers on Route (TR)	Number or location of transfers on rider's route
Trip Planning (TP)	Trip planning service that removes the burden of transit planning from the customer, usually by telephone or computer
Fares (F)	Cost for transit trips
Alternate Routes (AR)	Other choices for traveling to the rider's destination
Park and Ride (PR)	Park and ride information, such as location, access, servicing routes, and facilities
Disability Info (DI)	Services for passengers with disabilities, such as wheelchair-accessible buses and facilities
Arrival/Departure (AD)	Real-time transit vehicle arrival and departure from stops and stations
Connection Time (CT)	Real-time information on how long rider will have to wait for a connection
Detours/Delays (DD)	Real-time information on short-term transit vehicle detours and delays, including snow routes and road construction
Trip Time (TT)	Real-time information on how much time a particular trip will take
Weather (W)	Real-time weather updates
Vehicle Location (VL)	Real-time information on the current position of a transit vehicle
Parking Availability (PA)	Real-time information on parking availability at selected locations, including park & ride lots

Table B-2. Description of four trip stages or locations as presented to participants.

Chart Label	Description
Pre-trip	Anywhere the rider plans for a future transit trip, including home, work, school, other places
Going to	Traveling from the trip origin to the wayside
Wayside (At)	Bus stop, rail station, ferry terminal, transit center, park & ride
On-board	Traveling on a transit vehicle

Table B-3. Description of nine information delivery systems as presented to participants.

Chart Label	Description
Printed on paper	Information printed on paper so the user can take it with them, such as a published brochure or printed from a computer
Printed on signs	Static sign permanently attached to particular location
Announcements	Speech broadcasted over a public address (PA) system, automated or non-automated
Telephone	Access by landline or cellular telephone, including interactive voice response (IVR) system or human operator
Talk to transit person	Speaking directly with a transit representation, such as a bus driver or transit station employee
Message sign	Electronic message sign that displays text messages
Video / Kiosk	Information viewed on a video monitor, including interactive kiosks and passive video terminals
Computer / Internet	Use of a computer to access information, mostly likely through a connection to the Internet
Wireless device	Hand-held computer that can receive broadcasts wirelessly, including PDA, advanced cellular phone, laptop, or pager

B.4 Breakout Discussion Groups

While the surveys gathered general preferences on *what*, *where*, and *how* riders want to get transit information, breakout discussion sessions allowed us to probe in more depth to understand qualitatively the participants' experience using information and their needs and desires for new and better access to information. The participants in each workshop were divided randomly into two groups and were separated into different rooms. Discussions were tape recorded to provide an accurate transcript of the participants' questions, issues, and responses. The discussion moderator followed a prewritten guide developed to generate a consistent line of discussion.

The moderator's guide (see Appendix I) consisted of a series of topics for pre-trip, wayside, and in-vehicle information needs. The pre-trip topics focused on how the participants prepare for their transit trip, what information they need, and what information they would like to have. Probes were included for multi-modal transit trips, trip familiarity, and information priorities. Specific attention to the design of Internet-based trip planners was included, such as the participants' frequency of use, desired information, frustrations, and suggestions. Another topic of interest was preferences for live vs. automated telephone systems. The primary wayside topic focused on preference for real-time signage at stops and stations, including what types of displays are preferred, how often the displays should be updated, where signs should be located, and how many transit vehicles should be covered with one sign. In-vehicle information topics included the type, number, and location of real-time information inside a bus or train, as well as preferences for in-vehicle annunciation systems. Pictures of current and prototype information displays were used at some workshops to provide real-time information display format preferences for local transit agencies and help stimulate discussions about possibilities for information presentation.

APPENDIX C:
PARTICIPANT SELECTION AND RECRUITMENT

***Rhode Island Public Transit Authority* (RIPTA)**

Three workshops were held in association with the Rhode Island Public Transit Authority (RIPTA). All meetings were scheduled on weekdays in November 2002. RIPTA staff selected the workshop locations. One workshop was held at the University of Rhode Island (URI) campus, in Kingston, from 4:00 p.m. to 6:00 p.m. Two additional workshops were held in downtown Providence from 5:00 p.m. to 7:00 p.m. at a location near RIPTA's Kennedy Plaza Intermodal Transportation Center. The 7:00 p.m. ending time enabled participants who used public transportation to attend the workshops to catch the last bus home.

A member of the research team initially met with RIPTA's assistant general manager to discuss the overall approach to the research. Subsequent to that kickoff meeting, RIPTA administrative staff followed up on the workshop details. RIPTA staff gained internal agency approval, reserved meeting space, and sent out meeting notices. The consultant prepared meeting materials. Arrangements for food and beverages were shared between RIPTA and the consultant team.

RIPTA administrative and marketing staff recruited workshop participants using several techniques. For the URI/Kingston meetings, RIPTA worked in cooperation with the Center for Transportation Studies to recruit students. For the Providence meetings, RIPTA recruited participants from special-interest groups and individuals who had previously communicated with the Authority. In addition, flyers were posted at key locations, specifically RIPTA's transit hub, Kennedy Plaza, soliciting interested participants.

Although RIPTA staff did not use a formal screening instrument to guide selection, they did strive to achieve a balance between riders and non-riders, age groups, ethnic background, and gender. Workshops included participation from people with disabilities, including visual and mobility impairments. The workshop at URI consisted of college students and staff. The two Providence workshops included representatives from the Gray Panthers, an advocacy group focusing on issues relevant to seniors.

RIPTA staff reviewed the workshop materials before the meetings, but chose not to incorporate any local materials. Staff members were in attendance at the workshop and the discussion groups to greet individuals, help out with meeting arrangements as necessary, answer factual questions, and record specific service-related concerns for agency follow-up.

In order to allow a margin for last-minute cancellations, approximately 30 participants were recruited for each meeting. A total of 82 individuals participated in the three workshops. Each participant received a cash incentive of $40 for his or her participation. Snacks were available at the URI afternoon workshop, and a light dinner was available at the evening workshops in Providence. All meetings were held in facilities that were accessible to individuals with disabilities. These facilities were made available at no cost to the project.

***Central Ohio Transit Authority* (COTA)**
Three workshops were held at the headquarters of the Central Ohio Transit Authority (COTA) in Columbus. Sessions were scheduled from 6:30 p.m. to 8:30 p.m. on three consecutive weekday evenings in November 2002. Bus service was available to and from the facility.

COTA staff recruited workshop participants using several approaches. First, COTA solicited participation from local groups and organizations, including City Year and the Mid-Ohio Regional Planning Commission (MORPC), which serves as the area's metropolitan planning organization. City Year is a national service organization that assigns young adults to community service activities, and participants use the bus extensively as they access work assignments throughout the metropolitan area. In addition, COTA staff recruited from an internal list of persons who indicated an interest in participating in research studies.

The consultant team communicated with designated COTA staff through telephone and e-mail. COTA staff gained internal agency approval, reserved meeting space, and sent out confirmation notices to meeting participants. The consultant team sent out follow-up e-mail confirmations, prepared meeting materials, and made arrangements for food and beverages.

COTA staff reviewed the workshop materials before the meeting but did not have any specific research requests. Photos showing COTA's RideFinder real-time kiosks were incorporated into the presentation slides. One staff member was available at each workshop and discussion groups to greet arriving participants, help out with meeting arrangements, and answer factual questions. COTA asked the consultant team to forward any specific concerns about the agency's services for review and follow-up.

In order to allow a margin for last-minute cancellations, approximately 30 participants were recruited for each meeting. A total of 77 individuals participated in the three workshops. Each participant received a cash incentive of $40 for his or her participation. A light dinner was available at each of the workshops. All COTA-sponsored meetings were held in facilities that were accessible to individuals with disabilities. Meeting facilities were made available at no cost to the project.

***Utah Transit Authority* (UTA)**
Three workshops were held in association with the Utah Transit Authority (UTA). These workshops were held in three different locations throughout the UTA service area on weekday evenings in November 2002. The first workshop was held in downtown Salt Lake City in a conference room at the UTA headquarters. The second workshop was held at Ogden Union Station in downtown Ogden. The third workshop was held at a community center in West Valley City, a southern suburb of Salt Lake City. Performing workshops in these different locations allowed data collection from a variety of transit riders, including city riders, long-distance riders commuting into Salt Lake City, and suburban riders, respectively.

Workshop meeting sites were selected and reserved by UTA representatives with guidance from the project team. The UTA representatives also arranged delivery of refreshments and presentation equipment for each of the workshop sites. The meeting sites were provided at no cost to the project.

UTA representatives worked with the project team to customize the tutorial presentation materials for use in the Utah workshops. This included providing photographic images of information displays and capabilities of the transit system as well as information about what technologies are available within the UTA service area.

Recruitment included distribution of an email advertisement to current users of a UTA internet transit notification system. This email directed recipients to a webpage that contained a screening questionnaire. This screener collected gender, age, frequency of ridership, transit dependency, name, telephone number, and availability on the planned workshop dates. A list of respondents for each workshop date was provided to the project team, along with data from the screener. Participants were selected from this list across the range of screening characteristics. UTA representatives then contacted the selected individuals via telephone to confirm their participation and provide instructions for attending the workshops.

A total of 54 individuals participated in the workshops. Each participant was paid an incentive of $50, as recommended by UTA representatives. A light meal was provided at each workshop.

***King County Metro Transit Authority* (KC Metro)**

Three workshops were conducted in association with King County Metro Transit (KC Metro). These workshops were held in different locations throughout the Seattle metropolitan area in November 2002. The first was held at the Bellevue Senior Center in Bellevue and was targeted at recruiting participants in the affluent eastside suburban neighborhoods. The second workshop was held at the Tukwila Community Center in Tukwila, a southern suburb of Seattle, and included participants who were typically of a lower socio-economic class than the other two workshops. The third workshop was held at the Seattle Community Center in the Seattle area of Seattle, near the University of Washington, and included a higher proportion of students.

Workshop meeting sites were selected by the project team with guidance from KC Metro representatives. The project team also supplied refreshments for these workshops. All facilities required a rental fee, which was paid by the project.

KC Metro consulted with the project team, providing invaluable insight to the design of workshop materials, including the tutorial presentation, background questionnaire, survey, and discussion materials and topics. Representatives met with the team three times to iteratively review and contribute to the project materials. KC Metro also supplied a comprehensive set of photographic images for use in the tutorial presentation to help conceptualize different types of transit information topics and display modes. Images of prototype real-time displays for use in transit stations were provided to both gain insight into preferences for different display types and infuse the breakout discussions with concrete examples of real-time displays. While originally meant for discussion in the Seattle area only, the prototypes were so helpful in discussion groups that they also were used in the Utah workshops.

KC Metro released to the project team a list of persons who had participated in their annual Rider/Non-Rider Survey and indicated a desire to participate in future research. Persons on the list were contacted via telephone by the computer aided telephone interview (CATI) center at

Battelle Seattle Research Center using a screener developed by the project team. This screener segmented potential participants by gender, age, frequency of ridership, transit dependency, and geographic location within the Seattle area. The interviewers attempted to recruit a balance across these characteristics and schedule participants to the most convenient workshop location. Workshops were over-recruited (30 participants each) to compensate for the effect of participant attrition.

A total of 69 individuals participated in the workshops. Each participant was paid $50, as recommended by KC Metro representatives. A light meal was offered at each workshop.

APPENDIX D:
WORKSHOP RECRUITMENT SCREENER

Hello, may I speak with _____ ?

[If not there, "Thank you and goodbye."]

I am _____ with the Battelle Seattle Research Center, and I am calling about a research project we are doing in collaboration with King County Metro Transit and the Federal Transit Administration. We are conducting several workshops with area residents, and I would like to ask you a few questions about your possible participation in one of these forthcoming workshops. We will be offering a light meal, and $50 compensation for participation. This call will only take a minute. Can I ask you a few questions?

We are calling you because King County Metro Transit informed us that in the past you agreed to participate in future research projects for King County Metro Transit.

[If refusal/does not have time now, "Thank you and goodbye."]

Thank you. I'd like to ask you a few questions, and if you are interested and eligible to participate, I would like to invite you to participate in one of the workshops.

Do you work for a public transportation agency?

☐ YES → Unfortunately, we ca not include agency employees in this study.
Thank you for your time.
☐ NO

[Interviewer note gender of R without asking. Seek about 50-50 mix for each workshop.]

☐ Male
☐ Female

We are looking for a range of perspectives on public transportation services from people of all ages. Please indicate which age category among the following you fit into.

☐ Less than 18 years old → Unfortunately, we need participants who are 18 or older. Thank you for your time. [**Seek 5 or more in each of the three age categories**]
☐ 18 to 24
☐ 25 to 54
☐ 55 or older

In the last 30 days, tell me how many one-way rides you have taken on public transportation (bus, train, ferry, Access, etc.)? A round trip counts as 2 rides. Count a trip where you had to transfer buses as one ride. **[Seek a mix of infrequent and frequent riders]**

- ☐ 0 to 5 rides
- ☐ 6 to 20 rides
- ☐ 21 rides or more

Would you say you ride public transportation mostly because you: **[Seek a mix of transit-reliant and choice users]**

- ☐ Usually do not have any alternative way to travel? Or,
- ☐ Because that is the way you prefer to travel, even though you have other options available?

We are planning to audio record some of the discussions in the workshops in order to be sure we understand everyone's comments correctly. These tapes will be destroyed after our report is prepared, and all information will be held strictly confidential when we are reviewing the tapes. We will also ask you to sign a consent form at the workshop before it starts. **Is this OK for you?**

- ☐ YES
- ☐ NO **[That's fine. Thank you for your time. Goodbye.]**

Thank you for answering these few questions.

→ We have three workshops planned that will last about 2 hours each. They are scheduled on the following days _____ and times _____. Which of these would work best for you?

- Workshop location #1
- Workshop location #2
- Workshop location #3

Answers to Questions about this Study

Battelle is a contract research company in Seattle, and we are working with Multisystems, a company in the Boston area. This research is being conducted for the Federal Transit Administration (FTA).

In accordance with the Privacy Act of 1974 (Public Law 93-579), this notice informs you of the purpose of the workshops and how the findings will be used.

AUTHORITY: The Federal Transit Administration has commissioned this study and it is endorsed by King County Metro.

PRINCIPAL PURPOSE: These workshops are being conducted in four different locations around the country to get a good cross-section of opinions on how transit agencies can improve the information that they provide to their customers. The FTA recognizes the importance of asking riders of transit systems what these agencies should be doing to improve the quality and content of information they offer the public that can enhance the riding experience. The results of this research will contribute to practical guidelines that transit agencies across the country can use to improve the information they provide.

ROUTINE USES: The information obtained from these workshops will be used mostly by individual transit agencies and planners to enhance their information services to their customers. Some findings may be presented in publications, journals or conferences.

DISCLOSURE: Providing information in these workshops is voluntary, and there is no penalty if you choose not to participate. However, you are encouraged to participate to insure that the data collected is as complete and reflective of broad public opinion as possible. What you contribute at these workshop discussions will be treated as confidential. Your name will not be used in any reports nor shared with anyone outside of the research team.

APPENDIX E:
TRANSIT INFORMATION WORKSHOP

RESEARCH PARTICIPATION CONSENT FORM

You have been recruited to participate in a study that will examine what types of information transit riders want and need for making trips within a public transportation system. If you agree to participate in this study, you will be asked to provide responses to questions regarding your transit information needs as well as participate in a group discussion session. This discussion will be audio taped. You will receive a cash payment for your participation. There are no risks in this study other than those of everyday life.

The information gathered in this study will be used to answer academic research questions regarding the design of mass transportation information systems. All data obtained are for research purposes only and will remain confidential. Names will not be associated with the questionnaires or discussion audio recordings in any way. The information will be reviewed only by Battelle, Multisystems, and Federal Transit Administration (FTA) scientists, and the data will remain with Battelle. It is your privilege to withdraw from this study at any time. If you withdraw, you will be paid for the time that you have participated.

I have read the above statement and agree to permit the use of my responses for research purposes.

_____ _____

Signature of Participant Today's Date

_____

Please Print Name

APPENDIX F:
QUESTIONNAIRES (BACKGROUND, SURVEYS [2], AND CODE SHEET)

QUESTIONNAIRE	FORM COLOR
Background Questions	(Green)
Survey – Trip You USUALLY TAKE	(Yellow)
Survey – Trip You Have NOT TAKEN BEFORE	(Pink)
Codes for Answering Questions	(Blue)

ID: _____ Workshop Location: _____ Date: _____

Background Questions

Please answer each question, and write in your response or check the answer box as needed.

When you are finished, return your sheets to the receptionist.

1. How old are you?
   - ☐ 18 to 24
   - ☐ 25 to 44
   - ☐ 45 to 64
   - ☐ 65 and over

2. What is your educational level?
   - ☐ High school or less
   - ☐ Trade or vocational school
   - ☐ Some college
   - ☐ College graduate
   - ☐ Post graduate work or degree

3. What is your employment status?
   - ☐ Employed full-time
   - ☐ Employed part-time
   - ☐ Unemployed
   - ☐ Student, working full or part time
   - ☐ Student, not working
   - ☐ Homemaker
   - ☐ Retired

4. Do you have a personal vehicle (e.g., car, truck, motorcycle) available for transportation when you want it?
   - ☐ Always
   - ☐ Most of the time
   - ☐ Sometimes
   - ☐ Rarely
   - ☐ Never

5. Estimate how many one-way **public transit trips** you made in the **last 30 days** for the following purposes. A round-trip counts as *two* one-way trips. If you did not make any public transit trips for this purpose, put a zero ("0") for that item. A public transit trip may include travel by bus, train, ferry, Access, etc.

Number of trips in last 30 days	Purpose of Trip
_____	To/from work
_____	To/from school or college
_____	Shopping or errands
_____	Personal appointments
_____	Medical/Social Service
_____	Social/Recreation/Visiting
_____	Other (Specify:_____)

6. Do you have to transfer to another bus, train or ferry on the public transit trip you take most often?

☐ Yes

☐ No

7. How many days (if any) in a typical week do you work at home (i.e., telecommute) rather than commute to work?

_____ Number of days in a week

8. Which of the following devices do you have available to use when you want? Check all that apply.

☐ Regular cell phone

☐ Cell phone with Internet access (e.g., WAP phone)

☐ Personal Digital Assistant (PDA) with wireless communications

☐ Portable computer with wireless communications

☐ Pager

☐ None of these

9. Do you have any of the following characteristics that affect your transit information needs?

☐ Seeing impairment

☐ Hearing impairment

☐ Physical disability

☐ English is not your native language

☐ None of the above

10. Please indicate how strongly you agree or disagree with each of the statements below.
(Please circle <u>one</u> number for <u>each</u> item below.)

	DISAGREE COMPLETELY ▼			NEUTRAL ▼			AGREE COMPLETELY ▼
I'm comfortable using high-tech devices at home or at work.	-3	-2	-1	0	+1	+2	+3
I prefer to find my own way rather than ask for directions.	-3	-2	-1	0	+1	+2	+3
I don't like to take risks with new products and services.	-3	-2	-1	0	+1	+2	+3
When I need information, I like to be able to ask someone rather than rely on a computer.	-3	-2	-1	0	+1	+2	+3
I get annoyed easily when my travel is delayed.	-3	-2	-1	0	+1	+2	+3
I would use public transit more if it were easier to get the information I need.	-3	-2	-1	0	+1	+2	+3
Public transit is convenient for most of my trips.	-3	-2	-1	0	+1	+2	+3
I would use public transit more if it didn't take so long.	-3	-2	-1	0	+1	+2	+3
I find I can't rely on the published public transit schedules.	-3	-2	-1	0	+1	+2	+3
It is confusing trying to figure out how to use public transit to get places.	-3	-2	-1	0	+1	+2	+3
It is easy to get the information I need for using public transit.	-3	-2	-1	0	+1	+2	+3
Planning a trip by bus to an unfamiliar place is easy to do.	-3	-2	-1	0	+1	+2	+3
I don't mind using public transit that requires me to transfer to get where I need to go.	-3	-2	-1	0	+1	+2	+3
It is important for me to be able to use a telephone to get public transit information.	-3	-2	-1	0	+1	+2	+3
It is important for me to be able to use the Internet to get public transit information.	-3	-2	-1	0	+1	+2	+3
Paper schedules and flyers are the best way for me to get the public transit information I want.	-3	-2	-1	0	+1	+2	+3
Overall I am satisfied with the information provided by my public transit agency.	-3	-2	-1	0	+1	+2	+3

This completes this set of questions. Please turn in your sheets before we begin the workshop.

Thank you.

ID: _____ Workshop Location: _____ Date: _____

A TRIP YOU *USUALLY TAKE* ON PUBLIC TRANSIT

What You Want to Know About	Essential to Me ▼	Nice to Have But Not Essential ▼
Timetables / scheduled service changes		
Route maps		
Trip planning service		
Closest stop or station on my route		
Number/location of transfers on my route		
Alternate route choices		
Fare		
Services for passengers with disabilities		
Park & ride facilities		
Real-time info on arrival/departure times		
Real-time info on how long trip will take		
Real-time info on how long I will have to wait for connection		
Real-time info on where bus/train/ferry is now		
Real-time info on impact of weather on my trip		
Real-time info on short-term detours/delays/ problems		
Real-time info on parking availability at selected locations		

ID: _____ Workshop Location: _____ Date: _____

A TRIP YOU HAVE *NOT TAKEN BEFORE* ON PUBLIC TRANSIT

What You Want to Know About	Essential to Me ▼	Nice to Have But Not Essential ▼
Timetables / scheduled service changes		
Route maps		
Trip planning service		
Closest stop or station on my route		
Number/location of transfers on my route		
Alternate route choices		
Fare		
Services for passengers with disabilities		
Park & ride facilities		
Real-time info on arrival/departure times		
Real-time info on how long trip will take		
Real-time info on how long I will have to wait for connection		
Real-time info on where bus/train/ferry is now		
Real-time info on impact of weather on my trip		
Real-time info on short-term detours/delays/ problems		
Real-time info on parking availability at selected locations		

CODES FOR ANSWERING QUESTIONS

These are the places where you might want to have information for your transit trip, and the ways you might be able to get the information.

Code	WHERE you use information
A	Pre-Trip: At home, at work, other places where you plan your trip
B	Going to: Bus stop, rail station, ferry dock, transit center, park & ride
C	At: Bus stop, rail station, ferry dock, transit center, park & ride
D	Onboard: Bus, train or ferry

Code	HOW you get information
1	Printed on paper (so I can take it with me)
2	Printed on signs (at stops; on buses, trains, or ferries; at other places)
3	Message sign (electronic)
4	Announcements
5	Phone (regular or cell phone)
6	Talk with a transit person
7	Wireless device (PDA, pager)
8	Computer (Internet web site, email)
9	Video (kiosk, monitor)

APPENDIX G:
TRANSIT INFORMATION TUTORIAL: POWERPOINT PRESENTATION

Transit Information Workshop

Purpose of this Research

WHAT types of information do transit riders need?

WHERE should the information be offered?

WHEN would the information be most helpful?

HOW should information be presented?

Purpose of this Research

Workshop locations:

- Providence/Kingston, Rhode Island
- Columbus, Ohio
- Salt Lake City, Utah
- Seattle, Washington

Goals:

Learn about the information needs of transit riders.
Create guidelines for transit planners.

Workshop Agenda

- Background on transit technologies
- Survey of your preferences
- Short break
- Group discussions

Introduction to

Transit Information Technology

WHAT Types of Information Do Transit Riders Need?

Maps, schedules, fares

Access details

- Wheelchair facilities
- Bicycle racks
- Paratransit

WHAT Types of Information Do Transit Riders Need?

Customized trip planning

- How do I get there from here?
- How much will my trip cost?

Real-time information

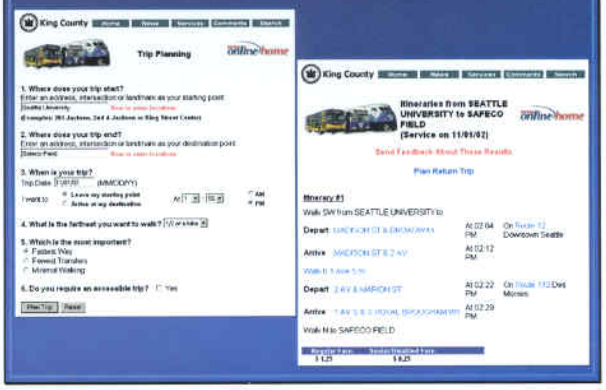
- When do I have to be at the stop?
- Will the train get here soon?

Customized Trip Planning

Using Telephone and Internet

Plan Your Trip: Using Your Telephone

Plan Your Trip: Using the Internet



Real-Time Information

When is the bus going to get here?

Is my trip going to be delayed by traffic?

Are there spaces left at the park & ride?

How long is the wait at the ferry?

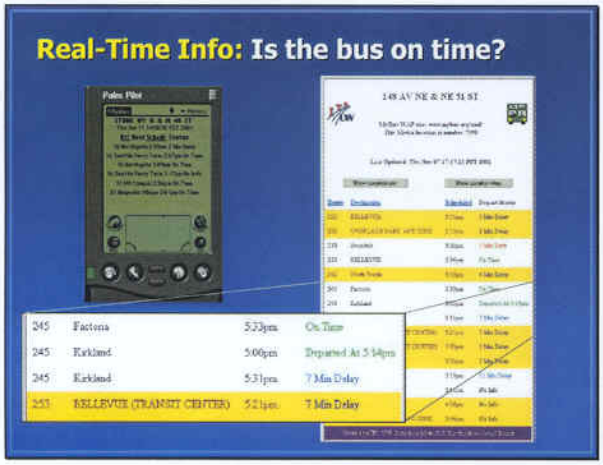
Is weather going to affect my trip?

Real-Time Info: Is the bus on time?

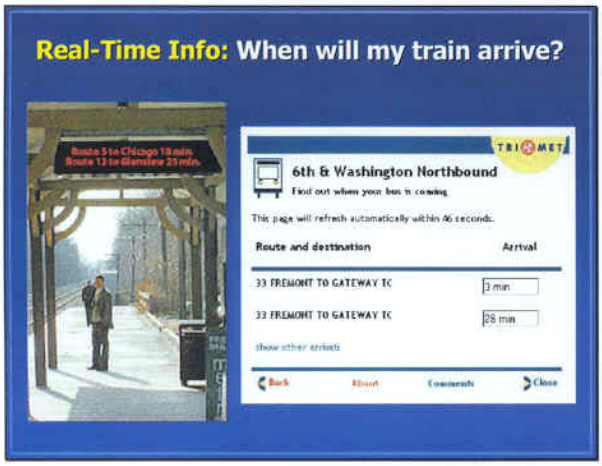
Bellevue TC 9:37 AM Tue Mar 02

Route	Destination	Scheduled	At Bay	Depart Status
222	Overlake Park & Ride	9:35 AM	3	On Time
222	Bellevue	9:45 AM	3	On Time
226	Bellevue Square	9:31 AM	7	Bus Departed
226	Downtown Seattle	9:35 AM	4	Bus Departed
	Bellevue Square	9:46 AM	7	On Time
	Downtown Seattle	9:50 AM	4	On Time
	Bellevue Square	10:01 AM	7	1 Min Delay
	Redmond Park & Ride	9:35 AM	1	No Info Avail
	Kingsgate P & R	9:35 AM	5	Bus Departed
	Avondale	9:50 AM	1	On Time
	South Renton P & R	9:35 AM	3	Bus Departed
	Clyde Hill	10:00 AM	6	5 Min Delay

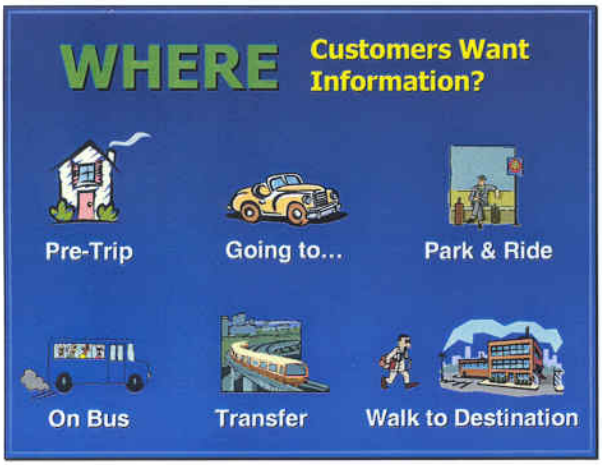
Save Time. Buy a Metro Pass. 624-PASS


Real-Time Info: Is the bus on time?
245 Factoria 5:33pm On Time
245 Kirkland 5:00pm Departed At 5:14pm
245 Kirkland 5:31pm 7 Min Delay
253 BELLEVUE (TRANSIT CENTER) 5:21pm 7 Min Delay

Real-Time Info: Where is the bus?
BUSVIEW


Real-Time Info: When will my train arrive?
TRIMET
6th & Washington Northbound
Find out when your bus is coming
This page will refresh automatically within 86 seconds.
Route and destination
Arrival
33 FREMONT TO GATEWAY TC
3 min
33 FREMONT TO GATEWAY TC
28 min
show other arrivals
Back
About
Comments
Close

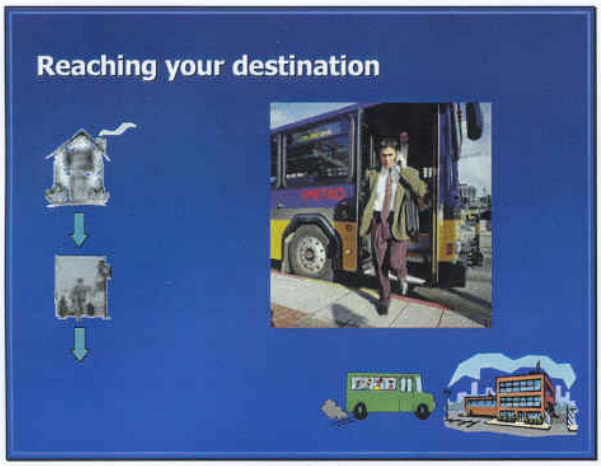
Real-Time Info: What else is there?
Parking Availability
Roof
Level 6
Level 5
Level 4
Level 3
Level 2
OPEN
CLOSED
© WSDOT
Oct 24, 2002 2:12 PM PDT


WHERE Customers Want Information?
Pre-Trip
Going to...
Park & Ride
On Bus
Transfer
Walk to Destination

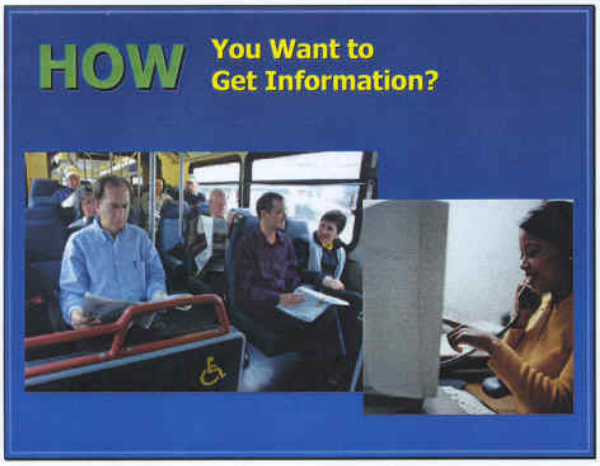
Pre-Trip: Before you start your trip

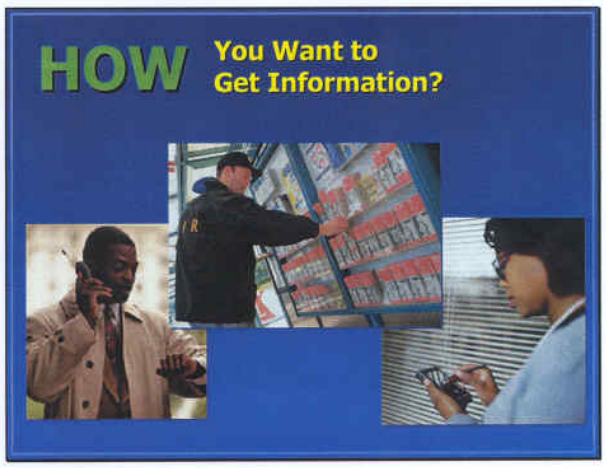
While you wait at the stop

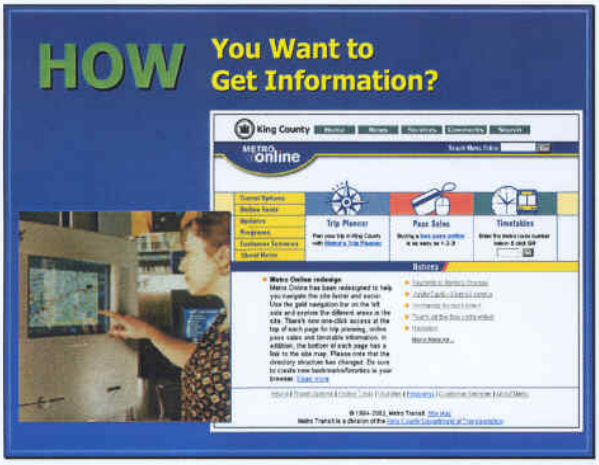
On the vehicle

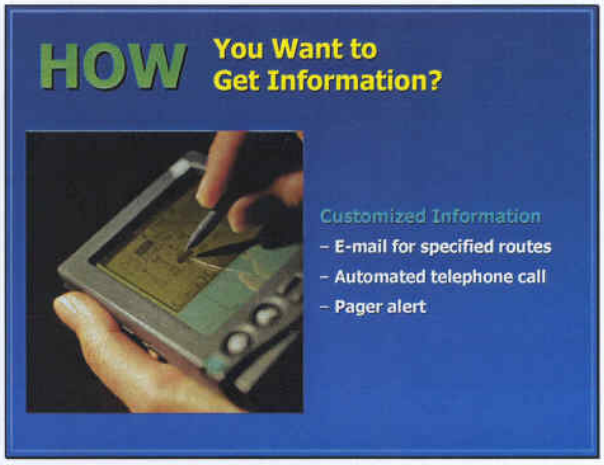

Reaching your destination

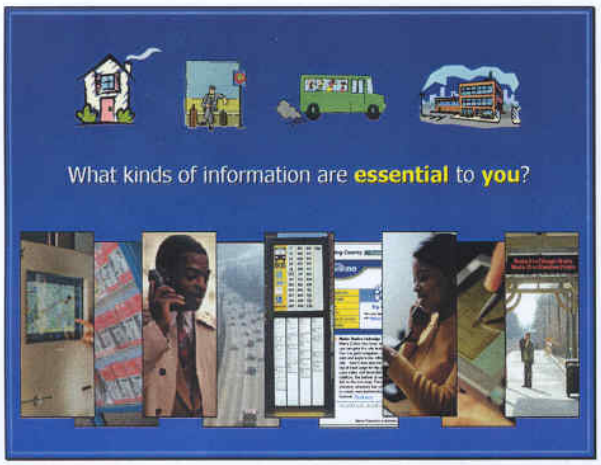
HOW You Want to Get Information?
What is it? Transit Watch.

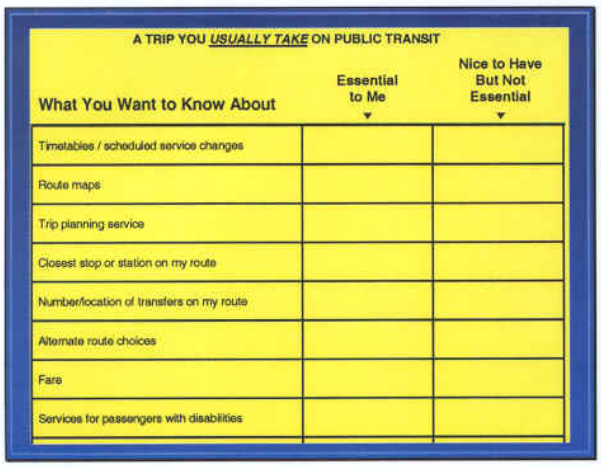

HOW You Want to Get Information?


HOW You Want to Get Information?



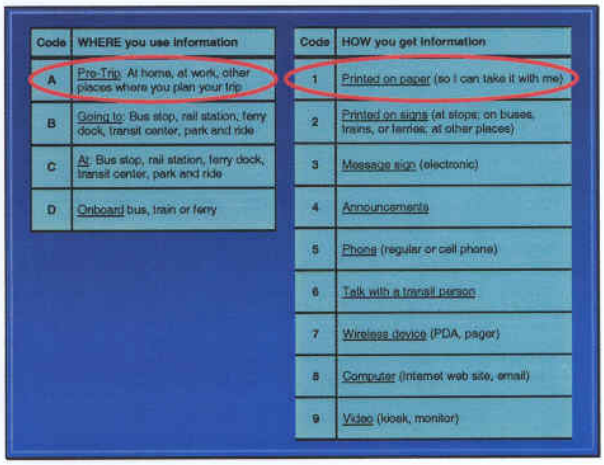






A TRIP YOU *USUALLY TAKE* ON PUBLIC TRANSIT

What You Want to Know About	Essential to Me	Nice to Have But Not Essential
Timetables / scheduled service changes		
Route maps		
Trip planning service		
Closest stop or station on my route		
Number/location of transfers on my route		
Alternate route choices		
Fare		
Services for passengers with disabilities		



Code	WHERE you use information
A	Pre-Trip: At home, at work, other places where you plan your trip
B	Going to: Bus stop, rail station, ferry dock, transit center, park and ride
C	At: Bus stop, rail station, ferry dock, transit center, park and ride
D	Onboard bus, train or ferry

Code	HOW you get information
1	Printed on paper (so I can take it with me)
2	Printed on signs (at stops; on buses, trains, or ferries; at other places)
3	Message sign (electronic)
4	Announcements
5	Phone (regular or cell phone)
6	Talk with a transit person
7	Wireless device (PDA, pager)
8	Computer (Internet web site, email)
9	Video (kiosk, monitor)

Code	WHERE you use information
A	Pre-Trip: At home, at work, other places where you plan your trip
B	Going to: Bus stop, rail station, ferry dock, transit center, park and ride
C	At: Bus stop, rail station, ferry dock, transit center, park and ride
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4	Announcements
5	Phone (regular or cell phone)
6	Talk with a transit person
7	Wireless device (PDA, pager)
8	Computer (Internet web site, email)
9	Video (kiosk, monitor)

A 1

A TRIP YOU *USUALLY TAKE* ON PUBLIC TRANSIT

What You Want to Know About	Essential to Me	Nice to Have But Not Essential
Timetables / scheduled service changes	A1	
Route maps		
Trip planning service		
Closest stop or station on my route		
Number/location of transfers on my route		
Alternate route choices		
Fare		
Services for passengers with disabilities		

A TRIP YOU *USUALLY TAKE* ON PUBLIC TRANSIT

What You Want to Know About	Essential to Me	Nice to Have But Not Essential
Timetables / scheduled service changes	A1	C2
Route maps		D4
~~Trip planning service~~		
~~Closest stop or station on my route~~		
~~Number/location of transfers on my route~~		
Alternate route choices	A8, C9	
Fare		A8
~~Services for passengers with disabilities~~		

You May Begin Filling Out Your Survey Sheets Now

APPENDIX H: ASSUMPTIONS, LIMITATIONS, AND STRENGTHS OF RESEARCH DESIGN

Several research designs were considered for this study that could meet the FTA's objectives within the limitations of time and resources available. The FTA desired to understand the information preferences of the nation's transit customers and derive guidelines that could benefit all transit agencies across the country in their efforts to meet these needs. This calls for a design that has a high probability of identifying the important preferences of riders, and perhaps non-riders as well, in order to better understand the role that transit information might play in encouraging both rider retention and new ridership.

Two broad research approaches were considered. The first assumed a representative national sample that would allow for estimating information needs for the entire population of riders and non-riders. A national random sample design, offering the ability to address the preferences of important sub-groups of riders and non-riders, would require a sample of several thousand respondents selected from a sampling frame of riders and non-riders that would be very difficult and costly to assemble. A random sample of the national population, or alternatively of several local populations, would require over-sampling the small population sub-group of riders, who would be difficult to identify for the sampling frame in the first place. The rationale for such a complex sample design would be the ability to infer from the sample, with a specified level of confidence, what the population's information preferences were across various rider and non-rider groups and agency types. The data collection under this design would likely be either a computer-aided telephone interview or a mail-out mail-back type of written survey. A series of initial focus groups would likely be included in order to identify and fine-tune the questions that would be included in the survey. The effort to implement this approach would be substantial and beyond the scope and means of this research project.

The second broad research approach, and the one chosen for this study, is based on a smaller and more manageable convenience sample of transit riders at selected locations across the country. As described in more detail elsewhere in this report, four urban workshop locations were purposefully selected to offer variation in the size and types of transit operations, and in the information services offered to riders as one way to provide a good cross-section of experience and perspective. Furthermore, within each of these four locations, workshop sites were selected in collaboration with the local transit agencies to reflect known variation in transit rider experiences (e.g., type of services used, length of trips, types of neighborhoods served, characteristics of riders), which are assumed to be related to differences in information preferences. Finally, the recruitment screening process for selecting participants into the workshops sought to balance participation along key individual characteristics, including gender, age, riding frequency, and transit dependency. This approach yielded 284 participants across 12 workshops in 4 cities.

H.1 Assumptions and Limitations of the Research Design

Several assumptions are inherent in the research design based on recruiting volunteer participants into a set of workshops. These assumptions include the following.

The sample of participants is not statistically representative of either transit riders or non-riders at the national, regional, or local level. This means that it is not possible to impute, for example, the proportion in a population of riders who prefer a particular type of transit information. This approach will provide an understanding of the relative preferences for one type of information over another type within the group of selected workshop participants, coupled with the ability to relate information preferences to participant characteristics. This research must be considered preliminary and suggestive of how other riders (and non-riders) with similar characteristics might be expected to express their information needs.

The samples are not large enough to allow for extensive disaggregation of the data into detailed rider sub-groups. However, patterns of information preferences may be used with caution to make inferences about the preferences for certain types of information under different conditions, such as pre-trip versus wayside or on board, or preferences for familiar trips versus unfamiliar trips. Where large differences are observed in the data, participant characteristics are expected to help explain those differences. For example, rider age and frequency of riding transit are expected to be related to the types of information wanted and the preferred ways of obtaining that information.

The process of selecting participants into the workshops is known to introduce various biases into the data. There were no readily available comprehensive sampling frames that included most or all of the transit riders in the selected workshop locations. Incomplete lists of riders were made available by some of the agencies, and these were used as the basis for selecting individuals to be invited into the workshops. Where the agencies provided the research team with lists of riders for recruitment, these lists were composed of people who had agreed to be contacted by the agency for participation in transit research. While efforts were made at each workshop location to hold meetings at a time and place accessible by transit and able to accommodate people with disabilities, other biases may have been introduced by the timing of the workshops (e.g., some people may not be able to attend an evening workshop), location (e.g., transit dependent persons may have greater difficulty getting to and from a workshop, and disabled riders might have more difficulty attending, though some did attend), and timing of recruitment (e.g., employed and/or shift transit riders might not receive the phone invitation). All participants were essentially self-selected volunteers, and it is not known how their characteristics and information needs may differ from those who either were not invited to attend (i.e., were not on any recruitment lists) or decided not to attend if invited.

In the case of King County Metro (Metro, Seattle, WA) respondents to an annual rider/non-rider survey were asked if they would be willing to be called in the future for research purposes. Participants in the three Seattle area workshops were recruited from this list, but they are not a random sub-sample of the individuals who had been selected into the rider/non-rider survey. In the case of the Utah Transit Authority (UTA, Salt Lake City, UT) riders are invited by UTA to sign up for transit updates over the Internet. Participants who were screened and selected from this list were obviously self-selected for having access to and experience with the Internet — a high-technology form of obtaining information. Participants from the remaining two workshop locations were recruited by the agencies themselves. At the Rhode Island Public Transportation Authority (RIPTA, Providence, RI), participants for two workshops were recruited from local

advocacy groups (including those representing the interests of seniors and persons with disabilities) and from lists of those who had previously communicated with the transit authority. Participants were also solicited through flyers posted in a downtown Providence intermodal center. The third Rhode Island workshop consisted almost entirely of university students. The Central Ohio Transit Authority (COTA, Columbus, OH) recruited individuals from agency lists and participation included a large percentage of young adults participating in community-based activities.

Although the final sample of workshop participants included about 20% non-riders (i.e., not ridden transit in the past 30 days), the focus of this research was on riders. The presumption was that riders could offer a better-informed and more in-depth perspective on transit information preferences compared with persons who do not ride transit. Many of the survey questions were only meaningful for persons with transit riding experience. Clearly, riders are over-represented among the workshop participants compared with any local population within a transit agency's jurisdiction. It was also likely, however, that many who had not ridden transit in the past 30 days had previously been riders, and perhaps even frequent riders. In any case, non-riders were asked to respond based on the experiences with transit they did have.

Some segments of the transit riding public were particularly difficult to recruit into the workshops, yet these segments are known to have information preferences that differ in important ways from other segments of the population. While a conscious effort was made to recruit older riders into the workshops, relatively few of them were on the agency lists or were agreeable to attend when contacted. It is known, for example, that older persons are less comfortable with the Internet, and perhaps for this reason fewer of them were on agency lists that required communication via the Internet. About 10% of the workshop participants were 65 or older. Nationally, about 7% of transit riders fall into this age category, but the proportion can be as high as 15% in some urban areas.

Another potential limitation of this research approach is associated with the complexity of the research design as discussed earlier. Some participants were confused by this approach. The research team knows this through observation of participants as they filled out the survey in the workshops and by identification of coded data entries that did not comport with the instructions given in the tutorial. As a result, in those instances where there was confusion, there is a higher likelihood of low quality data. Another example is whether the participants shared a common understanding of what the term "essential" information meant in this context. It was intended that the participants consider information essential if, after they have been made aware of all the possible types of information and ways to access them, they determine that having that information would make possible or facilitate their use of transit in important ways. These are examples of some of the measurement challenges faced in this study. It was assumed that the observed overall patterns that rise above the "noise" of this inherent measurement error provide valid and useful results.

H.2 Strengths of the Research Design

While the research design has some inherent limitations, it was chosen because it offers an efficient and powerful way to gain insight into transit information needs. The following sections describe the strengths of the design.

The workshops were composed of a quantitative and a qualitative component. The quantitative component surveyed the participants for their preferences for combinations of transit information that includes objective measures of *what* they wanted to know, *where* they needed to know it, *how* they preferred to access the information, and how these information needs varied by the importance of the information and their familiarity with the transit trip. In addition, the workshop discussions focused in depth on these measured needs to understand more qualitatively how participants thought about their access to and uses of information. This dual approach to understanding information needs yielded a rich set of insights for practical policy guidance.

The FTA is particularly interested in understanding both how transit riders use information as well as how they want it delivered through the more leading edge technologies, such as wireless devices, the Internet, and electronic message signs. The participants in these workshops were composed of a relatively high proportion of people who say they are comfortable with high technology (79.9%), or have ready access to high technology devices (54.7%). These individuals are expected to understand the value of technology in enhancing information more than the average population, and therefore expected to be able to offer useful insights and opinions.

The transit agencies at each workshop location were closely involved in the process of recruiting participants and defining the locations of the individual workshops. Also, the workshop discussion formats were customized to include any issues of particular interest to these agencies, and presentation materials were reviewed in advance with agency personnel. This approach enhanced the relevance of the research design and the findings for each of the locations where the workshops were held.

The ability to segment the workshop participants into groups of transit riders who are likely to have particular patterns of information needs allows for practical insights into the needs of riders of interest to transit agencies so that the agencies can prioritize and target their resources in ways that will be most useful given their unique circumstances, including the known makeup of their ridership. There is presumed to be less interest in this study in estimating national distributions of riders' information needs than there is in offering policy choices and practical guidance to individual agencies so they can allocate limited resources to meet their own most pressing information needs.

Finally, the literature review, with which this study began, identified very little research that looked beyond a general assessment of information needs of public transit riders. This is one of the first studies to ask not only what information people want, but where is it needed, how do users want to access it, and what presentation forms are most useful to people. In this sense, this research design was tailored to provide a comprehensive first look into these questions, with the recognition that much more focused research would likely follow. This research seeks to look broadly across these questions, offering insights into patterns of transit riders' information needs

as a basis for guiding agencies toward the best choices for their particular local situation which the agencies understand better than anyone else.

APPENDIX I:
DISCUSSION GROUP MODERATOR'S GUIDE

Our discussion this evening has the following goals:

1. Get your insights and understanding about the features of the advanced traveler information systems we reviewed earlier.
2. Help [Agency Name] Transit learn what kinds of advanced information features its customers would use.
3. Provide guidance to other transit agencies across the country about customer interest in traveler information.

Feel free to make any negative or positive comments about any of the things we are discussing today. This is a free-flowing discussion and there are no right or wrong answers.

Before we get started, here are some ground rules and background information.

AUDIO TAPING

This session is being taped so that we can write an accurate report. We're not keeping track of who said what.

GROUND RULES

1. Please talk one at a time.
2. Avoid side conversations with your neighbors.
3. We need to hear from everyone in the course of the discussion, but you do not have to answer every question.
4. Feel free to respond directly to someone who has made a point. You do not have to address your comments to me to get them on the table.
5. Say what YOU think. Do not let the group influence your opinion.

SELF-INTRODUCTIONS

Please introduce yourself to the group and tell us:

- Your name
- Briefly describe how you use public transit.

Introduction

- Information is only part of the picture (level of service, convenience of routes, other)
- Start with the planning stage.
- [quantity, rate, format of information is key]

Before you start trip: Pre-trip

- Do you plan transit trips? Or figure it out along the way?
    - Plan some trips and not others? What determines that?
        - Commute
        - Recreation/sports events
        - Other
- How long are your typical trips? (Show of hands: <15 miles vs >+15 miles)
    - Does trip length make a difference in info needs? If so, how?
- How far ahead do you plan (i.e., need the information)?
- What do you need to know before leaving on trip?
    - Discuss differences by trip type (familiar vs. unfamiliar)
    - Trip planning services.
        - Internet trip planners (ever used?)
        - Frequency of use
        - Desired info (fastest, minimal walking, fewest transfers)
        - Output (how many trip options?)
    - Multi-modal trips (linked bus, rail, air, etc.)
    - Discuss static versus real-time (dynamic) information.
    - Information priorities: what's most important? What should transit agencies provide?
    - Do you have available now what you need? If no, what else would you like to have?

En route (wayside)

- What kind of information do you need to have at stops and stations?
- What kinds of stops/stations should have this available? (some vs. all)
- What types of real-time information is preferred in what locations?
    - Show sign examples (from KC Metro). Discuss pros/cons.
    - ETA, countdown (how far ahead)
    - Continuous vs intermittent display (with advertisements?)
    - Timeliness, on time/late
    - Vehicle location
    - Number of vehicles ahead
    - Sign placement
- How do you prefer the real-time information to be displayed?
    - Video screen (interactive?)
    - Message sign (scrolling; number lines; refresh rate; number of routes)

En route (on the bus/train/ferry)

- What information do you need when riding?
    - Location inside/outside vehicle
    - How presented (audible, visual)
    - Types of display formats
- Differences by trip type (familiar vs. unfamiliar)

How do you judge the reliability of information? How important is that to you?

Now let's talk about some of the more advanced technologies that transit agencies are using to provide riders with information.

- How many of you use any kind of wireless device to get transit information? Discuss.
    - Cell, PDA, pager
- How important is it to have access to transit information all the time?
    - For those who want all-the-time access, how do you want to get that?
- Customized information (route, mode, timing)? If you could get that, what would be the essential information you would want?
    - Service delays or interruptions
    - Weather-related delays
    - Where my bus is now
    - Bus will arrive soon
    - Route changes
    - Snow routes
    - Service for special events
    - Traffic information
- How would you like transit agency to send you information you customize?
    - Email alerts
    - Phone messages
    - Specified routes, times
    - Willing to pay for service?
- How many of you use a computer to get transit information?
    - What do you like about that?
    - What would you want to use it for?
        - To get the information I need to plan a trip
        - To compare different travel choices (bus, rail, etc.)
        - To get information on transit service for special events
        - To learn about service changes
        - To see where the bus is now
    - Where would you use it?
        - Home; work; school; library; other??
    - What other features would you like that you do not have there?
- Discuss other technologies, such as kiosks, dynamic signage
- Finally, if [Agency Name] Transit could make one improvement in the information they make available to you, what would that be?

APPENDIX J:
DATA COMPILATION PROCEDURES

Several procedures were necessary to prepare the survey and discussion data for analysis. These steps included conversion to electronic form, compilation, filtration, and finally summarization. This appendix describes these activities in detail and explains how the results presented in Chapter 4 were determined.

Preference surveys

The preference surveys needed to be converted to a form that could be computed electronically before analysis could be performed. Each completed survey consisted of letter-number codes indicating *what* kinds of information the participants want to get, *where* and *how* they want to get it, and whether it was essential or non-essential (*importance*) for both a familiar and unfamiliar transit trip (*familiarity*). The project team devised a conversion method that reduced data entry error by mirroring the survey task that the participants had completed. Microsoft Access was used to create a database entry form that looked similar to the pink and yellow survey sheets (Appendix F).

After the codes for all participants were entered, a script converted the database into a single SPSS-compatible data file. This file contained binomial (i.e., 0 or 1) variables for every combination of what, where, how, importance, and familiarity. In addition, several levels of these variables were included to allow different types of analyses within SPSS. These included variables that described only "what," "what and where," or "what and how" for each level of importance and familiarity. This coding scheme created an SPSS data file that included 3200 individual variables for the raw survey data alone.

During coding, several contingencies were required to handle some participant coding inconsistencies. Some participants only indicated where they need information types, while others only indicated how they wanted to get it. Still others simply check-marked the information types they thought important. For these survey sheets, data were only coded for as much information as was provided, and missing data were entered for the remaining variable sets. For example, if a participant only provided what information they want, data would be entered for all values of "what", but the "what and where", "what and how", and "what, where, and how" data would be coded as missing values. Because of these discrepancies, not all data for all participants could be used in all analyses. Again using the above example, this participant's data would be included in analyses that sought information on what people wanted, but not included in more detailed analyses concerning where and how people want the information. It is for this reason that respondent sample sizes vary between different analyses in the results section of this report.

The background data were coded directly from the questionnaire into SPSS and merged with the survey data to enable segmentation of information preferences by demographic, transit behavior, and attitudinal responses. All survey and background data were labeled by workshop location to allow comparisons between geographic locations as well as individual workshop locations.

Several measures were compiled using combinations of variables. For instance, in the background questionnaire participants indicated how many of each type of trip they completed in the past 30 days (e.g., work, school, and socializing). These trips were summed to calculate the total number of trips taken in the past month, used as a measure of transit ridership frequency. A few respondents indicated as many as 300 total trips in the past 30 days. This number seems unrealistic – it was decided that the highest number of one-way trips one could take in a single month is 160 (perhaps a round trip to work and two other round trips to social, shopping, or other locations five days per week, and a smaller number of trips on non-working days). Therefore, all total trip amounts in excess of 160 trips were recoded to 160, and then this amount was redistributed over the individual types of trips in the original proportions.

Discussion transcripts

Each breakout discussion was recorded on audio tape to ensure that all comments, questions, and discussions were accurately captured. These tapes were each labeled with respect to the date, workshop city, workshop location within the city (where applicable) and the discussion group moderator. Tapes from the workshops completed by Multisystems were sent to Battelle for processing.

An external vendor was contracted to prepare transcriptions of all tapes. Attempts were made to identify speakers to help track consistent preferences. One member of the project team summarized each transcript into a document separated by a topic structure based on the moderator's guide (see Appendix I), extracting direct quotes wherever possible to help illustrate respondent preferences. The summarization was then used to create a write-up based on trip phase that augmented and clarified the results of the survey analyses.

APPENDIX K:
ANNOTATED BIBLIOGRAPHY

Abdel-Aty, M. A., Kitamura, R., & Jovanis, P. P. (1996). Investigating effect of advanced traveler information on commuter tendency to use transit. *Transportation Research Record 1550*, 65-72.

This article describes a computer-aided telephone interview (CATI) conducted with 500 respondents each in Sacramento and San Jose that was designed to determine people's use of and satisfaction with public transit. Non-transit users were polled as to why they do not use transit, and transit-users were asked a variety of questions about their transit use as well as ways to improve the transit system. Additional questions were asked of respondents regarding how hypothetical advanced information systems might affect their willingness to use transit. Respondents were asked to rate their satisfaction with transit routes, stop and station locations, transit departure and arrival times, operations hours, transit fares, and Park-and-Ride lots. Over 72% said they were satisfied or very satisfied with these information categories. Telephone, radio, and television were almost equally chosen as the means by which they would like to receive information. People who receive traffic reports are more likely to receive transit information, and therefore ride, and 38% of respondents indicated that they would more likely ride transit at least one day a week if appropriate and desired information were available. The most important information items indicated were frequency of transit service, waiting time at transit stops, transit route map, and operating hours.

Casey, R. F. (May 2002). *Advanced public transportations systems deployment in the United States: Year 2000 Update.* (FTA-MA-26-7007-02.1). Washington, DC: Federal Transit Administration.

This report is a compilation of existing and planned deployments of 17 APTS technologies and services elements across 221 transit agencies that were surveyed. "Of the 572 agencies surveyed in 2000, the *most widely deployed* APTS elements for which data were collected for the entire U.S. are Automated Transit Information (291 agencies), Advanced Communications (229 agencies), and Automated Operations Software (177 agencies)."(P. 1-2) Automated Transit Information is presented in three categories: pre-trip, terminal/wayside, and in-vehicle, and whether each of these systems is currently operational or planned.

Casey, R. F., Labell, L. N., Moniz, L., Royal, J. W., Sheehan, M., Sheehan, T., Brown, A., Foy, M., Zirker, M., Schweiger, C. L., Marks, B., Kaplan, B., & Parker, D. (December 2000). *Advanced public transportation systems: The state of the art update 2000* (FTA-MA-26-7007-00-1). Washington, DC: Federal Transit Administration.

Charles River Associates, Inc. (January 1997). *User acceptance of ATIS products and services: A report of qualitative research* (Interim Report). Washington, DC: USDOT ITSJPO/Volpe NTSC.

This report summarizes results from 12 focus groups conducted in 1996. Focus groups were convened to explore different aspects of ATIS, including pre-trip travel information, public transportation information system, in-vehicle static navigation system, in-vehicle dynamic navigation system, and an in-vehicle Mayday device. The focus groups had two objectives:

(1) to improve understanding of consumer reactions to ATIS product concepts, and (2) to help develop improved methods for further quantitative customer surveys.

Among the transit-related findings from the focus groups:

- "Transit users would appreciate improved information systems including intermodal schedule options and real time performance data, but they also expect such information to be freely provided by the carriers, just as for the airlines." P. 7
- "Among users of complex public transportation networks (for example, subway, bus, ferry, and commuter rail interfaces, as in New York), tailored routing and (especially) schedule assistance is valued." P. 21
- Transit users were interested in enhanced information about system performance at "key decision points in their journeys:" starting the trip, entering a rail station, and waiting for service on platforms or transfer points. (P. 24-5).
- Respondents sought information, especially "nonrecurrent delays," at these decision points. Preferred media included pre-trip systems, kiosks, and on-platform information about expected waiting time. P. 25
- Concourse kiosk displays were considered helpful in two ways: "to help both in negotiating complex networks in the easiest way – with routing, schedules, and fare alternatives – and to provide *current* system performance information." P. 25
- The main benefit from transit traveler information "derives primarily from the ability of the system to give peace-of-mind by reducing uncertainty." P. 25
- Transit ATIS may help "reduce defections from transit," but regular drivers showed little interest in transit ATIS. P. 25

Among the findings to guide future research efforts:

- Respondents had no trouble envisioning the various ATIS products being tested, but they had more trouble imagining how these produces would benefit them in everyday life. P. 9
- "In general, ATIS operational tests have found an *enhanced level of enthusiasm* for various ATIS concepts after trying them out." P. 18
- "Carefully crafted verbal concept descriptions appear to work reasonably well in conveying the essentials of the concepts, and getting people to think about application to their own travel." P. 25
- Including a description of how high-tech devices worked was helpful.
- Videotapes and/or demonstrations did not appear to be necessary. Participants appeared to visualize dashboard-mounted in-vehicle units well; demonstrations of telephone-based systems were helpful.
- The greatest difficulty was in conveying the potential benefits of ATIS features in respondents' own lives or the overall transportation system.

General reactions to ATIS

- Most important attributes of ATIS information were: accuracy, timeliness, reliability, costs (one-time and recurrent), level and personalization of decision guidance, ease of access to information, perceived safety implications. P. 9

- Respondents were concerned that pre-trip information about delays caused by incidents would be "too stale" by the time they were traveling. P. 19
- Participants expressed strong dissatisfaction with voice mail and telephone information systems with long menus. Demonstrations of SmarTraveler and a simulated New York transit-oriented system addressed these concerns by showing respondents that they could enter a key code to get the information they wanted.
- Participants were not interested in PDA-based units, based on a demonstration of the Motorola *Envoy*: "There was some concern about its physical size or chunkiness, too big to be thrown into a handbag or pocket, which limited the interest of existing PDA users." P. 20. Also respondents found the screen "too small and indistinct" to use when driving a car (unlike later models, the screen was not backlit). Although the portability of the unit was a benefit for drivers, the difficult interface reduced its desirability.
- Respondents see a benefit from real-time traffic information, but wonder whether the information would be current and geographically detailed, whether it would be more credible than existing broadcast sources, and whether the volume of users would overwhelm the system. Participants were more receptive after the system details were explained. Higher-income professionals who drove to work were more interested than members of the general public.
- Participants were more interested in traffic information than specific route guidance.

Key features of ATIS information (pp. 27-28)

- **Accuracy** – Information should be correct.
- **Timeliness** – Information should be current and received in enough time to allow participants to change travel decisions
- **Reliability** – Information should be comprehensive in its coverage and consistent in quality
- **Cost** – Capital and operating costs were important considerations
- **Degree of decision guidance** – Information should be sufficiently detailed with personalized content to allow participants to plan travel or adjust plans en route.
- **Ease of access** – Access to information systems should be minimally disruptive and not require too much time or skill
- **Perceived safety implications** – Information should allow users to avoid a dangerous situation or feel protected in an accident or emergency. Also, the means of accessing in-vehicle information should not distract drivers.

Charles River Associates, Inc. (May 1999). *TravInfo™ data coverage: Report of qualitative research*. Boston, MA: Author.

Dobies, J. J. (1996). *TCRP Synthesis 17: Customer information at bus stops: A synthesis of transit practice*. Washington, DC: Transportation Research Board.

This article outlines theory, research, examples, and effectiveness of static bus stop sign design. Sections of interest with regard to transit information preferences include the benefits of better information to different types of users, what type of information can and should be included, where to place signs, and the effects of ADA regulations on sign implementation. Aspects of sign design, including physical design, type of information to include, and placement, are discussed mostly in terms of manufacturing and transit agency efficiency

considerations with little human factors input. The article also includes details on program costs and effectiveness as well as a large assortment of bus stop sign examples (pictures).

Federal Highway Administration. (2001). *FHWA's final rule and FTA's policy for applying the national ITS architecture at the regional level* (FHWA-OP-02-003). Washington, DC: U.S. Department of Transportation.

This booklet outlines the general principle behind the FHWA and FTA joint policy for integrated ITS system architecture consistency. This policy ensures interoperability between different ITS systems within a particular region. Requirements specify that a regional ITS architecture must be developed within four years of the ITS system's effective date, and that no new projects deployed after April 2005 can advance without demonstrating compliance with the regional ITS architecture. Basic system implementation requirements, standards adoption criteria approval processes, and practitioner technical assistance programs are outlined. Several additional resources, including websites and personnel contacts, are listed.

Federal Highway Administration. (December 2000). *What have we learned about intelligent transportation systems?* Washington, DC: U.S. Department of Transportation.

Federal Transit Administration. (2000). *Advanced public transportation systems publications* (CD-ROM). Washington, DC: FTA/USDOT.

Goeddel, D. L. (November 2000). *Benefits assessment of advanced public transportation system technologies update 2000* (FTA-MA-26-7007-00-4). Washington, DC: Federal Transit Administration.

Goodman, J., Laube, M., & Schwenk, J. (2000). *Issues in Bus Rapid Transit*. Washington, DC: Federal Transit Administration.

Goodman, J., Laube, M., & Schwenk, J. (1998). *Bus Rapid Transit demonstration program*. Washington, DC: Federal Transit Administration.

Greco, P. (1995). Integrated transit communication and information systems. *Public Transit Report 1995/96*.

This article provides details on advances in information and communications systems for mass transit operations. Current automatic voice announcement technology is highlighted, reporting that it can identify stations, keeping passengers fully aware of the train's progress along its route, as well as communicating safety-related messages such as when train doors open and close.

Green, P., Levison, W., Paelke, G., Serafin, C. (December 1995). *Preliminary human factors design guidelines for driver information systems* (FHWA-RD-94-087). Washington, DC: Federal Highway Administration.

Henk, R. H., & Kuhn, B. T. (September 2000). *Assessing the effectiveness of advanced traveler information on older driver travel behavior and mode choice* (Report SWUTC/00/472840-00027-1). College Station, TX: Texas Transportation Institute.

This paper focuses on the older driver/traveler preferences in the specific area of ATIS. For the research documented herein, special focus groups (hands-on with ATIS technologies) and surveys were conducted to assess older driver utilization and understanding of many recently implemented ATIS technologies in the San Antonio, Texas area. These focus groups and

survey panels were developed for older drivers as well as younger drivers to identify and isolate special needs of older drivers relative to ATIS. Various characteristics of older drivers were discussed, such as degradation in visual and auditory perception, increase in the time needed to make complicated decisions, and the ability to obtain and/or interpret advanced traveler information. The general unfamiliarity of older drivers with advanced technologies (e.g., computers) could also influence the potential success of such technologies. For the purposes of this research "older drivers" were defined as individuals over the age of 55 years.

The majority of older drivers (256 or 59%) considered weather information "very important" compared to 47% (64) of younger drivers. About 12% (24) of older drivers considered transit schedules very important versus 3% (4) of younger drivers. Less than half of older drivers considered information about traffic congestion very important (177 or 45%), incidents/accidents (143 or 41%), lane closures (130 or 36%), or construction (132 or 36%). Among older drivers without access to ATIS information, 27% (79) cited cost, 32% (93) said awareness, 22% (64) did not understand the technology, and 18% (52) said it was not available in their area.

In focus groups, younger drivers found web applications easier to use than older drivers, but both groups found them relatively easy to use. Similarly, both groups said they would use in-vehicle navigation units with moderate frequency, if available. The younger drivers were willing to pay more than the older drivers: $200-300 compared to $100 as the most commonly cited response. Both groups found kiosks relatively easy to use. They considered the ability to print out route information the best feature of the kiosks and the speed of illustrating information the primary complaint. Older drivers frequently requested larger print for all three technology applications.

Higgins, L., Koppa, R., Weatherby, C., Edrington, D., & Zmud, J. (1999). *TCRP Report 45: Passenger information services: A guidebook for transit systems*. Washington, DC: Transportation Research Board.

This article outlines the principles behind the design and implementation of transit system information aids. User preferences for information provision are included, highlighting the differing information preferences for experienced riders versus new or infrequent riders. It provides guidelines and corresponding literature reviews for system and route maps, bus stop designation, automated telephone systems, timetables, general signage, and bus operator knowledge. An appendix includes detailed information on ADA guidelines for disabled individuals. This article is full of potential human factors guideline material.

Hill, E. (1997). Review and assessment of information kiosk systems. *Proceedings of the 1997 APTA Bus Operations, Technology, & Management Conference*, 60-77.

This article gives a detailed overview of kiosk information system design and usage. The design, implementation, problems, and lessons learned from several existing systems are discussed. Guidelines for kiosk system development, including physical design, electronic component and communication, software, included information, and user interface issues are presented.

Hobeika, A, Sivanandan, R., Jehanian, K. M., & Ameen, M. D. (1996). Advanced traveler information system users' needs in I-95 northeast corridor. *Transportation Research Record 1537*, 55-62.

This article covers user preferences for ATIS information for both public and private traffic and transit systems. Included literature review and survey results focuses on preference for types of pre-trip and en route information for the different modes of transportation. Results of the literature review indicate that people use traffic information en route rather than pre-trip, and that features such as system cost, accuracy, timeliness are more important than physical aspects of the ATIS. Key information needs of transit travelers included transit schedules and delays, estimated time of arrival, traffic delays, and weather conditions. Most respondents felt that arrival time and delays were very important to en route traveler information, and most found dynamic information systems (e.g., television, telephone, and automated booths) preferred over static information (e.g., maps and schedules). Respondents indicated they were unwilling to pay for dynamic en route services, indicating their perception that transit companies should provide free information.

Huff, M., Terranova, M., Frank, R. A., & Thornton, C. (1996). User acceptance of Georgia's Advanced Traveler Information System kiosk (Abstract). *Abstracts of the Third World Congress on Intelligent Transport Systems*, 57.

This article is an overview of plans for the evaluation of ATIS kiosks created for the 1996 Olympics in Atlanta, Georgia. The scope of the evaluation included assessments of traveler attitudes, kiosk use, preferences for capabilities and features, impact on traveler behavior, impact of environmental and ergonomic factors on usage, transfer of user acceptance to other circumstances and locations, and identifying ways to improve the kiosks. While no results are presented, several methods are included that might be of use to workshop development. Several kiosk capabilities are listed in addition to transit information: ride sharing and carpooling, Amtrak and Greyhound (commercial travel) information, airport airline schedules, weather conditions, travel and tourism information, and other general information (Olympics, major events, etc.). Preferences regarding the relative value of these categories were to be gathered. Impact on behavior was also assessed, determining whether the user altered his/her travel plans based on the ATIS information, as well as satisfaction with the changes in travel plans. Preferences for whether the kiosk should be located inside or outside were collected. The article identified gender, age, and technology familiarity as factors that could affect user acceptance of the kiosks.

Jensen, M., Cluett, C., Wunderlich, K., DeBasio, A., & Sanchez, R. (May 2000). *Metropolitan Model Deployment Initiative Seattle evaluation report, Final Draft* (FHWA-OP-00-020). Washington, DC: ITS Joint Program Office/USDOT.

Jones, W. S. (November 1995). *ITS technologies in public transit: Deployment & benefits.* Washington, DC: ITS Joint Program Office/USDOT.

This paper summarizes the findings from a 1994-95 study of deployment of ITS technologies. The study surveyed 35 transit agencies to ascertain the extent of deployment and the benefits of those technologies. The study examined the following technologies: automatic vehicle location/computer-aided dispatch, smart cards, automatic passengers, automatic annunciation, passenger information systems, and adaptive signal control.

A number of transit agencies surveyed their current and potential customers. They consistently learned that the single most common reason for not using transit was that it was difficult to use. Specifically, schedules were hard to get and to read and the information was not reliable. None of the surveyed transit agencies projected ridership increases from

advanced passenger information systems, but they considered them necessary to remain competitive.

The Los Angeles Smart Traveler project surveyed the public's response to kiosks. Some 79% found kiosks easy to use and only 5% found them difficult. About 84% said they would use them again, and 86% would encourage others to use them.

Kikuchi, S., Aneja, S., Chakroborty, P., Hofmann, A. J., Machida, M., & Perincherry, V. (September 1994). *Advanced traveler aid systems for public transportation. The Intelligent Transit Mobility System (ITMS)* (DOT-T-95-07). Washington, DC: Federal Transit Administration.

KRW, Inc. (1996). *TCRP Report 12: Guidelines for transit facility signing and graphics*. Washington, DC: Transportation Research Board.

Lappin, J. E. (January 2000). *Advanced Traveler Information Service (ATIS): Who are ATIS customers?* Washington, DC: ITS Joint Program Office/USDOT.

This paper offers answers to "Who are ATIS Customers?" using different, complementary research and evaluation approaches. The following evaluation approaches were used: (1) an empirical assessment of external conditions that appear to be critical to strong customer demand for ATIS services; (2) a general population survey used to segment the population according to attitudes and values toward time, technology, travel, and information; and (3) customer characteristic trends drawn from MMDI customer satisfaction surveys of the Puget Sound Traffic Conditions web site, *TrafficTV* in Seattle, Metro Online transit web site in Seattle, TransitWatch® real-time bus departure times at two transit centers in Seattle, TrafficCheck traffic television in Tempe (AZ), and observations of customer use of the Trailmaster travel conditions web site in Phoenix and the Transguide travel conditions web site in San Antonio.

"The quality of the ATIS services is at least as important as the level of network congestion. Information quality determines whether, how frequently, and with what level of confidence the traveler consults traveler information. Quality determines whether the information will meet customer needs with respect to personal benefit and value." (p.2)

"Conditions that suggest high demand for ATIS transit services are not as well studied, but appear to be related to the complexity of the transit network and services, the age of the transit rider population, and the level of technological sophistication of the ridership. Younger riders expect transit information to be as easily accessed as that provided by any market-based service. Their expectations are probably conditioned by the current service economy and by information available on the Internet. Technologically sophisticated riders are aware of many of the tools available for tracking cars and busses, and can easily imagine the personal benefits of real-time transit status information, in addition to the other services that advanced media can provide." (pp. 2-3)

Market segments were defined based on responses to questions included in an ITS supplement to the 1997 Puget Sound Regional Council household travel survey. Four segments were defined: Control seekers, Web heads, Low-tech pre-trip information seekers, and Mellow techies. About two thirds of web-based ATIS users were web heads or control seekers and, conversely, web heads were not likely to use non-web-based ATIS services.

Low-tech pre-trip information seekers were considered a significant users group for non-web-based services.

Web heads were more likely than other groups to consider on-line transit information easy to user, but they had very high standards for accuracy. Low-tech pre-trip information seekers were generally satisfied with the information they received.

Lappin, J. E. (February 2000). *What do ATIS customers want?* Presented at the ATIS Data Collection Guidelines Workshop, Scottsdale, AZ (Sponsored by USDOT and ITS America).

This slide presentation focuses on the customer perspective on ATIS services. Elements include why drivers consult ATIS, how they use it, and critical features of ATIS traffic and transit services. Conclusions indicate that fee-based ATIS must provide value to customers. Potential customers will seek out quality information but ignore low-quality data. Individual use and market demand appears to increase with good experience. However, transit customers do not appear to be interested in paying for better info.

Drivers identified the following critical features in an ATIS traffic service: accuracy, timeliness, reliability, convenience/speed, degree of decision guidance and personalization, and safe operation. Camera views (on web and television) should be clearly labeled with location and direction, updated frequently with a time stamp, and load quickly. Incident info should provide relevant details (where, when, type of incident), impact on network, and be up-to-date. Traffic service should include direct speed measures by segment, travel time between user-selected O-D, and dynamic route guidance. Coverage should include major freeways/arterials, HOV lanes, and express lanes. Information should be provided at least every five minutes during the peak with time stamps. Drivers need en-route information because conditions change quickly. Also, weather information is important. ("Weather is like an incident.")

Web users want quick download, multi-dimensionality, color-coded maps, and uncluttered visuals. Television viewers want just to see traffic, voice-over descriptions, recommended alternate routes, and uncluttered visuals. Phone users want fast, easy, hands-free access to location-specific information. No one wants advertising. Also, users want information on ramp delays, trends (are conditions getting better or worse), predictions, windows of opportunity, major event information, and parking lot information.

Critical features of ATIS transit service include real-time information on the web, by phone, at bus stops, and on monitors at malls/office parks near major transit centers. Also, detailed route maps, with stops and transfer locations identified. Features should include point-to-point trip itineraries for transit and multimodal trips, also estimated trip time and fastest routes. Also, secure online bus pass purchase.

Other research suggests transit riders are not interested in paying for better system information.

Lappin, J. E. (December 2000). What have we learned about advanced traveler information systems and customer satisfaction? *What Have We Learned About Intelligent Transportation Systems?* Washington, DC: Federal Highway Administration.

This paper synthesizes customer satisfaction findings from advanced traveler information systems research and evaluation dating from 1996, including project evaluations from the Metropolitan Model Deployment Initiative in Seattle, San Antonio, and Phoenix. Demand for

ATIS transit services appear to be related to the complexity and variability of the transit network, age of the transit rider population, and level of technological sophistication of the riders. ATIS transit customers want services that provide real-time information (pre-trip and en-route), 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.

Kiosks and WinCE mobile computers evaluated as part of the MMDI were not popular venues for travel or transit information. Problems with kiosks included poor placement in relation to the trip decision, unreliable performance, and a challenging user interface. Customers did not pay much attention to information on mobile hand-held computers, possibly because of low market penetration or insufficient promotion.

Levine, J. (August 2002). *Ann Arbor Area Public Transportation Service Evaluation, 2002.* Ann Arbor, MI: A. Alfred Taubman College of Architecture and Urban Planning/The University of Michigan.

This is a report of an on-board survey of AATA riders in May and June of 2002, repeating for comparative purposes some questions covered in the prior survey in 2000. "A major theme of the current study was communications, advertising and the motivations of bus riders, particularly those who have the option of driving." (P. 5) Satisfaction with the four main sources of information has declined somewhat since 2000 but remains high for printed schedules (#1), customer phone line, Internet, and "Ride Lines" information brochure. Printed schedules are the most common source of information about AATA (63.2%), with bus drivers a distant second (22.5%), website third (20.2%), Ride Lines Brochure (17.2%), customer service phone line (11.7%), and other riders (10.9%). Other sources garnered less than 10%. 23% of riders recalled seeing or hearing AATA advertising within the past month, mostly on the bus itself and on TV. Respondents expressed the greatest satisfaction with "information on bus routes and service" (5.67 on a 1 to 7 scale, worst to best), and the least with "frequency of service" (4.81). 60.3% said they were "very satisfied" with information on bus routes and service. Results show that the percent who say they have used the AATA web site increased from 38% in 2000 to 47.1% in 2002.

Levine, J. (October 1999). *Evaluation of the Advanced Operating System (AOS) of the Ann Arbor Transit Authority (AATA): Customer Satisfaction and Response to AOS.* Ann Arbor, MI: A. Alfred Taubman College of Architecture and Urban Planning/The University of Michigan.

This study develops implementation data on AATA's on-time performance and vehicle-to-vehicle timing of transfers at four major transfer locations. Systematic evaluation of on-time performance indicated that AATA improved on-time departures. The opposite was observed regarding on-time arrivals. Bus-to-bus transfer times within the AATA system tended to have no significant change from 1997 to 1999. Some improvement was noted when on-time performance and transfer times were analyzed jointly.

In a customer evaluation survey, passengers were asked how receptive they would be to real-time information (which was not available at the time). Although interest was high, the level of interest declined from 86% (useful or very useful) in 1998 to 71% in 1999. Passengers were given a choice of information media: Internet, cable television, bus stop display, or over the phone. In 1998 and 1999, over 61% said they would be "very likely" to use the

information if available at bus stops. Other options were Internet (27.4% "very likely"), cable television (33.3% very likely), and telephone (33.7% very likely). (P.8)

Levine, J. (October 1999). *Evaluation of the Advanced Operating System (AOS) of the Ann Arbor Transit Authority (AATA): AATA Web Survey*. Ann Arbor, MI: A. Alfred Taubman College of Architecture and Urban Planning/The University of Michigan.

A survey was completed of users of the AATA's worldwide web site in 1997. The sample was self-selected and hence not scientific. The survey focused on the usefulness of the site itself, as well as interest in real-time schedule information. The website was generally seen as useful, though only a minority of users indicated that they would utilize real-time schedule information if it were posted there.

The sample size was 80, so caution must be used in interpreting findings. About 21% visited site to get schedule information, 15% to view a map of bus routes, 3% to learn how to ride AATA buses, 1% for information on bus fares, 1% to contact AATA personnel, and 1% to fine information on special services. About 40% were just browsing and 18% indicated another purpose. Among bus riders (N=51), 30% have used info from the web page to plan a bus trip. Among those (N=14), 93% found the information very accurate and 7% somewhat accurate. About 79% of trip planners will definitely use the web page again for trip planning and 14% probably will.

Respondents were asked what kind of real-time information would be most useful to them on the web page. Two answers were allowed; percentage based on responses (N=116). Responses were as follows:

- Minutes until bus arrives at stop I select (33%)
- Actual bus location for all routes (25%)
- Actual bus location for routes I select only (24%)
- Other (3%)
- Real-time info not useful to me (15%)

No meaningful differences were observed between responses from riders (N=74) and nonriders (N=42).

Participants were asked whether they would access information about actual locations of buses along the routes (N=80). About 75% said yes. Among those (N=59), 44% would definitely and 25% would probably use the information deciding whether or not to take a bus trip.

Marston, J. R., & Golledge, R. G. (1998). Improving transit access for the blind and vision impaired. *Intellimotion*, *7*(2), 4-5.

Mehndiratta, S. R., Kemp, M. A., Lappin, J. E., & Nierenberg, E. (2000). Likely users of advanced traveler information systems: Evidence from the Seattle region. *Transportation Research Record 1739*, 15-24.

This article reports findings about the claimed use of and interest in traveler information systems among segments of the general population in the Seattle metropolitan area. Research is based on data collected from a 1997 intelligent transportation system supplement to the Puget Sound Regional Council's transportation panel travel diary study. In general, interest in traffic information was found to be a function of complex travel behavior, demographics,

and factors related to attitudinal and technology interest. It was also found that the potential market for ATIS includes several market segments with different needs; each is drawn to ATIS for distinct and varying reasons. First, the so-called control seeker segment includes people who desire greater than average control over their environment. The second segment of interest, dubbed webheads, includes individuals who are very comfortable with high technology, and it is possible that they would be drawn to ATIS at least partially through specific high-technology dissemination media. A third segment is made up of individual who are less comfortable with (or less interested in) technology and are primarily interested in pre-trip information, which they use to make departure time and route choice decisions.

Research to date has suggested that ATIS users are likely to be wealthier, more educated, have a longer commute, and to be more conversant with technology than average members of the general population. Research also suggests that members of the general public remain skeptical about ATIS services and products.

Mehndiratta, S. R., Kemp, M. A., Lappin, J. E., & Brand, D. (1999). What advanced traveler information system information do users want? Evidence from in-vehicle navigation device users. *Transportation Research Record 1679*, 41-49.

This paper reports findings from research into user preferences for advanced traveler information disseminated to drivers of private vehicles. The research is based on trade-off surveys conducted in the Chicago, Boston, and Seattle metropolitan areas. Survey respondents had significant hands-on experience with vehicles equipped with dynamic in-vehicle navigation units. The structure of consumer preferences was similar across the three market areas. In a familiar commuting environment, users were split in their opinions about whether they would prefer to receive routing advice or simply information about traffic delays. Geographic coverage of routes and frequency of information updates were also important factors. The survey indicated diminishing returns for information improvements.

Survey instrument included "Kano" questions, based on research of Noriaki Kano who suggested segmenting product/service attributes into "expected," "normal," or "delightful." Using this framework, surveys included questions like the following:

Suppose that your car had a navigational system that automatically receives and uses up-to-date information. Please choose one of the following statements that best describes how you would feel if the information service provided coverage for all roads, including local streets. Assume for now that cost is not a consideration.

1. *That's not good enough; I probably would not use such a service.*
2. *That is about the minimum that I would accept and use.*
3. *Such a service meets my needs, and I would use it.*
4. *That is great, perhaps even better than I need.*

This framework allowed researchers to evaluate consumer preferences in a "threshold-based, satisficing framework, as opposed to the utility-maximizing theory that underlies conjoint and discrete-choice models. They allowed exploration of such questions as whether consumers expect and derive commensurate value from premium (high-cost) ATIS services or whether cheaper services with intermediate levels of coverage and update frequency would provide similar or better value."

Mitretek Systems, Inc. (September 1996). *Key findings from the Intelligent Transportation Systems (ITS) Program: What have we learned?* Washington, DC: Federal Highway Administration.

This paper summarizes the lessons learned from ITS and APTS systems. The report indicates that pre-trip traveler information has met with user acceptance, but it had not been determined which techniques for disseminating information are most effective (kiosks, signage, home computers, cable, personal communicators). In addition, it had not been determined whether any of these approaches, when combined with traffic information, would induce travelers to switch from automobiles to transit. Studies of rural travelers indicated that rural areas could benefit from ITS applications. Mayday applications were the top priority for rural areas. Travelers surveyed at Yosemite National Park about variable message signs indicated that they preferred information about road closures, current traffic conditions, parking availability, and campsite availability. Information on rural weather-related road conditions was valuable to the traveling public and state agencies.

Monji, T., Kubota, H., Sakamoto, K., & Sugiura, T. (1995). Analysis of information needs for community-level travelers. *Proceedings of the Second World Congress on Intelligent Transport Systems, 4,* 1783-1788.

Northwest Research Group, Inc. (2000). *2000 rider / nonrider survey.* Final Report. Prepared for: King County Department of Transportation, Transit Division. Seattle, Washington.

Polak, J., & Jones, P. (1993). The acquisition of pre-trip information: A stated preference approach. *Transportation, 20,* 179-198.

This paper describes a study into the effects of pre-trip traveler information, examining traveler information needs, the level of detail and form for providing information, traveler uses of the information, and impacts on behavior. The study was conducted in England and Greece. The authors contend that information provided pre-trip, or high in the traveler's decision chain, offer the widest potential for altering behavior. This is relevant for choice of public transportation because mode choice is most likely to be made prior to initiating the travel. Also relevant is the notion that mode choice is open when leaving home but largely determined when leaving elsewhere to return home. Results show that the likelihood of choosing a public transportation mode decreases with longer trip distance or trip times and availability of free parking at the destination. Travelers generally showed reluctance to engage in extensive information searches pre-trip, rather desiring minimal information that is judged *relevant to their particular trip needs.* Whether a trip is for commuting or not appears related to willingness to shift mode based on information, but how this works out depends on the structure of travel in different cities (congestion, parking, etc.). A finding is that information services need to offer multi-modal traveler information.

Radin, S., Jackson, D., Rosner, D., & Pierce, S. (2002). *Trip Planning State of the Practice* (FTA-TRI-11-02.6). Washington, DC: Federal Transit Administration.

Radin, S., Sen, B., & Lappin, J. (January 2000). *Advanced Traveler Information Service (ATIS): Private sector perceptions and public sector activities*. Cambridge, MA: Volpe NTSC.

Schneider, H. (1995). The intelligent way to move around the system. *Public Transit Report 1995/96*.

This article provides an overview of integrated intelligent transportation systems for railway transit operations and their impact on transit system usability. Six types of information sources are briefly discussed: audio systems, safety signals, digital displays, control options, driver support, and spoken text. Audio systems are sufficient for informing passengers as to when they should board or vacate trains. Visual displays (such as video monitors) should be used to provide information on the location of trains in the station. These monitors could be located either on the platform or inside train interiors. Audio and visual systems can supplement each other to improve system efficacy.

Schweiger, C. L. (April 1995). *Review and assessment of en-route transit information systems*. Washington, DC: Federal Transit Administration.

Stearns, M. D., Sussman, E. D., Belcher, J. (September 1999). *Denver RTD's computer aided dispatch/automatic vehicle location system: The human factors consequences* (DOT-FTA-TRI-11-99-29). Washington, DC: Federal Transit Administration.

Transit Cooperative Research Program. (2001). *BRT: Bus Rapid Transit: Why more communities are choosing Bus Rapid Transit* (TCRP Project A-23). Washington, DC: Transportation Research Board.

Turnbull, K. F. (February 2000). *Assessment of the Seattle Smart Traveler*. Washington, DC: Federal Transit Administration.

Washington State Transportation Center. (1998). *Choosing the route to traveler information systems deployment: Decision factors for creating public/private business plans*. Washington, DC: ITS America Advanced Traveler Information Systems Committee and USDOT.

ATIS works best as a cooperative venture of public and private organizations. However, the details of how public and private agencies will work together to develop, deploy, operate, and maintain ATIS have not been determined. Current ATIS deployment activities suggest that a variety of business approaches for deploying and operating an ATIS may be possible and appropriate. This report discusses the issues that affect the development of a business plan for deploying and operating an ATIS. It is intended to help regions interested in ATIS understand the factors that influence the selection of a business approach to ATIS services and work through the process of balancing between needs and goals that are often mutually exclusive.

Agencies often have different expectations about data accuracy than consumers. For example, a transit authority may define "late" as 20 minutes for operational purposes, but customers may perceive a 20-minute delay very differently. Similarly, the agency's ability to predict arrivals may have to be much more precise to address customer needs. For these reasons, transit operators may be reluctant to introduce customer information systems that rely on the agency definition of "late."

"Differences like these in the perception of data 'accuracy' can easily lead to confusion about the availability of data. At the same time, they can make some agencies reluctant to allow access to data that they believe could be easily 'misused,' which can cause friction among participants. P. 33

Weatherford, M. (August 2000). *Assessment of the Denver regional transportation district's automatic vehicle location system* (FTA-MA-26-7007-2000.2). Washington, DC: Federal Transit Administration.

Wourms, D. F., Cunningham, P. H., Self, D. A., & Johnson, S. J. (September 2001). *Gap Analysis. Bus signage guidelines for persons with visual impairment: Electronic signs* (FTA-VA-26-7026-02.1). Washington, DC: Federal Transit