National Evaluation of the SafeTrip-21 Initiative: I-95 Corridor Coalition Test Bed Final Evaluation Report: Providing Multi-modal Travel Information to Airport Users

Contract Number: DTFH61-06-D-00005 Task Order T-09-008

Submitted to:
United States Department of Transportation
ITS Joint Program Office,
Research and Innovative Technology Administration
RITA Report Number: FHWA-JPO-11-011

Submitted by:
Science Applications International Corporation
December 30, 2010

U.S. Department of Transportation
Federal Highway Administration

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TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. FHWA-JPO-11-011	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle: National Evaluation of the SafeTrip-21 Initiative: I-95 Corridor Coalition Test Bed, Final Evaluation Report: Providing Multi-modal Travel Information to Airport Users		5. Report Date December 30, 2010	
		6. Performing Organization Code	
7. Authors: Chris Armstrong, Jennifer Rephlo, Sheryl Miller, Robert Haas		8. Performing Organization Report No.	
9. Performing Organization Name and Address Science Applications International Corporation (SAIC) 8301 Greensboro Drive, Mailstop E-12-3 McLean, VA 221021		10. Work Unit No. (TRAIS)	
		11. Contract or Grant No. DTFH61-06-D-00005, Task No. T-09-008	
12. Sponsoring Agency Name and Address United States Department of Transportation ITS Joint Program Office Research and Innovative Technology Administration (RITA) 1200 New Jersey Avenue, SE Washington, DC 20590		13. Type of Report and Period Covered	
		14. Sponsoring Agency Code HOIT-1	
15. Supplementary Notes Mr. James Pol, COTM			

16. Abstract

The purpose of this document is to present the findings of the national evaluation of the I-95 Corridor Coalition's Airport Ground Transport Travel Information project, one element of the I-95 Test Bed conducted under the USDOT's SafeTrip-21 Initiative. The Airport Ground Transport Travel Information Project is a system which was designed to provide trip planning information via a website, mobile website, and airport kiosk, for individuals traveling to or from BWI airport. The goal of the evaluation was to assess this application of the I-95 test bed by looking at website usage and user's perceptions of the accuracy and usefulness of the website, by analyzing changes in airport ground transportation mode usage, and by understanding the technical and institutional issues associated with making airport ground transport information available to the public. The evaluation found that targeted marketing efforts were effective in spurring visits to the website, and that severe weather events similarly drove up website usage. With nearly 90 percent of users having only visited the website one time, there were very few regular or return users of the website. This may be an indicator that air travelers do not need this type of information very often or more than once, or that those who travel less often, and who are therefore not as familiar with the airport and the various travel options there, perceive more value in the information. Survey respondents seemed to be satisfied with the website overall. The large majority of respondents agreed that the website provided them with the information that they were looking for, that the website was well organized, that it was easy for them to find what they were looking for, and that it has improved their impression of BWI airport. Some respondents, however, did report encountering problems or frustrations while using the website and some did not feel that the information presented on the website is accurate. The large majority of respondents agreed that the information provided is very valuable information to have prior to traveling to/from BWI airport and that other major airports across the country should provide this type of information. The website did succeed in informing some users of new travel options for getting to/from BWI airport. Approximately one-third of respondents reported that the website informed them of a new or better travel option and nearly half of respondents felt that they would be very likely to use a travel option that they learned about from the website. From an institutional perspective, much can be learned from this pioneering effort to deploy a multi-modal traveler information system that includes deploying a kiosk in an airport environment. Due to the fact that the kiosk is not staffed, it is critical that the system requirements address how the system will function during non-normal operating modes to reduce the likelihood for failures (or to at least reduce down-time if failures occur). It is important to identify all potential stakeholders early on and also to establish a formal written agreement or memorandum of understanding between all involved parties, most importantly those who will maintain the unit.

17. Key Words airport, kiosk, traveler information, real-time traveler information, multi-modal, safetrip-21, evaluation, final report, deployment		18. Distribution Statement No restrictions.	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21.No of Pages 89	22. Price N/A

Form DOT F1700.7 (8-72) Reproduction of completed page authorized

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ABBREVIATIONS

API	Application Program Interface
BWI	Baltimore Washington International Airport
CBSA	Core-Based Statistical Area
FHWA	Federal Highway Administration
ITS	Intelligent Transportation Systems
MTA	Maryland Transit Authority
MARC	Maryland Area Regional Commuter
MOE	Measure of Effectiveness
RITA	Research and Technology Administration
SAFETRIP-21	Safe and Efficient Travel through Innovation and Partnerships in the 21st Century
SAIC	Science Applications International Corporation
USDOT	United States Department of Transportation
VDOT	Virginia Department of Transportation
WMATA	Washington Metropolitan Area Transit Authority

EXECUTIVE SUMMARY

Under the guidance of the Volpe Center, the I-95 Corridor Coalition was one of two organizations selected to conduct a test bed in support of the United States Department of Transportation's (USDOT) SafeTrip-21 Initiative. Under the direction and funding of the RITA ITS Joint Program Office, SAIC was selected to conduct an independent national evaluation of the technologies being deployed as part of the two test beds. This document presents the findings of the national evaluation of one of the four applications that comprise the I-95 Corridor Coalition's Test Bed, the Airport Ground Transport Travel Information project.

PROJECT BACKGROUND

The Airport Ground Transport Travel Information project was developed by the I-95 Corridor Coalition in partnership with the University of Maryland and INRIX. Named the BWI Ground Access Information System, the primary purpose of the system is to provide information to travelers about the available ground transportation options to and from Baltimore-Washington International (BWI) Thurgood Marshall Airport in Baltimore, Maryland. It is available via website, mobile website, and kiosk inside the airport, and provides information about different travel options including driving, taxi, and vanpool, as well as various public transit options including Amtrak, commuter rail, light rail, and buses. Additionally, the system provides estimated cost and travel time information for some of the ground transportation options, real-time traffic conditions information for major roadways surrounding the airport (via a color-coded map), and updates about construction or transit delays along the planned route, all of which aim to help airport travelers better plan their trips to and from BWI Airport. The system was designed to help make airport travelers more aware of all modal options available to/from BWI and to give travelers access to the information pre-trip, on-the-go, and inside the airport. Although the interfaces for the website, mobile website, and kiosk applications are different, the content available through each is largely the same because each application pulls information from the same system.

EVALUATION APPROACH

Taking USDOT goals for the SafeTrip-21 Initiative into account along with the project team's more specific goals for the project, the team focused on the following five evaluation objectives:

- Understand the institutional issues associated with making airport ground transport information available to the public.
- Understand the needs of customers with respect to airport ground transport travel information.
- Determine whether airport ground transport travel information improves awareness of travel options out of the airport.
- Analyze the changes in airport ground transportation mode usage.
- Analyze the perceived accuracy and usefulness of the three interfaces of the airport ground transport travel information.

For each evaluation objective, the team identified corresponding hypotheses, measures of effectiveness, and evaluation activities. The evaluation approach activities included: analysis of website usage statistics; administration of a web-based survey of users of the website; and conduct of interviews with the deployment partners to document institutional issues and lessons learned with regard to the deployment experience.

Although the evaluation team planned to analyze usage data collected for the website, mobile website, and kiosk applications, usage analysis focused solely on the general trip-planning website as this is the only application that was fully deployed within the timeframe of the evaluation. Similarly, the web-based survey of users focused only on users of the general trip-planning website.

The general trip-planning website experienced approximately 21,000 unique visitors over the 8-month evaluation period and the survey was available to website users for a 3-month period during this time (from December 10, 2009 to March 8, 2010). The team was able to obtain 85 completed surveys during this time, as well as 47 partially completed surveys, for a total of 132 surveys. It should be noted that a total of 342 surveys would be needed to capture a statistically valid sample size of users, and that the lack of a statistically valid sample size was considered throughout the analyses, interpretations, and conclusions presented here.

SUMMARY OF FINDINGS

The results are summarized below according to three categories:

- Understand the institutional issues associated with making airport ground transport information available to the public.
- Understand perceptions of the system and use of the system
- Analyze the changes in airport ground transportation mode usage.

Understand the Institutional Issues Associated with Making Airport Ground Transport Information Available to the Public

The first objective of the evaluation was to understand the technical and institutional issues associated with deploying an airport ground transportation information system. A number of interesting findings were uncovered through the evaluation that will provide lessons learned for future deployments. Findings are discussed below.

Look for opportunities to make use of any synthesized data already available from other systems. For a multi-modal traveler information system where multiple data sources must come together seamlessly, a key to success can be looking to other agencies and organizations for already-compiled data. In many cases the exact data needed for the system may already be available, eliminating the need to receive and manipulate raw data, and resulting in significant savings of both time and money. Many agencies and organizations are moving toward open source data, meaning that this will be a more common occurrence in the future.

Consider potential failures and security issues in the system requirements. For a remote system that cannot be fully monitored by a staff person, it is especially important that the system requirements address potential failures and security issues (e.g., how to prevent users from bypassing the system and directly accessing the Internet). Considering ways in which a system might fail and how the system will respond to those failures can result in a more robust system.

Establish a clearly defined operational plan for the system. For a remote system that cannot be fully monitored by a staff person, it is critical that the deployment team clearly define operational plans that include details such as periodic paper replacement (i.e., who is responsible for replacing the paper and how often they are responsible for doing so).

Identify and involve all stakeholders early on in the process. It is important to identify all potential stakeholders early on and to have a formal written agreement or memorandum of understanding between all involved parties, in particular with those who will maintain the unit. Involving all stakeholders early allows them to voice opinions up front for inclusion in the system requirements.

Understand Perceptions of the System and Use of the System

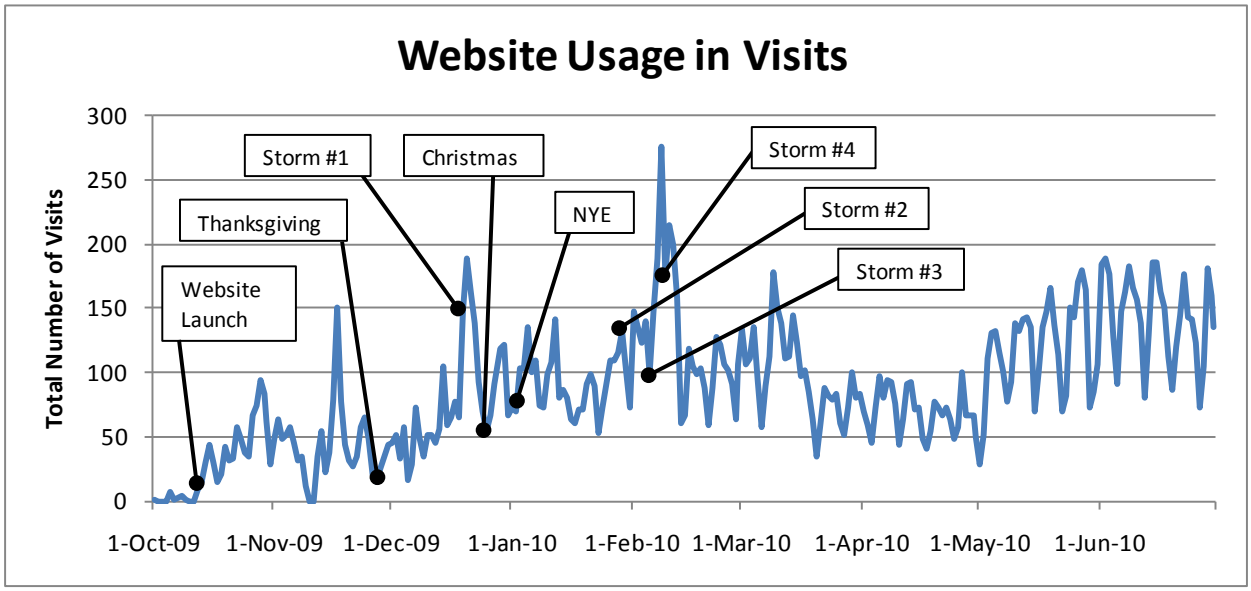
Three of the evaluation objectives tie to gaining an understanding of perceptions of the system and use of the system:

- Analyze the perceived accuracy and usefulness of the three interfaces of the airport ground transport travel information.
- Determine whether airport ground transport travel information improves awareness of travel options out of the airport.
- Understand the needs of customers with respect to airport ground transport travel information.

Findings related to each of these objectives follow.

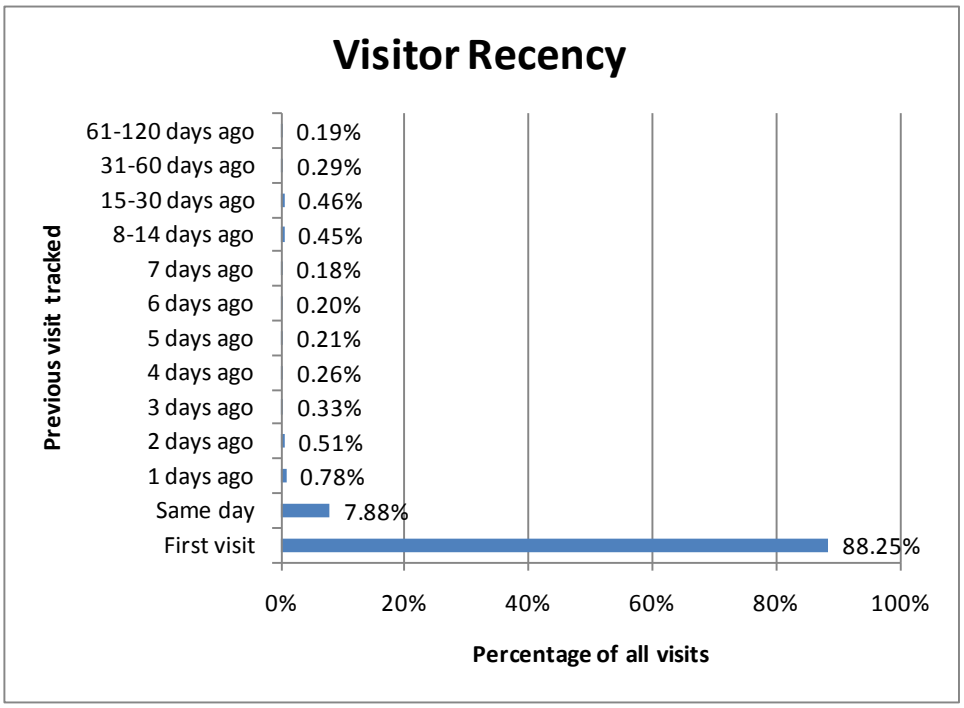
Assessing Perceptions of the Accuracy and Usefulness of the Airport Ground Transport Travel Information System

Usefulness can be gauged in part based on whether visitation to the website increases over time. The BWI Ground Access Information System website experienced steady growth after its initial launch in October 2009 followed by periods of ups and downs in growth through the end of the evaluation period in June 2010. The initial launch was effective in growing the website user base and in establishing initial airport traveler exposure. The additional targeted marketing efforts including advertisements on the BWI Airport website home page were effective in continuing growth in the website user base and number of visits to the website. Interestingly, while there were several factors that were affecting website usage simultaneously, it appears that using Twitter may have been a particularly effective marketing tool in increasing awareness of the website. Severe weather events also drove up website usage, which indicates that travelers looked to the website for alternate transportation options (or possibly to get a sense for current traffic conditions) at times when driving may not be a desirable option for getting to/from BWI Airport. The graph below shows the impact of these various factors on website usage during the course of the evaluation period spanning from October 2009 to June 2010.



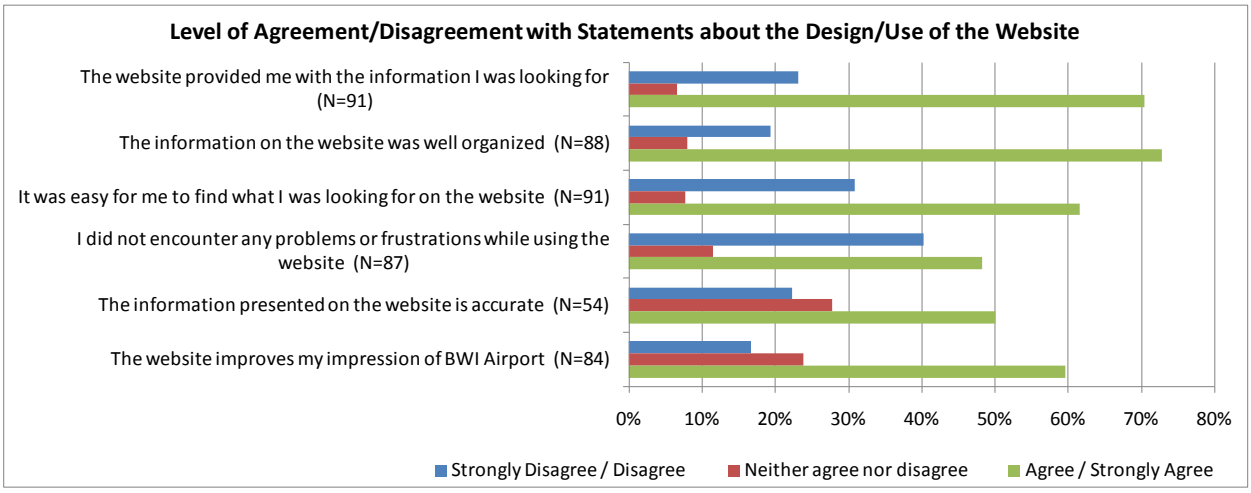
Website Usage by Day, October 2009 – June 2010.

The number of return visitors to a website is typically another indicator of the perceived usefulness of the site. However, in the case of the BWI Ground Access Information System website, this may not be the best indicator. A low visit frequency may instead be an indicator that air travelers do not need this type of information very often or more than once. Furthermore, it could be argued that the website provides the most value to those who travel less often and who are therefore not as familiar with the airport and the various travel options there. With nearly 90 percent of users having only visited the website one time (as shown in the chart below), there were very few regular or return users of the website. This is further supported by the survey data. Those who travel through BWI once or twice a week were not well represented (in fact, only 1 respondent out of 131 fell into this category).



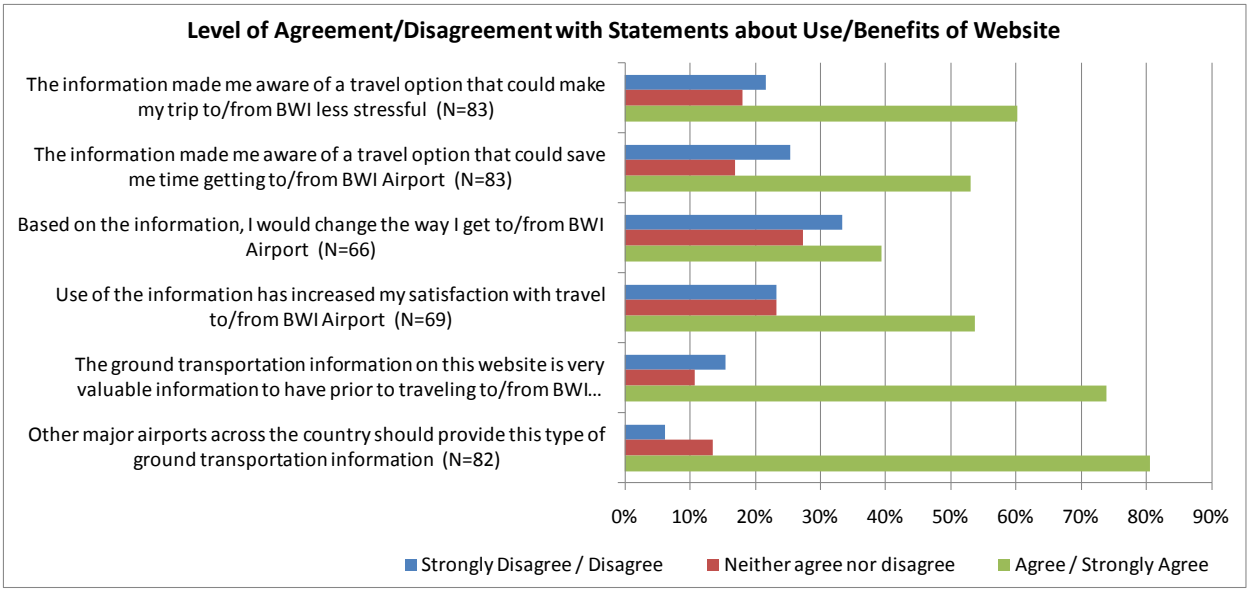
Visitor Recency, October 2009 – June 2010.

As shown in the chart below, respondents seem to be satisfied with the website overall. The large majority of respondents agreed that the website provided them with the information that they were looking for, that the website was well organized, that it was easy for them to find what they were looking for on the website, and that the website has improved their impression of BWI airport. Over 60 percent of respondents agreed or strongly agreed with each of these four statements. Many respondents (40 percent), however, reported that they encountered problems or frustrations while using the website and 30 percent did not feel that the information presented on the website is accurate.



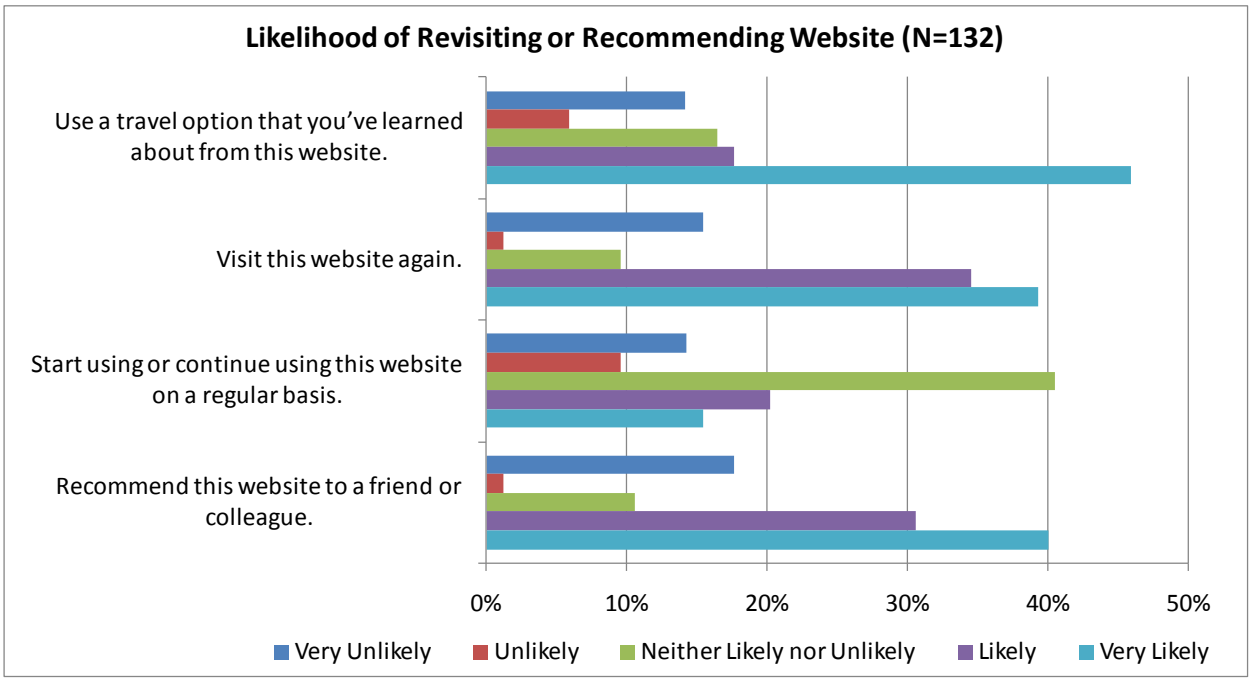
Level of Agreement/Disagreement with Statements about the Design and Use of the Website.

The large majority of respondents agreed that the information provided on the website is very valuable information to have prior to traveling to/from BWI airport and that other major airports across the country should provide this type of ground transportation information (74 and 80 percent, respectively, as shown in the chart below). About half of respondents agreed that the information made them aware of a travel option that could make their trip to/from BWI less stressful, that the information made them aware of a travel option that could save them time getting to/from BWI airport, and that having this information has increased their satisfaction with travel to/from BWI airport.



Level of Agreement/Disagreement with Statements about Use/Benefits of the Website.

As shown in the following chart, nearly half of respondents (46 percent) felt that they were very likely to use a travel option that they learned about from the website. Seventy (70) percent of respondents indicated that they were likely or very likely to visit the website again or recommend the website to someone else, but very few (15 percent) felt that they would be very likely to start using the website on a regular basis. Those who have never flown into or out of BWI or who do so less than once a year were those who were most likely to respond that they were likely or very likely to use a travel option that they learned about from the website (70 percent). Similarly, these individuals were those who were most likely to indicate that they would recommend the website to someone they know.



Respondents' Likelihood of Revisiting or Recommending Website.

Assessing Ability of Airport Ground Transport Travel Information System to Improve Awareness of Travel Options to/from BWI Airport

Respondents were asked whether the website informed them of a new travel option for getting to or from BWI airport and whether it informed them of a better travel option (as compared to the modes of which they were previously aware). These two questions were asked separately and respondents were able to check multiple modes in response to each question. Approximately one-third of respondents (29 percent) reported that the website informed them of a new travel option for getting to or from BWI airport and 30 percent reported that it informed them of a better travel option. The most common travel option that respondents learned about was the MARC service at the airport (41 percent). Other common responses were: Metrorail (nearly 35 percent), Amtrak (nearly 35 percent), light rail (31 percent), bus routes (21 percent), and airport shuttle buses (15 percent). Respondents were slightly less enthusiastic and somewhat more divided when indicating the travel options they learned about that were better than the modes of which they were previously aware. The most common responses included light rail (26 percent), Metrorail (19 percent), MARC service (19 percent), and Amtrak (19 percent).

A number of survey respondents (24, or 19 percent) indicated that they had used the website previously and were able to comment on whether they had tried a new travel option that they had learned about from the website. Nearly half of these respondents (11 people) reported that they had tried a new option after a previous website visit. Overall the survey results seem to indicate that the website does, in fact, increase awareness of alternate travel options.

Assessing Customer Needs with Respect to the Airport Ground Transport Travel Information

Customer needs can best be assessed through the suggestions for improvement that they offered on their survey responses. Suggestions included:

- Allow the user to input their flight departure or arrival time (and have the system automatically plan based on that).
- Provide the user the option to input their desired arrival time (rather than only having the option of inputting the desired departure time).
- Provide enhanced information (e.g., allow for more origins/destinations, include more public transit options, and include specific directions to access buses).
- Provide the opportunity to save a trip for later reference.
- Provide the opportunity for the user to select one option once presented with itinerary options to facilitate printing the itinerary of choice.
- Provide the option to reverse the trip to plan a return trip immediately after planning an outbound trip.
- Expand the site to allow for trips to/from Pennsylvania.

Analyze the Changes in Airport Ground Transportation Mode Usage

The final objective of the evaluation was to explore changes in mode use to/from the airport as a result of the trip planning system. Although the evaluation team obtained mode usage data with the intention of comparing mode usage before and after the system was deployed to determine any impact, that analysis is not presented as it was determined that any slight change in mode usage as a result of the system would not be discernable due to the extremely high number of travelers that travel through BWI airport each day and due to the limited duration of the test period. The airport sees approximately 2 million travelers during an average month while the website only experienced 2,400 visitors per month on average for the 9 months that it was available to the public. Additionally, the mobile website and kiosk were only available for a short time.

Based on travel data obtained from BWI airport, fewer than 5 percent of BWI travelers use public transit or an airport shuttle to get to or from the airport. Only 9 percent of survey respondents indicated that they tried a new mode after learning about it from the website. If it is conservatively assumed that the survey responses are representative of the population of website users, and if it assumed that website usage would remain constant over time, this would only account for a total of 7 individuals taking an alternate mode each day (after having learned about it from the website), or a 0.26 percent increase in ridership on alternate modes. Given the variability in the ridership on any given mode from day to day, a change of this magnitude would not be discernable.

CONCLUSIONS

Based on the evaluation results, the following conclusions are made:

- It appears that the additional targeted marketing efforts including advertisements on the BWI Airport website home page were effective in continuing growth in the website user base and number of visits to the website. In particular, it appears that using Twitter specifically was an effective marketing tool in increasing awareness of the website.

- Severe weather events drove up website usage, indicating that travelers looked to the website for alternate transportation options (or to get a sense for current traffic conditions) at times when driving may not be a desirable option for getting to/from BWI Airport.

- With nearly 90 percent of users having only visited the website one time, there were very few regular or return users of the website. This may be an indicator that air travelers do not need this type of information very often or more than once. This may also be an indication that those who travel less often, and who are therefore not as familiar with the airport and the various travel options there, perceive more value in the information. This is further supported by the survey results which indicated that 70 percent of respondents were likely or very likely to visit the website again or to recommend the website to someone else, but very few (15 percent) would be very likely to start using the website on a regular basis.
- Website visitors seem satisfied with the website overall. The large majority of respondents agreed that the website provided them with the information that they were looking for, that the website was well organized, that it was easy for them to find what they were looking for on the website, and that it has improved their impression of BWI airport. Over 60 percent of respondents agreed or strongly agreed with each of these four statements. Many respondents (40 percent), however, did report encountering problems or frustrations while using the website and 30 percent did not feel that the information presented on the website is accurate.
- The large majority of respondents agreed that the information provided on the website is very valuable information to have prior to traveling to/from BWI airport and that other major airports across the country should provide this type of ground transportation information (74 and 80 percent, respectively).
- The website did succeed in informing some users of new travel options for getting to/from BWI airport. Approximately one-third of respondents (29 percent) reported that the website informed them of a new travel option and 30 percent reported that it informed them of a better travel option. Of those who indicated that they learned of a new travel option, half of these individuals (11 people) reported that they tried that new option. Overall the survey results seem to indicate that the website does, in fact, increase awareness of alternate travel options.
- Nearly half of respondents (46 percent) felt that they were very likely to use a travel option that they learned about from the website. Those who were less familiar with BWI (i.e., those who have never flown into or out of BWI or who do so less than once a year) were most likely to respond that they were likely or very likely to use a travel option that they learned about from the website (70 percent).

From an institutional perspective, much can be learned from this pioneering effort to deploy a multi-modal traveler information system that includes deploying a kiosk in an airport environment. When deploying equipment in an environment like an airport, there can be challenges not encountered when deploying ITS technologies in other environments. For example, the stakeholders who need to be involved to deploy a piece of technology in an airport can be quite diverse. Not all players may be obvious at first and all are not likely to have a background or interest in transportation. As a result it is important to work with the airport staff early on to identify all potential stakeholders and to have a formal written agreement or memorandum of understanding between all involved parties, including those who will maintain the unit. Involving all stakeholders early can allow them to voice opinions up front for inclusion in the system requirements.

Another challenge with an airport environment is that it may not be possible to identify a location that can be monitored by a staff person. In the case of this project, the kiosk was not able to be regularly monitored. As a result, the system designers found that it was important to plan for any

possible problems. For example, it is important to consider the need to periodically replace paper and to prevent users from bypassing the planned information system to access the Internet directly. Considering ways in which a system might fail and how the system will respond to those failures can result in a more robust system.

A final key institutional lesson is to look for opportunities to make use of any synthesized data already available from another agency or organization. This is especially important when pulling diverse data sets from multiple organizations, as is the case with a multi-modal traveler information system. As more and more agencies and organizations move toward open source data, there will be increasing opportunities for this type of cost savings in the future.

1. INTRODUCTION

In February of 2008, the Volpe Center established two test bed locations across the country to conduct a variety of field tests in support of the United States Department of Transportation's (USDOT) SafeTrip-21 Initiative. The overall goals of the initiative are to:

- Expand and accelerate the U.S. DOT's research in vehicle connectivity with the wireless communications environment.
- Build upon Intelligent Transportation Systems (ITS) research in advanced-technology applications.
- Explore and validate the benefits of deployment-ready applications that provide travelers, drivers, and transit and commercial motor vehicle operators with enhanced safety, real-time information, navigation assistance.

The Volpe Center solicited proposals from potential partners with real-time ITS information, navigation, communication, and electronic payment systems currently installed (or with the potential to be installed) in an integrated operational setting. The Test Bed sites were to test and evaluate integrated, intermodal ITS applications, particularly those that do not entail extensive public sector infrastructure requirements but achieve immediate benefits and demonstrate the potential for sustainable ongoing deployment.

The Volpe Center made two awards, one being the California Connected Traveler Test Bed, which involved an integrated Test Bed in the San Francisco Bay area, an independent application related to work zone safety that would be deployed in California, and an independent signal monitoring system. The other award was the I-95 Corridor Test Bed, which involved a Test Bed along the I-95 Corridor from North Carolina to New Jersey as well as an independent application related to work zone safety that would be deployed in North Carolina.

The I-95 Test Bed includes the following three field test applications:

- Long Distance Trip Planner: This application is a web-based trip planner system that provides travelers with cross-jurisdictional, real-time information about current travel times between key destinations along the I-95 corridor.
- Public Traffic Map Displays: This application involves providing real-time information about traffic conditions on large flat-panel display screens installed at Tyson's Corner Center Mall and at two Virginia Department of Transportation (VDOT) Welcome Centers.
- Airport Ground Transport Travel Information: This application involves creating a trip planning information tool for travelers at Baltimore-Washington International (BWI) Thurgood Marshall Airport. The information is available to travelers through a website, mobile website, and a kiosk located in the ground transportation area of the airport.

The I-95 Corridor Coalition also hosted a separate field test application to test the following:

- Portable Sources of Work Zone Traffic Data: This application involves the use of portable traffic monitoring devices which can be used to monitor traffic congestion in work zones.

Under the direction and funding of the RITA ITS Joint Program Office, SAIC was selected to conduct an independent national evaluation of the technologies being deployed as part of the two test beds, which are being managed by the Volpe Center. This document presents the findings

of the national evaluation of one of the four applications that comprise the I-95 Corridor Coalition's Test Bed, the Airport Ground Transport Travel Information project.

The remainder of this document is organized as follows:

- **Section 1 – Introduction.** Provides information on I-95 Corridor Coalition Field Operational test deployed under the SafeTrip-21 Initiative.

- **Section 2 – Background.** Provides background information on and a description of the Airport Ground Transport Travel Information project, also known as the BWI Ground Access Information System. Includes a description of the information available via the website, mobile website, and kiosk applications. This section also summarizes the evaluation approach, hypotheses, and measures of effectiveness developed previously and detailed in the Evaluation Plan.

- **Section 3 –Website Usage Statistics.** Details an analysis of usage of website application of the BWI Ground Access Information System including detailed insight into the website user base, the effect of targeted marketing efforts and major usage events, and website user characteristics.

- **Section 4 –Web-Based Survey.** Details the data collection plan and process, and presents the results from the web-based survey of users of the website application.

- **Section 5 – Deployment Experience Assessment.** Details the design, deployment, and operational phases of the deployment by identifying successes, shortfalls, and significant lessons learned.

- **Section 6 – Summary and Conclusions.** Summarizes the major findings of the evaluation and states the major conclusions drawn from the results.

2. BACKGROUND

This section provides background on the project as well as background on the evaluation, including information on the evaluation objectives, hypotheses, and measures of effectiveness, as well as evaluation activities.

2.1 Airport Ground Transport Travel Information Project

The Airport Ground Transport Travel Information project consists of a system developed by the I-95 Corridor Coalition in partnership with the University of Maryland and INRIX. Named the *BWI Ground Access Information System*, the primary purpose of the system is to provide information to travelers about the available ground transportation options to and from Baltimore-Washington International (BWI) Thurgood Marshall Airport in Baltimore, Maryland. It is available via website, mobile website, and kiosk inside the airport and provides information about different travel options including driving, taxi, and vanpool, as well as various public transit options including Amtrak, commuter rail, light rail, and buses. Additionally, the system provides estimated cost and travel time information for some of the ground transportation options, real-time traffic conditions information for major roadways surrounding the airport (via a color-coded map), and updates about construction or transit delays along the planned route, all of which aim to help airport travelers better plan their trips to and from BWI Airport. The system was designed to help make airport travelers more aware of all modal options available to/from BWI and to give travelers access to the information pre-trip, on-the-go, and inside the airport. Although the interfaces for the website, mobile website, and kiosk applications are different, the content available through each is largely the same because each application pulls information from the same system.

2.1.1 BWI Website Application

The BWI Ground Access Information System website was the first of the three BWI SafeTrip applications to be developed and launched by the project team. The website serves as a pre-trip planner to travelers looking for information about the various modes of ground transportation available to and from BWI Airport. Travelers can visit the website and enter their starting location for travel to the airport or end location for travel from the airport in order to assess the options available. Figure 2-1 below is a screen capture of the system available via the website application, accessed using Microsoft Internet Explorer.

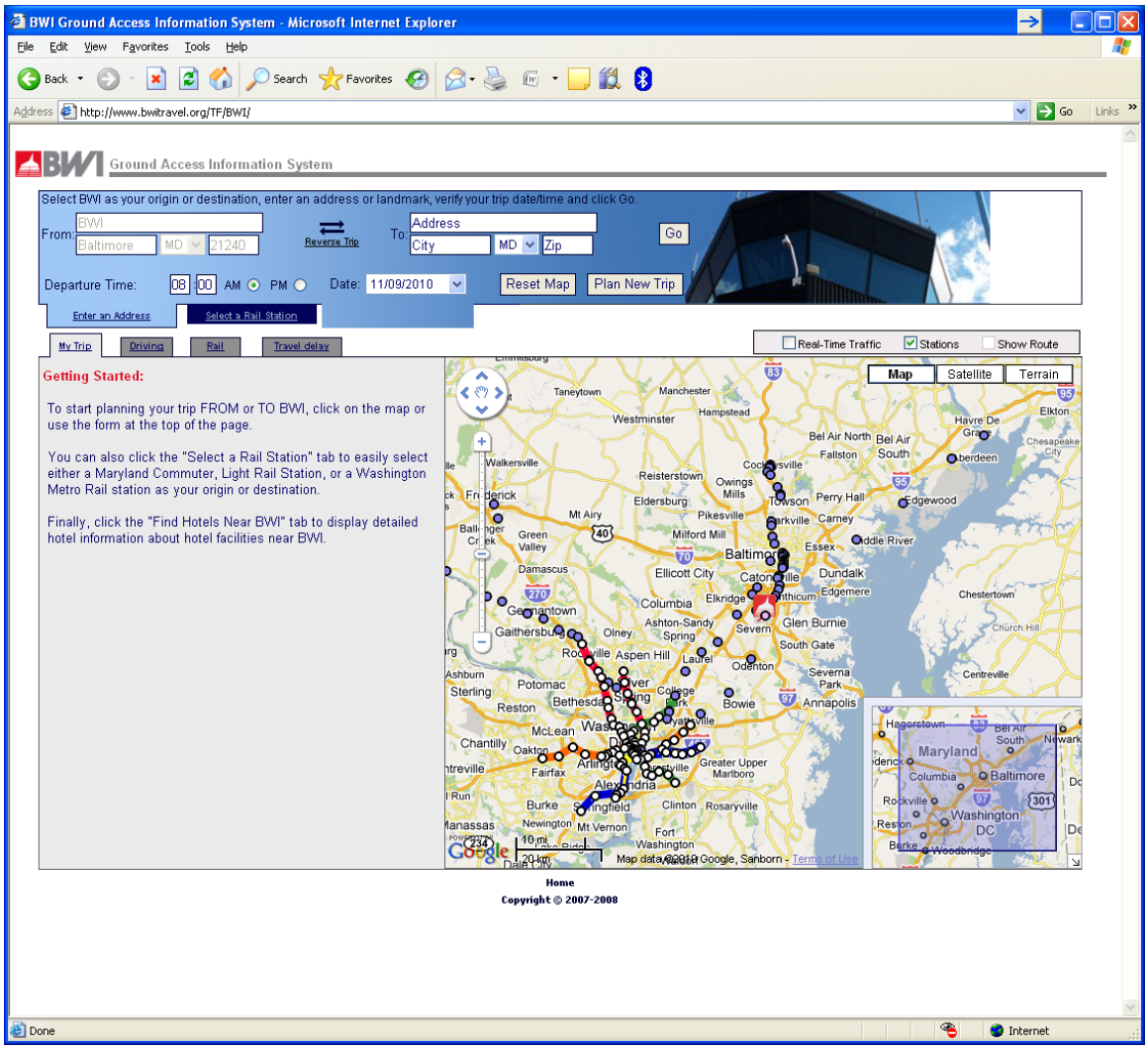


Figure 2-1. BWI Ground Access Information System Website Application.

To begin using the BWI Ground Access Information System website, users must first provide information about their origin or destination regarding travel to or from BWI Airport. There are several options for entering an origin or destination into the system. The first option allows travelers to enter any beginning or ending street address and use the *Reverse Trip* button to designate a trip to BWI versus a trip from BWI. Alternately, travelers can choose to enter a beginning or ending transit station by selecting the *Select a Rail Station* tab and choosing from a list of transit stations that serve the greater Baltimore, Maryland area or from a list of transit stations that serve the greater Washington, D.C. area. Travelers can select any station on the Maryland Transit Authority (MTA) Light Rail system[1] which serves greater Baltimore; any Maryland Area Regional Commuter (MARC) station[2] which serves Maryland, West Virginia, and Washington, D.C.; or any Washington Metropolitan Area Transit Authority (WMATA) Metrorail station[3] which serves the National Capitol Region. Upon selecting a transit station, users are

[1] Additional information including a list of stations for MTA Light Rail: http://mta.maryland.gov/services/lightrail/.

[2] Additional information including a list of stations for MARC Commuter Rail: http://mta.maryland.gov/services/marc/.

[3] Additional information including a list of stations for WMATA Metrorail: http://www.wmata.com/rail/.

prompted to enter whether their trip is being planned from the selected transit station to BWI or from BWI to the selected transit station. A third option for identifying an origin or destination for the trip involves selecting any point or transit station on the map which then prompts the user via a pop-up window to select whether they are traveling to or from BWI.

Figure 2-2 below shows screens shots of the three options for entering origin or destination information on the website.

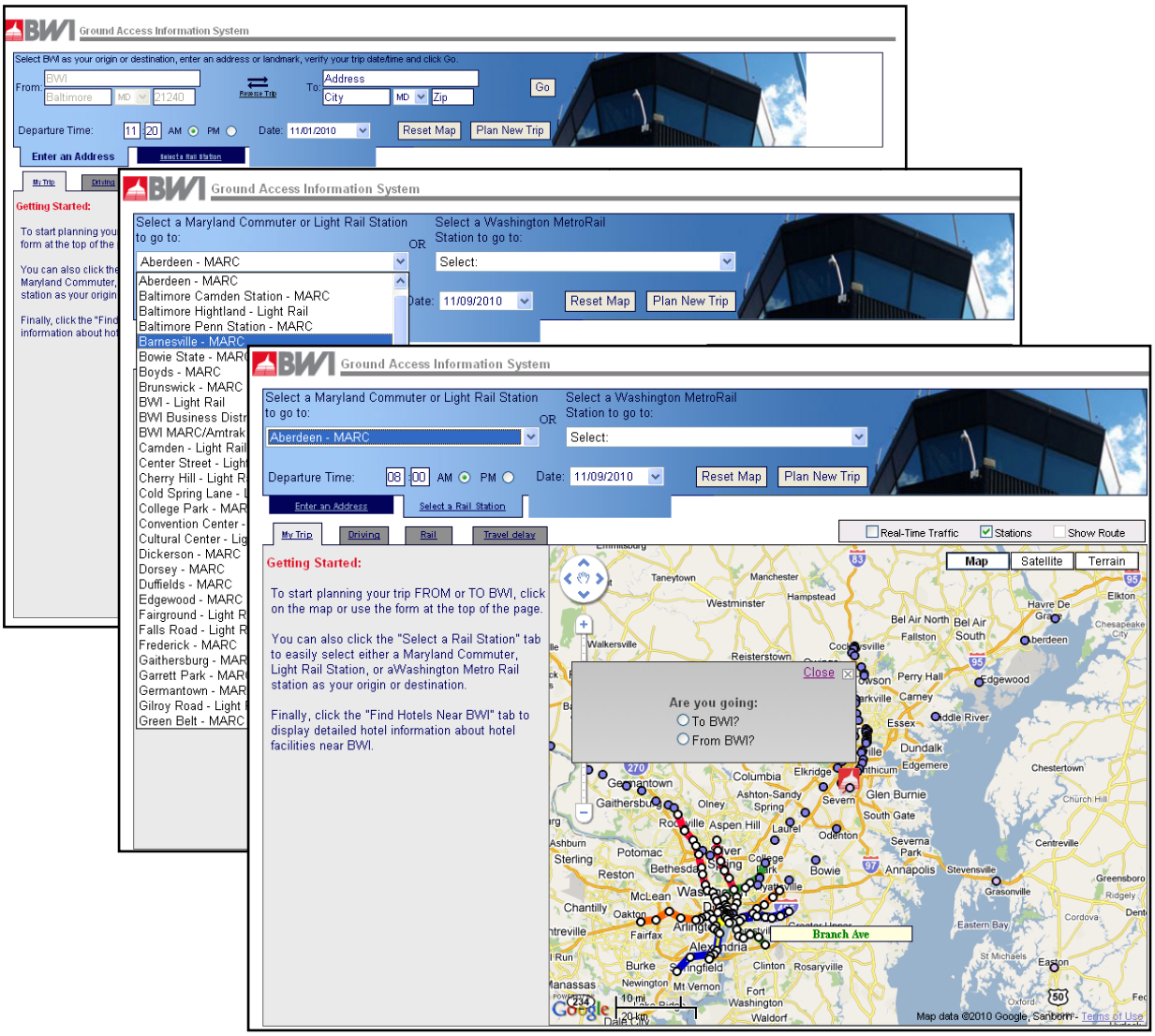


Figure 2-2. Options for Entering Origin or Destination on BWI Ground Access Information System Website Application.

After establishing an origin or destination, users can then enter the departure time and date of their trip and select the *Go* button to receive detailed information about each of their ground transportation options to or from BWI Airport. For the purposes of demonstrating the functionality of the website application, a trip was planned from BWI Airport to Washington, D.C. Figure 2-3

below shows the summary of travel options provided on the *My Trip* tab when a trip is planned using the system. For each trip planned the following information is provided on the *My Trip* tab if available for that trip:

- The total distance to or from BWI from the origin or destination entered.
- The estimated cost of taxi service for the trip.
- The estimated cost for an Airport Shared Ride Van (including services by Airport Shuttle and Super Shuttle).
- A summary of the trip for driving by vehicle or taxi including estimated time and a link to detailed driving directions.
- A summary of the available transit options for the trip (based on schedule information) including begin stop/station, end stop/station, transit agency, total trip time, walking distance to final destination, and total fare if available for each option.

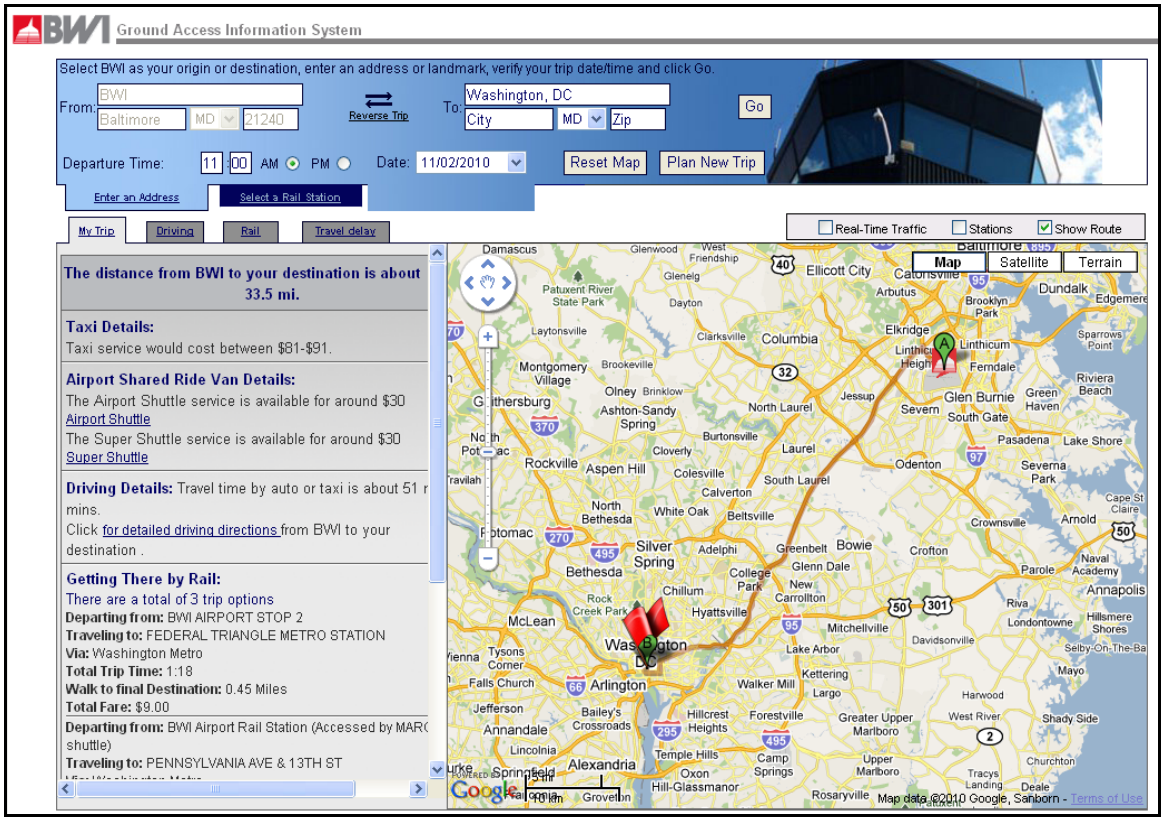


Figure 2-3. Example of Information Provided on *My Trip* Tab of Website Application.

More detailed information related to the driving trips and transit trips mentioned above is available by selecting the *Driving* and *Rail* tabs located to the right of the *My Trip* tab. The *Driving* tab provides detailed turn-by-turn driving directions for the trip while the *Rail* tab provides a detailed step-by-step itinerary for each of the transit options available for the trip; as many as three transit options may be provided. The detailed information provided for each of the transit options allows travelers to consider differences in total trip time, total fare, number of transfer required, and walking distance to final destination when deciding which transit trip to choose. Additionally, the *Travel Delay* tab provides a real-time estimate of delay that may occur along

roadways near BWI Airport related to the trip planned if a user decides to drive or take a taxi or shuttle.

Figure 2-4 below shows an example of the information provided on each of those tabs.

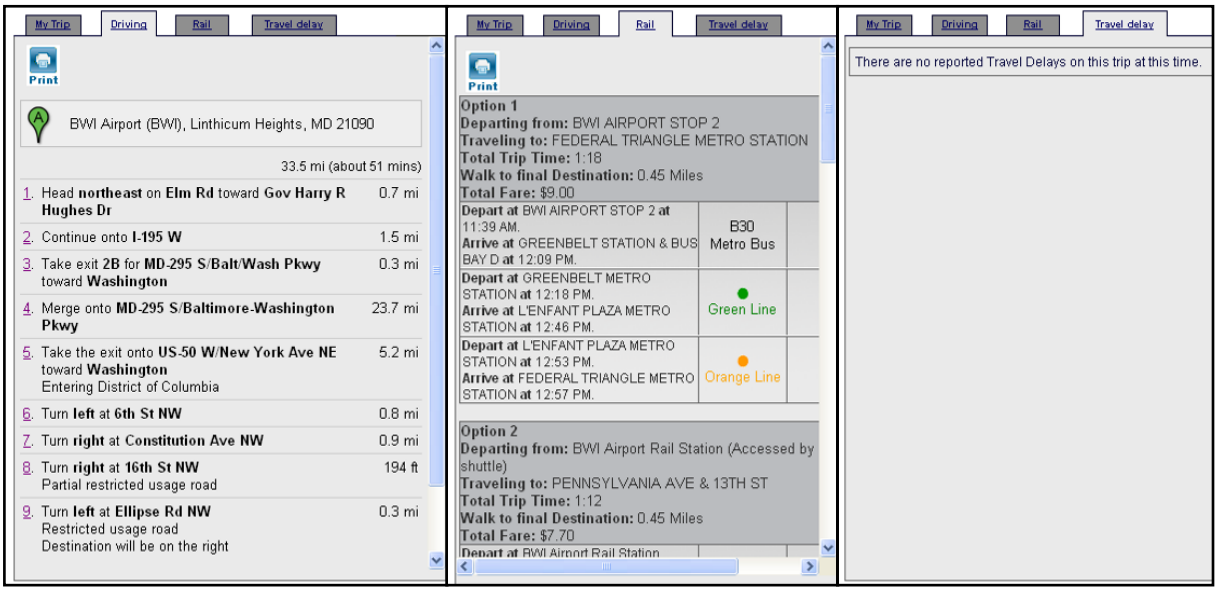


Figure 2-4. Example Information Provided on *Driving, Rail,* and *Travel Delay* Tabs of Website Application.

For added convenience, users can print the information available on the *Driving* and *Rail* tabs in order to reference it during their trip (they do so using the "print" button as shown in the figure above). A printout of the *Driving* and *Rail* tabs is available in Appendix A and shows a complete list of the information provided for the example trip planned between BWI and Washington, D.C. Although not visible in

Figure 2-4 above, the *Rail* itinerary also includes information about any system-wide delays or disruptions and updates specific to the transit routes presented as options for the trip planned (see Appendix A).

The website application also provides map information via Google® Maps API in the right window of the interface (see Figure 2-3). Users have the ability to zoom and pan the map as well as select between map, satellite, or terrain views of the area. Additionally, travelers can choose to view real-time traffic conditions along highways via a color-coded map, to view the location of all transit stations available in the system, or to view the highlighted route of the trip planned by selecting the check boxes in the top right hand corner of the map (Figure 2-5). Users can toggle these options on and off by checking the box next to *Real-Time Traffic*, *Stations*, and *Show Route*, respectively. When the *Real-Time Traffic* box is selected, each segment of roadway with congestion information available is color-coded according to whether the traffic on that segment is free flowing (green), is experiencing moderate congestion (yellow), is experiencing heavy congestion (red), or is stop and go (brown), with a separate color (black) used if that segment of roadway is closed.

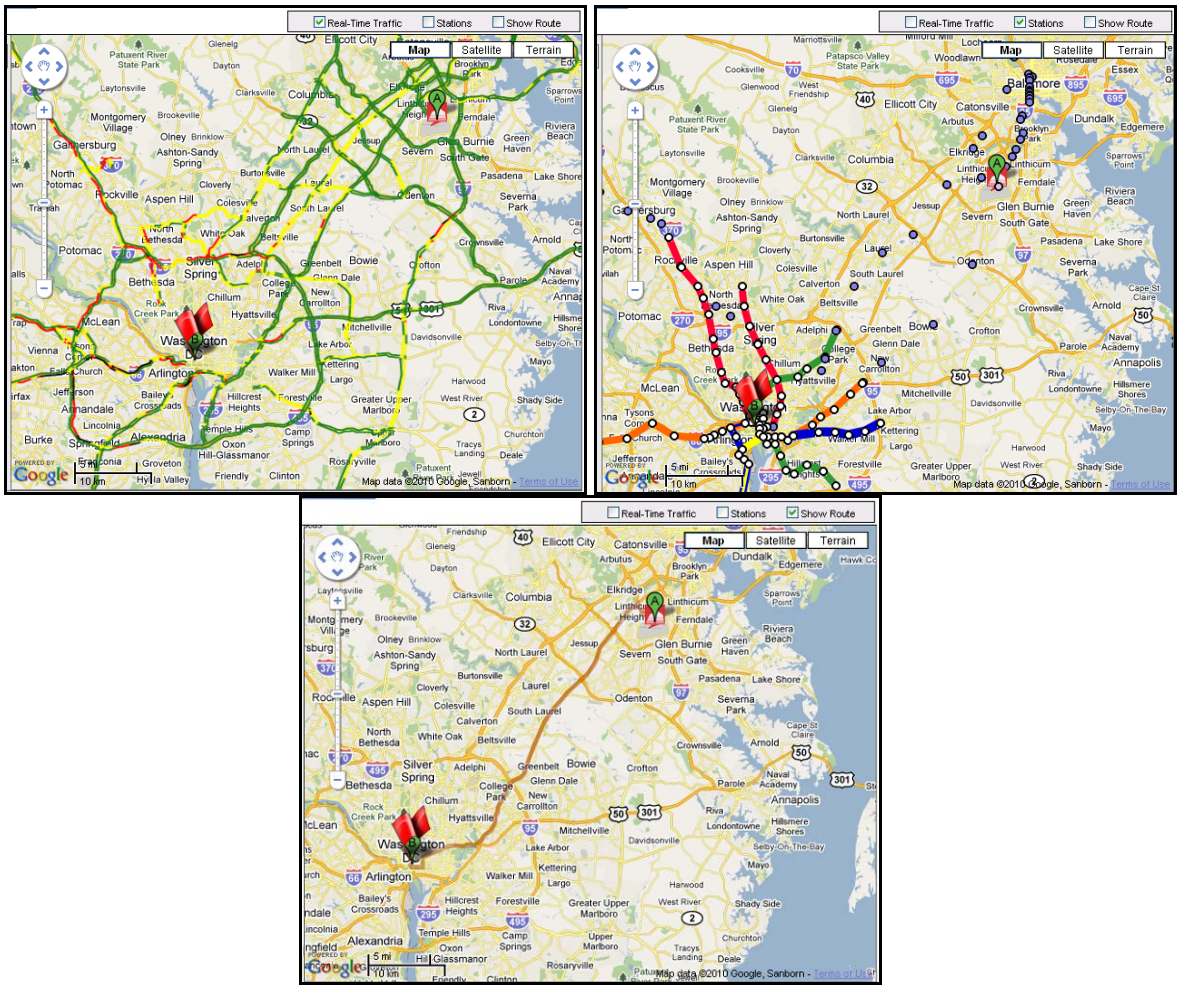


Figure 2-5. Map Information Available on Website Application.

When the project team completed development, BWI Airport staff were contacted to coordinate marketing and launch of the website. On October 14, 2009, the BWI Ground Access Information System website application was launched on the BWI Airport website.[4] Initially, the website application was debuted on a dedicated "Safe Trip" page designed by BWI Airport staff and hosted on their website. Travelers could access this page from the *TO & FROM BWI* tab on the homepage of the BWI Airport website. The Safe Trip page provided a brief overview of the project as well as a description of and link to the BWI Ground Access Information System website application. Approximately 2 months after the website application was initially launched, further marketing efforts took place to increase awareness of the website application among travelers to and from BWI. The details and resulting impacts of these marketing efforts are explained later in this report in the Usage Statistics chapter (chapter 3).

It is important to note that the website application remained live through July 10, 2010. At that time, it was pulled from the BWI Airport website because of requests by BWI Airport staff to upgrade the BWI Ground Access Information System with additional information about the various bus routes that serve the airport. Further details regarding these requests, the deployment of the website application, and the partnership between the project team and BWI

[4] www.BWIAirport.com.

Airport are presented in the Deployment Experience Assessment chapter of this report (chapter 5).

2.1.2 BWI Mobile Website Application

The next BWI SafeTrip application to be launched by the project team was the BWI Ground Access Information System mobile website[5] was developed to serve as an on-the-go trip planner for travelers who are looking for information about ground transportation options to and from BWI Airport using a mobile device. As mentioned previously, the mobile website accesses information from the BWI Ground Access Information System just as the website does, but presents it in a slightly different manner.

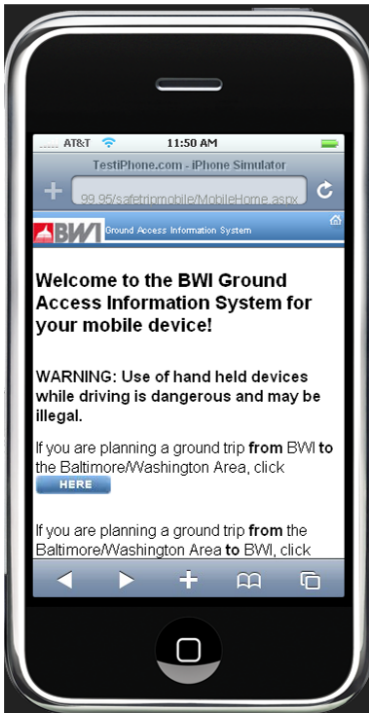
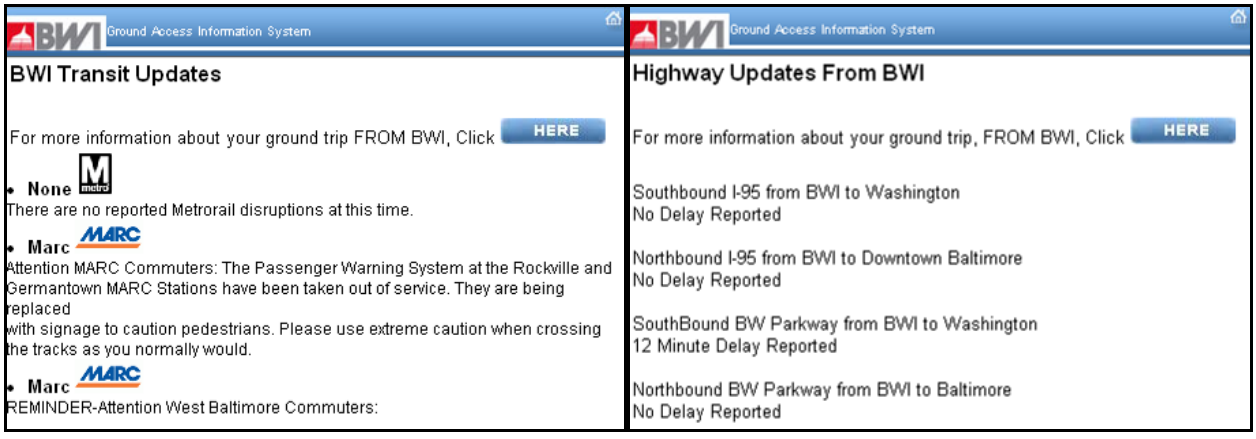


Figure 2-6. BWI Ground Access Information System Mobile Website.

Figure 2-6 shows the home page of the mobile website as it appears on an Apple iPhone.[6] To begin using the system, users choose whether they are planning a trip to or from BWI by selecting one of the two buttons available on this page. Next, a list of messages about transit delays, disruptions, or updates for all systems serving BWI is provided (shown on the left in Figure 2-7). Users can then navigate to the next page by clicking the button to receive more information about their ground trip. This page provides highway updates for trips either from BWI or to BWI based on which option the user selected (shown on the right in Figure 2-7). The updates provide delay information for highways surrounding the airport including I-95 and the Baltimore-Washington Parkway. After navigating through both the transit and driving delay information, users can then access the trip planner portion of the mobile website shown in Figure 2-8 below. From this page, the mobile website application essentially operates the same as the website application. Users can plan trips to or from BWI and access detailed information about the different ground transportation options available to them.



[5] BWI Ground Access Information System mobile website: http://69.33.199.95/safetripmobile/MobileHome.aspx.

[6] An iPhone Simulator was used in Figure 2-6 to clearly display mobile website content: http://www.testiphone.com/.

Figure 2-7. Transit and Highway Updates Provided on Mobile Website.

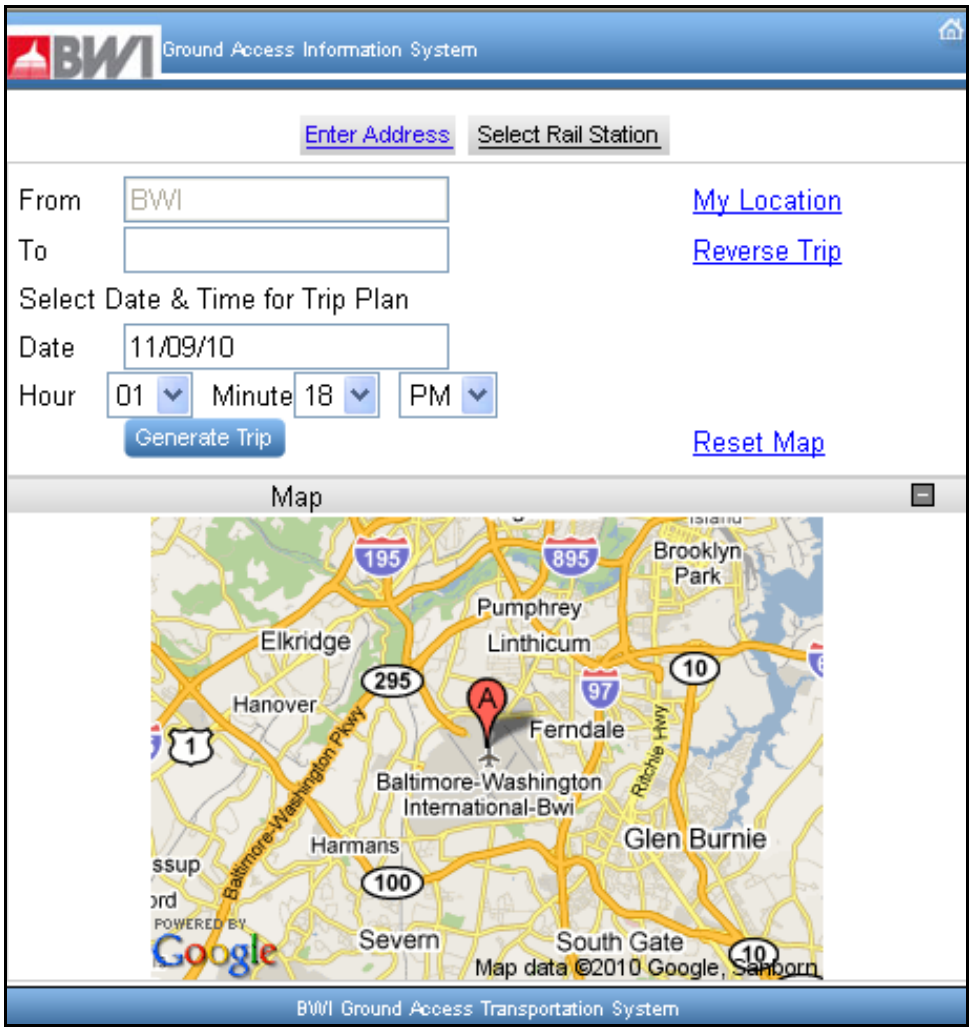


Figure 2-8. Trip Planner Page on Mobile Website.

One important point of clarification is that although the mobile website is referred to throughout the report as an "application" of the BWI Ground Access Information System, it is only a mobile-supported website accessible by browser, not an application that can be downloaded to a mobile device. However, because the application is simply a mobile website, it can be accessed by any mobile device that is browser-supported regardless of make, model, or data connection speed. Additionally, enhanced functionality is available on mobile devices that are GPS-supported. Instead of entering an origin or destination, users can select *My Location* on the *Enter an Address* tab (as seen in Figure 2-8) and the system will automatically enter their approximate location using the mobile device's GPS capabilities.

It is also important to note that this test was re-scoped during the development phase to reflect USDOT's concerns on distracted driving. Previously, the project team envisioned the mobile website to be a simpler, more compact version of the website application. However, concerns about travelers accessing the information via a mobile device while driving resulted in several enhancements to the design of the mobile website to address this issue. The developmental changes made to prevent distracted driving included:

- A warning message was added to the home page of the mobile website reading "WARNING: use of hand held devices while driving is dangerous and may be illegal."
- A change in the presentation of the information to present the current delay information first before allowing the user to request itinerary information.
- Both the ability to pan or zoom on the map and the real-time traffic information were removed, so that users could not use the application to navigate roadways or view traffic congestion while driving.
- The detailed driving directions available on the Driving tab were removed from the mobile website to avoid providing turn-by-turn directions that can be useful while driving.

Many of these developmental changes were requested during user acceptance testing conducted by the project team with USDOT on February 19, 2010. After development was finalized, the mobile website was authorized for launch by USDOT on March 22, 2010 with the understanding that I-95 Corridor Coalition and USDOT would not distribute major publicity or media releases associated with the launch. Additionally, the mobile website was never publicized by BWI Airport. The challenges associated with launching the mobile website are further discussed in the Evaluation Approach section of this chapter (chapter 2) as well as in the Deployment Experience Assessment chapter (chapter 5).

2.1.3 BWI Kiosk Application

The final piece of the BWI Ground Access Information System is the kiosk application which was intended to provide ground transportation options to travelers inside BWI Airport, specifically in the ground transportation area of the baggage claim terminal. As mentioned previously, the kiosk accesses information from the BWI Ground Access Information System just as the website and mobile website do, but presents it to users in a slightly different manner. Figure 2-9 is a photograph of the kiosk displaying the screen saver while still in the development phase. Similar to other information kiosks, it is navigated using the touch screen monitor or the keyboard and trackball built into the console. To begin using the system, a user simply touches the screen or keyboard to remove the screen saver.

Figure 2-9. BWI Ground Access Information System Kiosk Application.

Figure 2-10 below shows the content and interface of the kiosk application. With the exception of the touch-screen controls provided to operate the map, the kiosk functionality is exactly the same as that of the website application. Users can plan trips to or from BWI by typing an address on the *Enter an Address* tab, by choosing a transit station on the *Select a Rail Station* tab, or by selecting any point or transit station on the map using their finger or the built-in trackball. They can also access specific information about the different ground transportation options available to them after a trip is planned by viewing a summary on the *My Trip* tab or by selecting the *Driving, Rail, or Travel Delay* tabs for more detailed information. For their convenience, the kiosk also has a built-in printer which allows users to print the itinerary provided on the *Driving* or *Rail* tabs and take it with them. These printed itineraries are the same as the examples provided for the website application in Appendix A.

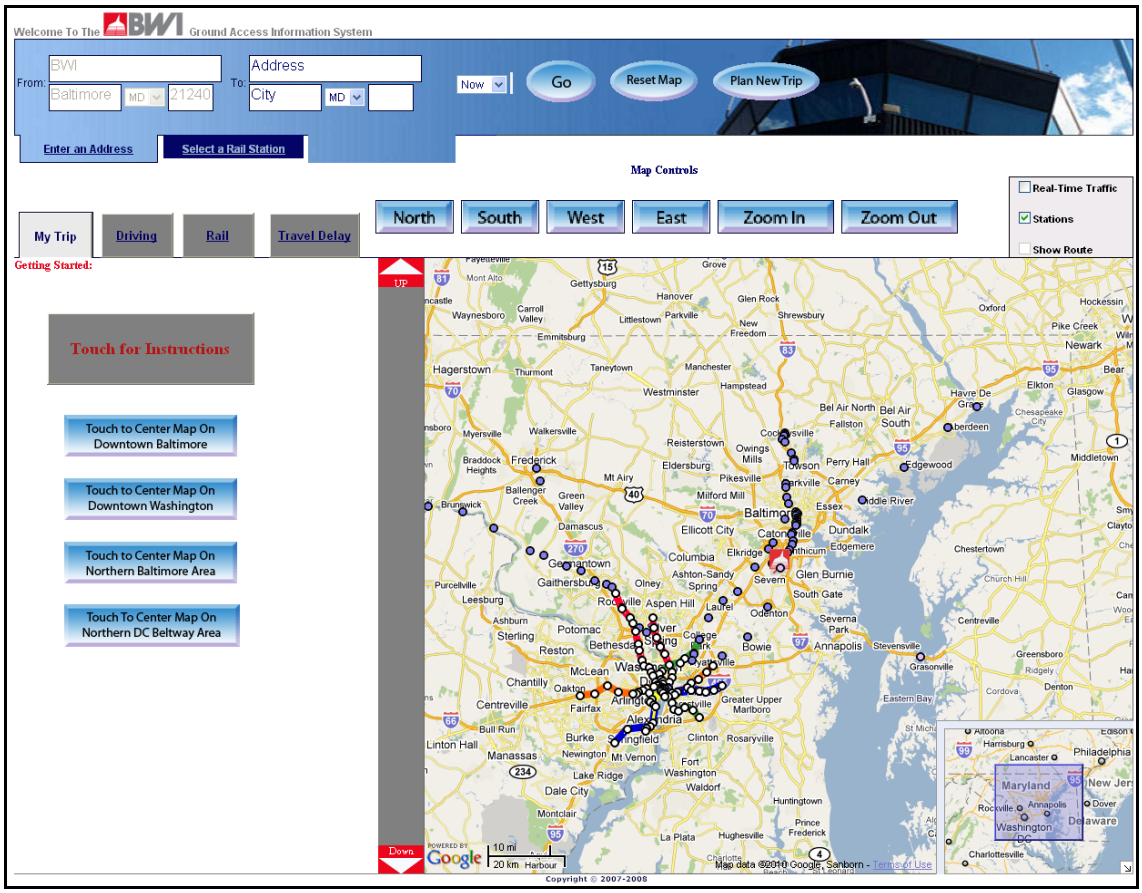


Figure 2-10. BWI Ground Access Information System Kiosk Interface.

The kiosk had the longest development period of the three applications for a number of reasons. It was initially launched and installed at BWI Airport on April 1, 2010. It was placed on the lower level of Concourse C across from baggage claim 13-14 as identified in Figure 2-11. A few months after installation, the kiosk was removed from BWI Airport for a number of reasons identified by BWI Airport staff and the project team including:

- Location –The kiosk needed to be relocated to a location where more foot traffic takes place.
- Hardware – Airport staff felt that it was important that the kiosk be secured to eliminate any risk of it tipping over. Staff also desired to have the electrical plug secured to the wall such that it could not be unplugged.
- Software – Developmental changes were needed to prevent users from using the kiosk for reasons other than intended (e.g., browsing the Internet).
- Ownership – There was no agreement in

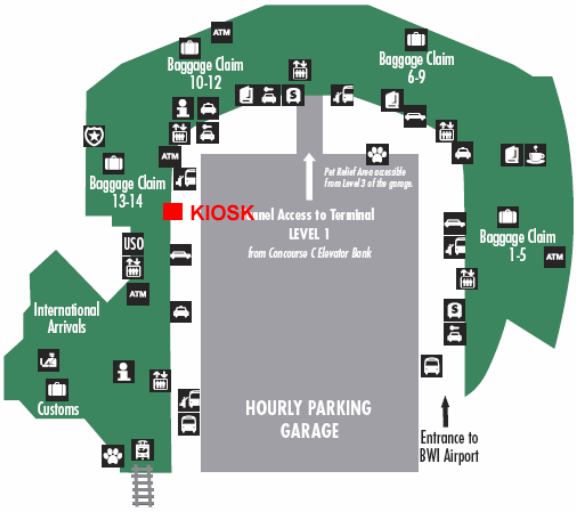


Figure 2-11. Initial Location of Kiosk on April 1, 2010

place regarding which party owned the kiosk and which was responsible for maintaining the kiosk.

- Design – BWI Airport staff requested that the BWI Ground Access Information System be expanded to provide information about additional bus routes that serve BWI Airport.

Since the time the kiosk was removed, the project team has continued to work with airport staff towards resolution of these identified problems. At the time of this report, all issues have not yet been resolved and the kiosk has not yet been re-installed at BWI Airport. Greater detail regarding the deployment challenges are provided in the Deployment Experience Assessment chapter of this report (chapter 5).

2.2 Evaluation Approach

2.2.1 Objectives, Hypotheses, and Measures of Effectiveness

In developing objectives for the evaluation, the team first considered USDOT's goals for the SafeTrip-21 initiative which are as follows:

- Expand/accelerate the U.S. DOT's research in vehicle connectivity with the wireless communications environment.
- Build on Intelligent Transportation Systems (ITS) research.
- Explore/validate the benefits of real-time traveler information.

Taking these goals into account along with the project team's goals in carrying out the project, the team identified six evaluation objectives. Due to the fact that the mobile website was not actively marketed or well-used, one of the objectives (focused on exploring usage of the mobile website) had to be dropped from the evaluation. The following five evaluation objectives were explored in this evaluation:

- Understand the institutional issues associated with making airport ground transport information available to the public.
- Understand the needs of customers with respect to airport ground transport travel information.
- Determine whether airport ground transport travel information improves awareness of travel options out of the airport.
- Analyze the changes in airport ground transportation mode usage.
- Analyze the perceived accuracy and usefulness of the three interfaces of the airport ground transport travel information.

For each evaluation objective, the evaluation team then identified corresponding hypotheses, measures of effectiveness (MOEs), and evaluation activities, as shown in Table 2-1.

The evaluation approach activities included:

- Analysis of website usage statistics during the evaluation period.
- Administration of a web-based user survey of users of the website.
- Archived data on mode share for outbound trips at BWI airport
- Conduct of interviews with the deployment partners to document institutional issues and lessons learned with regard to the deployment experience.

It should be noted that the evaluation activities originally planned for the evaluation included analysis of kiosk usage, but due to the fact that the kiosk was not in place for a substantial amount of time, this analysis was removed from the evaluation.

Table 2-1. Evaluation Objectives, Hypotheses, MOEs, and Data Sources for the BWI Ground Access Information System.

ST-21 Goal	Evaluation Objectives	Hypothesis	MOE	Relevant Evaluation Activity
Expand and accelerate the U.S. DOT's research in vehicle connectivity with the wireless communications environment	N/A	N/A	N/A	N/A
Build on ITS research	Understand the institutional issues associated with making airport ground transport information available to the public	Deployment of the BWI Airport Ground Transport Travel Information will provide a reference and insights into future similar services	Lessons learned from development and deployment activities	Interviews with deployment partners
Explore / validate benefits of real-time traveler information	Understand the needs of customers with respect to airport ground transport travel information	The open feedback portion of the user survey will provide insight into the specific needs of users	– User needs	– User surveys – Archived web usage data
	Determine whether airport ground transport travel information improves awareness of travel options out of the airport	Users will perceive value in tailored ground transport travel information at airports	– User perceptions	– User surveys
	Analyze the changes in airport ground transportation mode usage	The real-time trip planning information will help airports users make an informed decision about mode choice	– Mode choice	– User surveys – Archived data on mode share for outbound trips at BWI airport
	Analyze the perceived accuracy and usefulness of the three interfaces of the airport ground transport travel information	The real-time trip planning information will be accurate and useful to airport travelers	– User perceptions – Usage statistics (e.g., number of users, frequency of use) – User ratings of the timeliness, accuracy, usefulness, acceptance, etc. of the information	– User surveys – Archived web usage data

3. USAGE STATISTICS

In order to gather comprehensive information about use of the BWI Ground Access Information System, the evaluation team planned to analyze usage data collected for the website, mobile website, and kiosk applications. However, due to the deployment challenges discussed in the Background chapter of the report, this chapter focuses solely on usage of the BWI Ground Access Information System website as it was the only application fully deployed within the timeframe of the evaluation.

Usage data for the website was collected beginning with the website's launch in October 2009 and extended through June 2010, when the system was pulled down to undergo further developmental changes at the request of BWI Airport staff. Exploring website usage data addresses several of the evaluation objectives. The evaluation team used an analytics tracker called Google Analytics™ to analyze data on the frequency of visits, looking at whether users were returning or new to the website, and looking at where the majority of web traffic was originating. This information supplements the other evaluation activities in determining how frequently the application is used and by what audiences. Some of the specific measures available in the website analytics tracker include:

- Visitor frequency.
- Visitor type (i.e., new vs. returning).
- Visitor location.
- Visitor trending (e.g., page views, time on site, total visits).
- Visitor loyalty (e.g., recency, length of visit, loyalty).

All of these measures are available by day or over any specified time period, allowing for an in-depth analysis of website usage. With the wide variety of metrics available on Google Analytics™, the evaluation team was able to perform specific analyses that are important to evaluating usage of a website. This report will delve into several different analyses that define website usage including determining the size of the website user base, observing how usage was affected by targeted marketing efforts or other major events, and capturing user characteristics throughout the evaluation period. Each of these analyses is discussed in more detail in the sections below.

3.1 Website Launch

As mentioned in the Background chapter, the website application was launched on the BWI Airport website in October 2009 with a link on a dedicated "Safe Trip" page. This page was available on the homepage of the BWI Airport website as a menu item on the "TO & FROM BWI" tab, which provides travelers with a variety of ground transportation-related information. Although the BWI Ground Access Information System website did begin experiencing use when this link was posted initially, usage was low and inconsistent during the first few months following the launch. After identifying options for increasing awareness, BWI Airport staff began implementing enhancements to the BWI Airport website to draw the attention of more travelers visiting their website to the BWI Ground Access Information System website.

The primary enhancement involved adding an attention-getting button advertisement on the home page of the BWI Airport website that linked to the Safe Trip page, and changing the menu link on the *TO & FROM BWI* tab to read "Trip Planning" instead of "Safe Trip," a title that is more

self-explanatory. BWI Airport staff also updated the language on the actual Safe Trip page to introduce and describe the information provided by the trip planner system in greater detail.

Figure 3-1 shows the two links to the trip planner website available on the BWI Airport website home page while Figure 3-2 is a screen shot of the Safe Trip page with the updated language. These updates were pushed live on December 10, 2009.

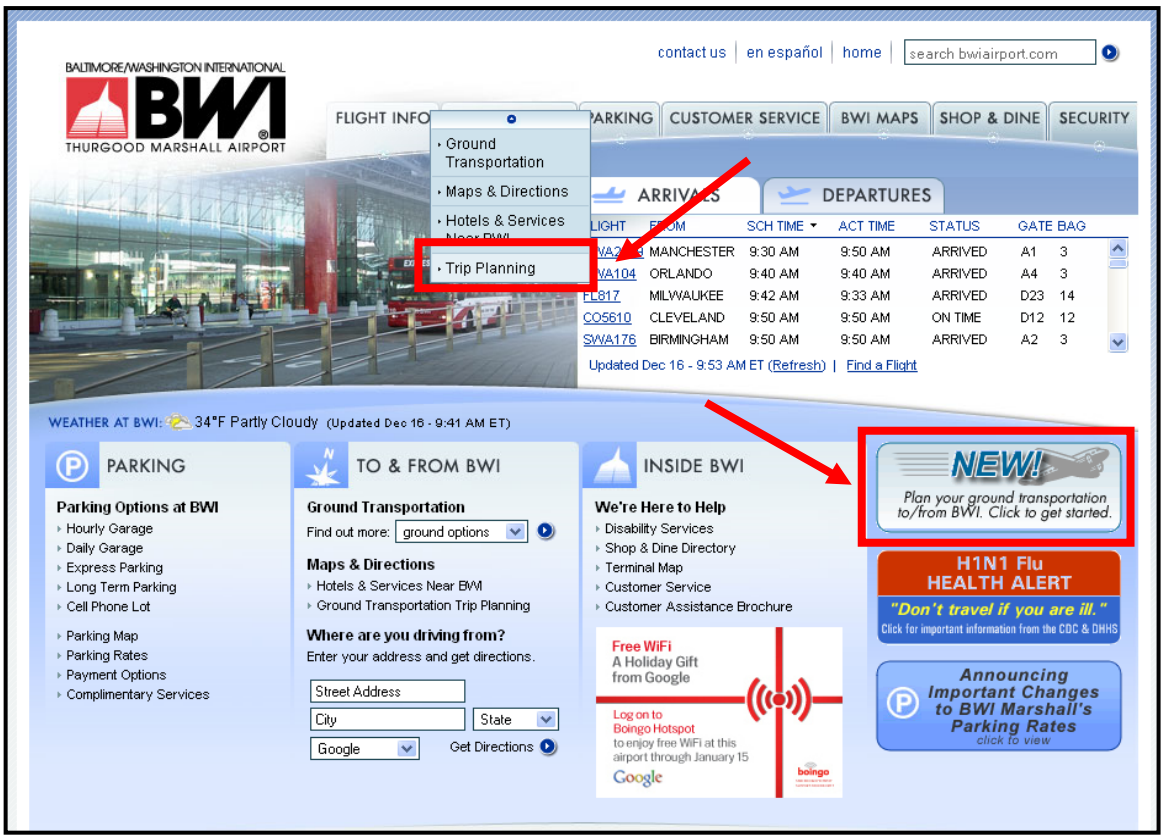


Figure 3-1. Button Advertisement and Menu Link to the BWI Ground Access Information System Website on the BWI Airport Website Home Page.

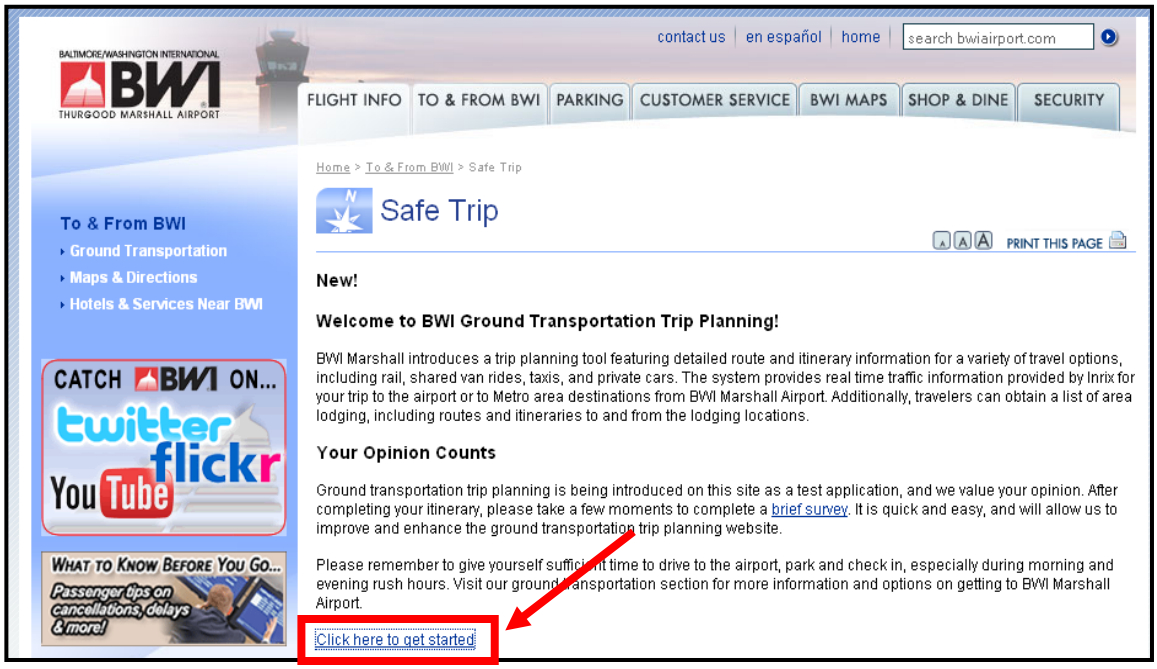


Figure 3-2. Website Link Available on BWI Airport "Safe Trip" Page.

Additionally, BWI Airport had been advertising the BWI Ground Access Information System website to their "followers" on their Twitter™ account. With nearly 2,000 followers at that time, the BWI Airport account provided an additional opportunity to increase awareness of the ground transportation trip planner website. Beginning with its first "tweet" on November 5, 2009 (see Figure 3-3), BWI Airport staff continued "tweeting" about the BWI Ground Access Information System website for several months. Table 3-1 shows the date and content of each tweet posted throughout the evaluation period.

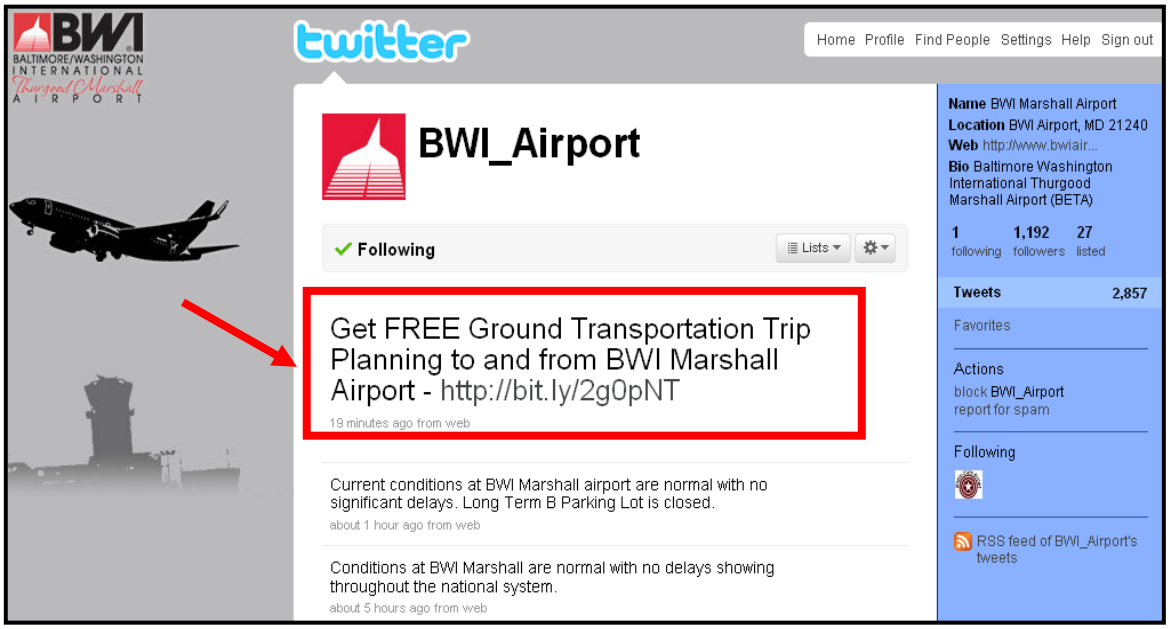


Figure 3-3: First BWI Airport Tweet on November 5, 2009.

Table 3-1. List of Tweets Posted on BWI Airport Twitter™ Account – November 11, 2009 – February 9, 2010.

Date	Tweet Content
November 11, 2009	**Get FREE Ground Transportation Trip Planning to and from BWI Marshall Airport** – http://www.bwiairport.com/en/travel/safe-trip
December 16, 2009	**How do YOU get to/from BWI Airport? Try our NEW tool to plan your ground transportation.** http://www.bwiairport.com/en/travel/safe-trip
December 21, 2009	**What's the best way to get to/from BWI Airport at the time of your trip? We'll show you!** http://www.bwiairport.com/en/travel/safe-trip
December 29, 2009	**Looking for a new way to get to/from BWI? Try our NEW ground transportation tool!** http://www.bwiairport.com/en/travel/safe-trip
December 30, 2009	**Looking for a new way to get to/from BWI? Try our NEW ground transportation tool!** http://www.bwiairport.com/en/travel/safe-trip
January 4, 2010	**Worried about getting 2 the airport on time? Plan ahead with this new ground transportation tool!** http://www.bwiairport.com/en/travel/safe-trip
January 21, 2010	**NEW! Use this link to plan your ground transportation to/from BWI Airport.** http://www.bwiairport.com/en/travel/safe-trip
February 9, 2010	**What's the best way to get to/from BWI Airport at the time of your trip? We'll show you!** http://www.bwiairport.com/en/travel/safe-trip

The BWI Airport Twitter™ account and the Safe Trip page were also used to advertise the survey that was developed by the evaluation team to collect user feedback on the BWI Ground Access Information System website (the survey is presented in the User Perceptions chapter of this report, chapter 4).

Although efforts to increase awareness were on-going, the evaluation team began collecting usage statistics immediately following the website's launch. It is important to note that the evaluation period is defined as October 2009 through June 2010, or the time period beginning when the website was launched and extending to the time when it was pulled down for further development. In the following sections, the evaluation team identifies the website user base and explores the website usage associated with targeted marketing efforts, holiday travel, and major weather events throughout the evaluation period.

3.2 User Base

Knowing the total number of individuals who have used the BWI Ground Access Information System website is an important factor in evaluation. This information helped determine the required sample size for user survey activities, and has helped provide insight into the level of exposure that the website has received. There are two metrics available in Google Analytics™ which are important to distinguish between when analyzing website usage: *visits* and *visitors*. The number of visits is an indication of the general usage of a website, as in how many times the content is viewed in total, whereas the number of visitors is an indication of how many individuals are using the website. A single visitor could account for multiple visits after using the website more than once. Figure 3-4 shows the website usage by total number of visits by month from the website's launch through the end of the evaluation period in June 2010.

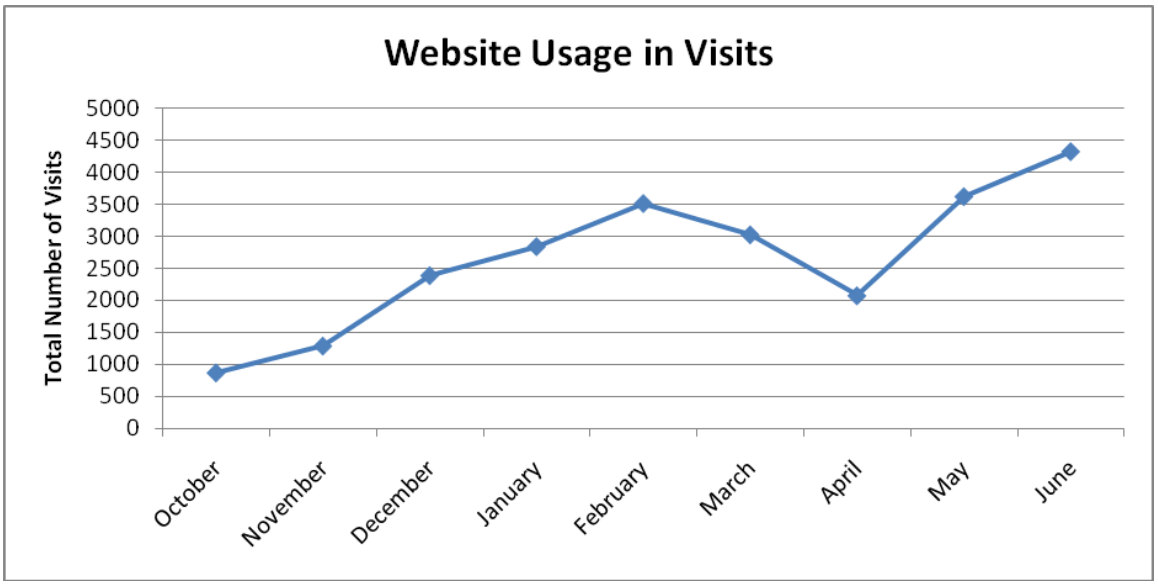


Figure 3-4. Total Number of Website Visits by Month, October 2009 – June 2010.

It is important to realize that a large number of visits does not necessarily translate to a large number of visitors and vice versa. The number of visits is an indicator of how much the website is being used, while the number of visitors is an indicator of how many people are using the website. The relationship between visits and visitors can provide insight into how frequently visitors are using the website, which will be addressed specifically in the discussion of website user characteristics later in this chapter. The total number of individuals who have visited the website one or more times, or visitors, is the metric used to determine the website user base. Google Analytics™ determines the user base by measuring *absolute unique visitors.* This metric uses first party cookies stored on a user's computer to determine if he/she has visited the website previously within a specified time period. It is important to consider the possibility of error in this metric as web browsers generally allow users to delete or disable cookies if they would like (i.e., if a user deletes his/her cookies before returning to the website again, he/she will be marked as an absolute unique visitor on his/her next visit). However, as long as users have not deleted their cookies at any point over the time span of using the website, they will be recognized as a returning visitor for up to 2 years and only counted once as an *absolute unique visitor* over the website life cycle.

Figure 3-5 shows how the user base has grown over time from when the website was first launched in October 2009 through the end of the evaluation period in June 2010.

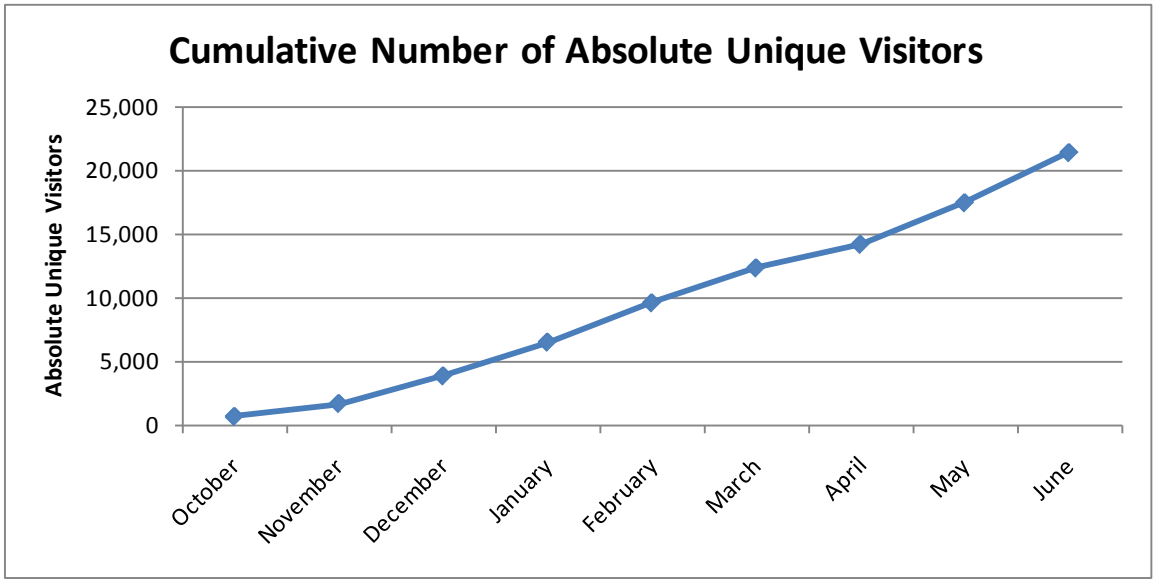


Figure 3-5. Cumulative Number of Absolute Unique Visitors by Month, October 2009 – June 2010.

At the end of June 2010, a total of 21,108 visitors made up the website user base, accounting for 23,937 total visits to the website, and an average of 1.13 visits per user. Knowing that the population of interest for the evaluation is all of the website users, the evaluation team was able to analyze the website user base to approximate the number of surveys required to capture a statistically valid sample size. Additional details on this analysis and user survey activities can be found in the User Perceptions chapter.

In order to assess the true growth of the user base throughout the website's life cycle, Figure 3-6 presents the cumulative difference in the number of absolute unique visitors from month to month, which represents the growth rate of the website user base. Also apparent in Figure 3-5 above, October 2009 through February 2010 shows positive growth in absolute unique visitors; however, Figure 3-6 clearly identifies that there was a decline in growth by month between February and April before growth spiked again in May and June 2010.

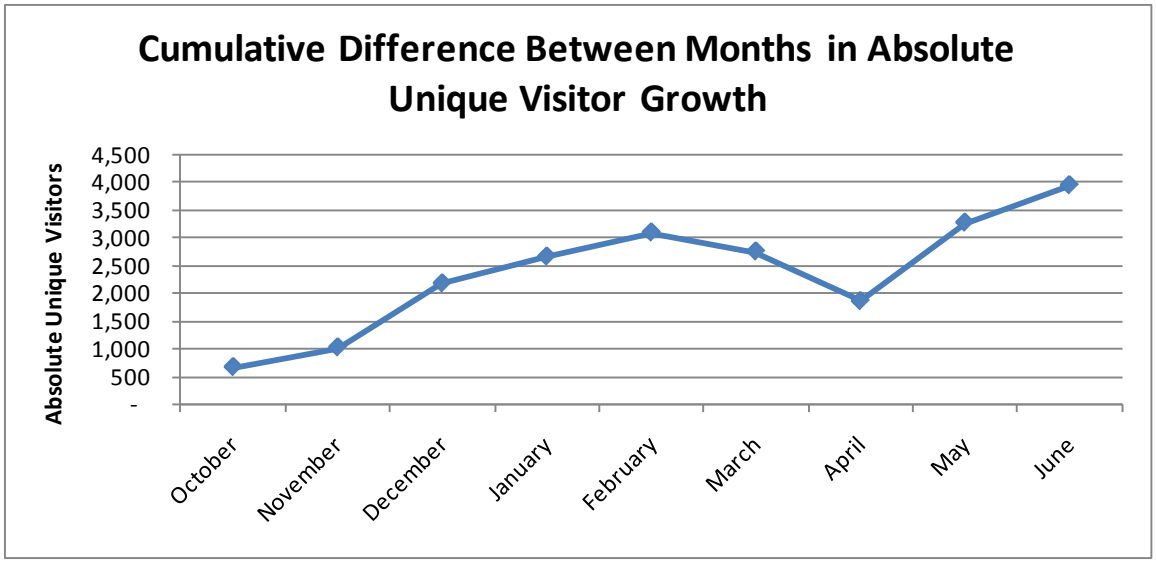


Figure 3-6. Cumulative Difference of Absolute Unique Visitors by Month, October 2009 – June 2010.

While the initial steady increase in visitors can likely be attributed to the targeted marketing efforts put forth by BWI Airport staff, the rise and fall in usage by month afterwards may be more so related to the general patterns of travel at the airport. Figure 3-7 below shows the total number of passengers traveling into and out of BWI Airport by month throughout the evaluation period.[7] When comparing Figure 3-6 and Figure 3-7, the two graphs certainly do not line up exactly, but it appears that there is a relationship between the growth in the website user base and the airport throughput in terms of passengers. The website user base began growing slowly in October and November as the result of initial targeted marketing efforts. December through January saw an increase in the rate of growth due to significant events that impacted usage, which will be discussed in greater detail later in this chapter. In March, it appears growth in the user base began to decrease back down toward the original October and November levels, but instead, the growth in the user base remained at nearly 2,000 users per month through the end of April. It is possible that the spike in airport travel in March and April helped maintain growth in the user base at levels that may not have been seen otherwise at that point had it not been for the significant events that occurred in December through February. Through May and June, airport travel increased to over 2 million passengers per month, which appears to have had a significant impact on the website user base growth as it also increases at its highest rate of growth through those months. While the impact of airport travel on the website user base is not exactly clear, it does appear that the number of passengers traveling through the airport in a given month may have been relative to the growth in the website user base.

[7] Source for BWI Airport Travel Statistics - **http://www.bwiairport.com/en/about-bwi/stats**

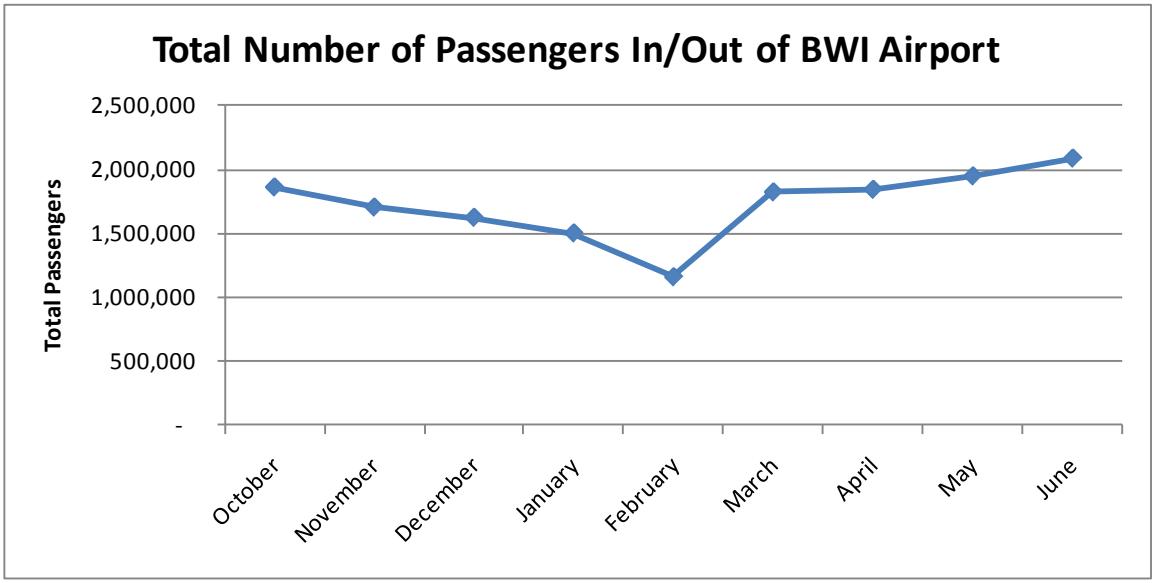


Figure 3-7. Total Passengers In/Out of BWI by Month, October 2009 – June 2010.

3.3 Targeted Marketing Efforts

The topic of the website user base and how it has grown over time leads well into a discussion of how website usage has been affected by targeted marketing efforts and certain major usage events. There is certainly an explanation for the changes in website user base growth across several months. Assessing website usage shows the user response to the marketing efforts put forth by BWI Airport staff and provides further insight into the public need for and use of the website in addition to insights obtained from survey activities.

3.3.1 Impact of Direct Marketing on Usage

As mentioned before, BWI Airport staff took several strides to create awareness about the website, beginning with its launch in October 2009 when the website received immediate exposure to travelers flying to and from BWI Airport. The two additional marketing efforts of providing a button advertisement on the home page of the BWI Airport website and tweeting about the BWI Ground Access Information System website supported the growth of the website user base. In fact, these efforts created initial exposure to the website in the form of various bumps and spikes in visits during the first months of the website life cycle. Figure 3-8 below shows the impact of direct marketing on website usage in number of visits by day.

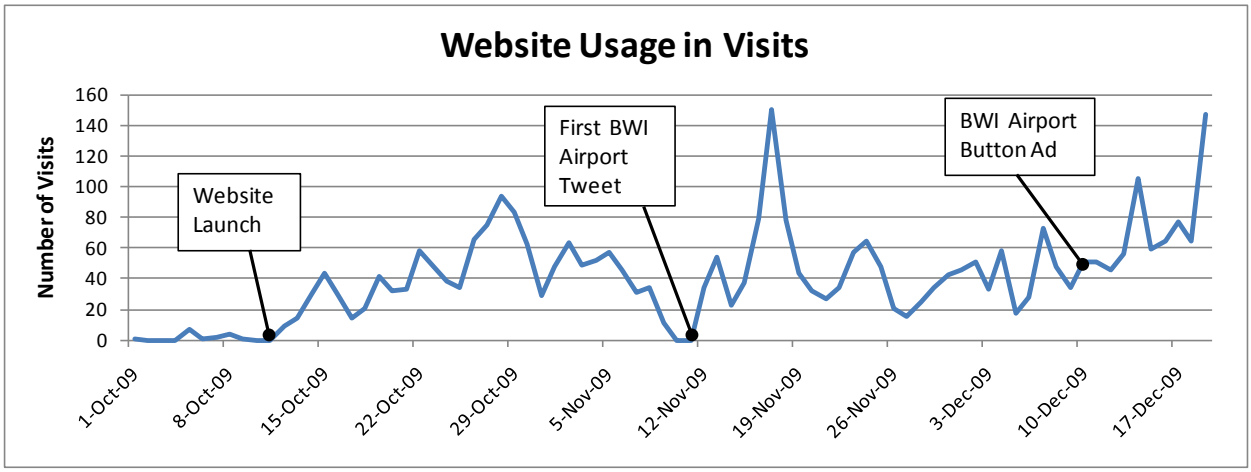


Figure 3-8. Impact of Marketing on Website Usage by Day, October 1, 2009 – December 19, 2009.

Because Twitter™ was relatively new at the time of this project and a new form of outreach for BWI Airport, it is important to explore what type of impact the tweets posted on the BWI Airport account may have had on website usage. Twitter users generally have a short attention span when it comes to reading any single tweet because of the high-volume nature of social media. Depending on the number of accounts a user is "following", the home page, or "feed," on his/her Twitter account may see hundreds or even thousands of tweets per day. Although it does depend on a specific user's habits, it is very likely that a significant impact on website usage resulting from a single tweet will not exceed 24 hours. In fact, frequent users are most likely to view a tweet in the minutes or hours after it is posted. For that reason, comparing the cumulative number of visits to the website the day before a tweet was posted to the cumulative number of visits the day after a tweet was posted may give some indication as to how effective the tweets were in drawing users to the website. Table 3-2 below provides the percent difference in visits between the day before the tweet and the day after the tweet. To better understand whether or not the percent difference for a single tweet was significant, the percent difference in cumulative number of visits by day was calculated for the whole of the evaluation period. After excluding the first month after the website launch because of the large percent differences that can occur when the number of visits is still low, the average percent difference in cumulative visits per day from November 2009 to February 2010 was 2.18 percent. While there were several factors that were affecting website usage simultaneously, it appears that the tweets posted on the BWI Airport account may have had an effect on the website usage. There were only two tweets that did not see an impact above the average percent difference across the months when tweets were posted.

Table 3-2. Percent Difference in Visits Relative to Tweets.

Date	Cumulative Number of Visits Prior to Tweet	Cumulative Number of Visits After Tweet	Percent Difference
November 11, 2009	1,264	1,298	+ 2.69 %
December 16, 2009	2,985	3,062	+ 2.58 %
December 21, 2009	3,625	3,763	+ 3.81 %
December 29, 2009	4,365	4,486	+ 2.77 %

Date	Cumulative Number of Visits Prior to Tweet	Cumulative Number of Visits After Tweet	Percent Difference
December 30, 2009	4,486	4,553	+ 1.49 %
January 4, 2010	4,902	5,037	+ 2.75 %
January 21, 2010	6,448	6,537	+ 1.38 %
February 9, 2010	8,827	9,041	+ 2.42 %

3.3.2 Impact of Major Holidays on Usage

It is clear that the targeted marketing efforts and general airport travel patterns affected both the growth of the website user base and the number of visits to the website in general. However, the evaluation team also discovered these efforts were not the only reasons for major increases in website usage. Spikes in usage also occurred during times when website users may typically be more interested in travel information such as major holidays or inclement weather events. Figure 3-9 shows the website usage in visits for November through January by day. There is a clear increase in usage on the days surrounding Thanksgiving Day, Christmas Day, and New Years Day, times of historically high travel activity. The figure even shows that website usage slowly declines several days after these holidays, likely aligning with the decline in airport travel.

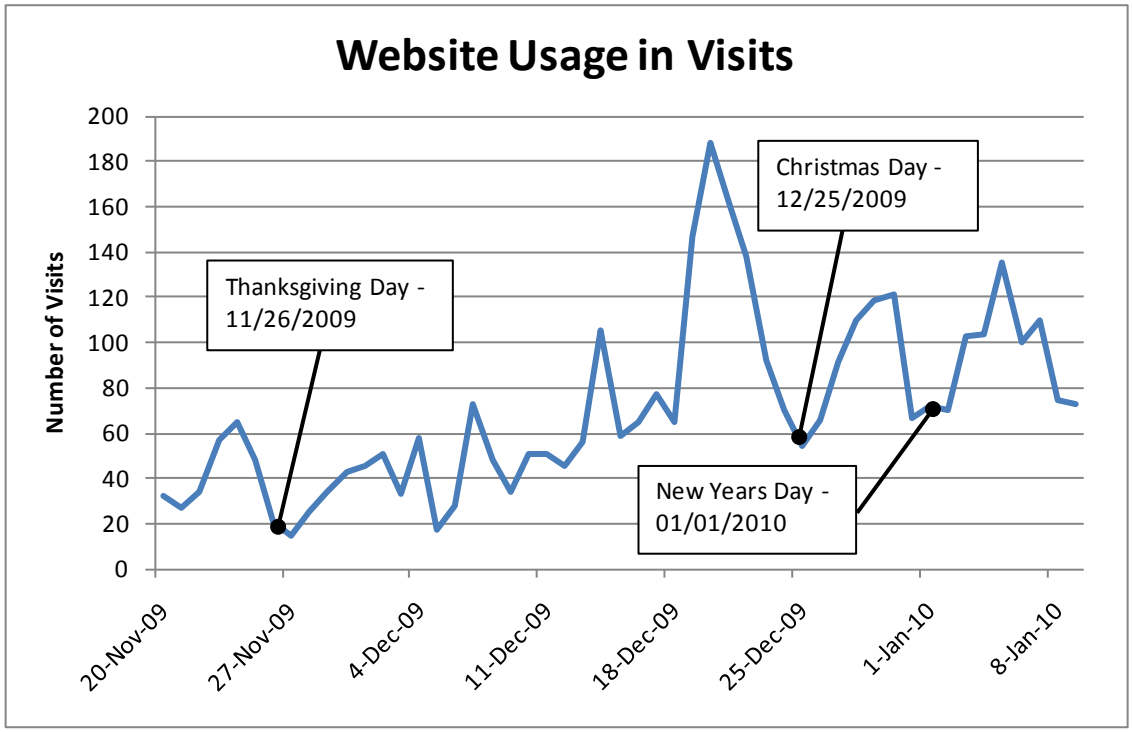


Figure 3-9. Website Usage in Visits by Day, November 14, 2009 – January 15, 2010.

3.3.3 Impact of Weather on Usage

Similarly, several large winter storm events hit the Mid-Atlantic region of the United States in December 2009 and January and February 2010. The beginning and end dates for these inclement weather events are as follows:

- Winter storm with snowfall exceeding 20” in certain areas – December 18-20, 2009.
- Winter storm with snowfall exceeding 5”-10” in certain areas – January 29-31, 2009.
- Winter storm with snowfall exceeding 20” in certain areas – February 5-7, 2010.
- Winter storm with snowfall adding 10” – 20” to previous storm snowfall in certain areas – February 9-11, 2010.

All of these storms affected travel into and out of BWI Airport and produced record-setting snowfalls over several days in Virginia and Maryland. Figure 3-10 shows how website users responded to these storm events by viewing the information available on the BWI Ground Access Information System website in the subsequent days. The increase in website usage aligns closely with the duration and impact of each storm.

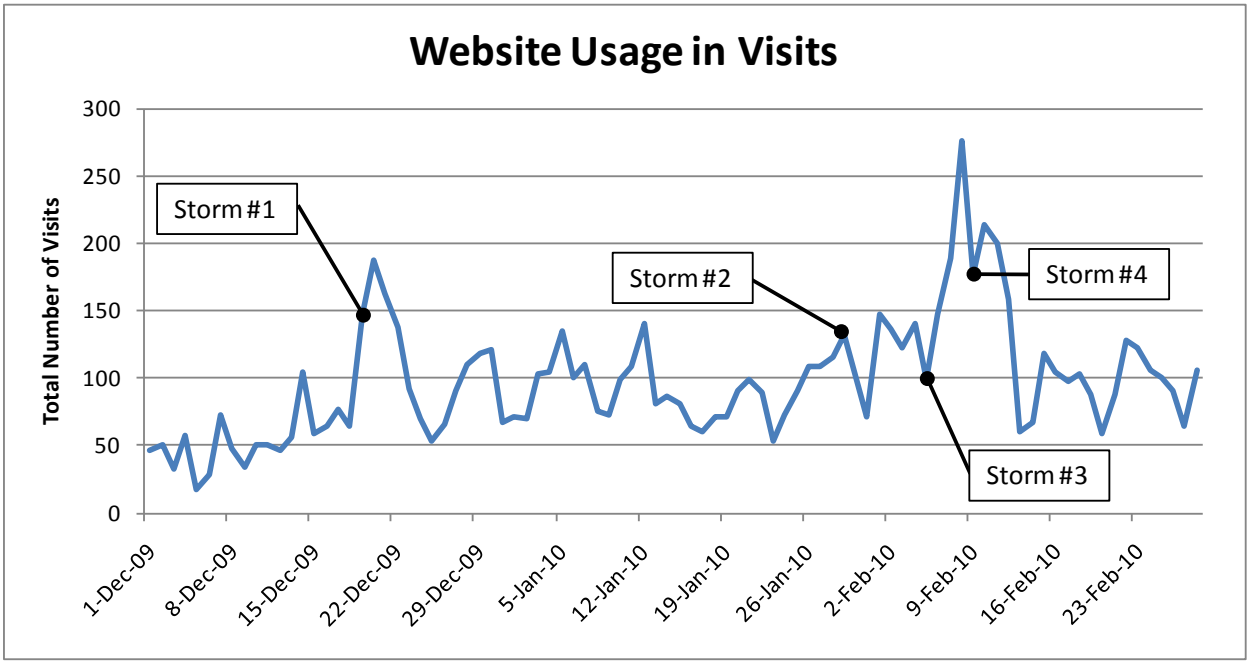


Figure 3-10. Website Usage in Visits by Day, December 1, 2009 – February 28, 2010.

In summary, Figure 3-11 below displays usage in number of visits over the entire life of the website from its launch through the end of the evaluation period. Although Figure 3-11 presents the total number of visits over the same time period as Figure 3-4 in the Website User Base section above, it uses a different collection period interval (by day instead of by month) and clearly paints a different picture. The increased definition in the graph clearly shows how the targeted marketing efforts and major events identified above, which can occur on a single day or over successive days, significantly affected website usage. From the perspective of the entire life of the website, usage increased steadily with the targeted marketing efforts, which grew the website user base and likely created the level of exposure that resulted in the spikes in usage during the major events that followed as users likely became more familiar with the type of information offered on the website. Without the targeted marketing efforts, usage could have remained low due to a lack of initial user exposure to the website. However, even after user exposure was established by the targeted marketing efforts, usage could have declined and not spiked again if it was not for the occurrence of major events such as holiday travel and inclement weather. As Figure 3-11 shows, the time periods between these major events are marked by

significantly lower usage comparatively. That is not to say there are no users accessing the website on a regular basis or visiting it to receive ground transportation information for normal reasons, but the overall website usage clearly shows that users visit the website significantly more in response to these types of events.

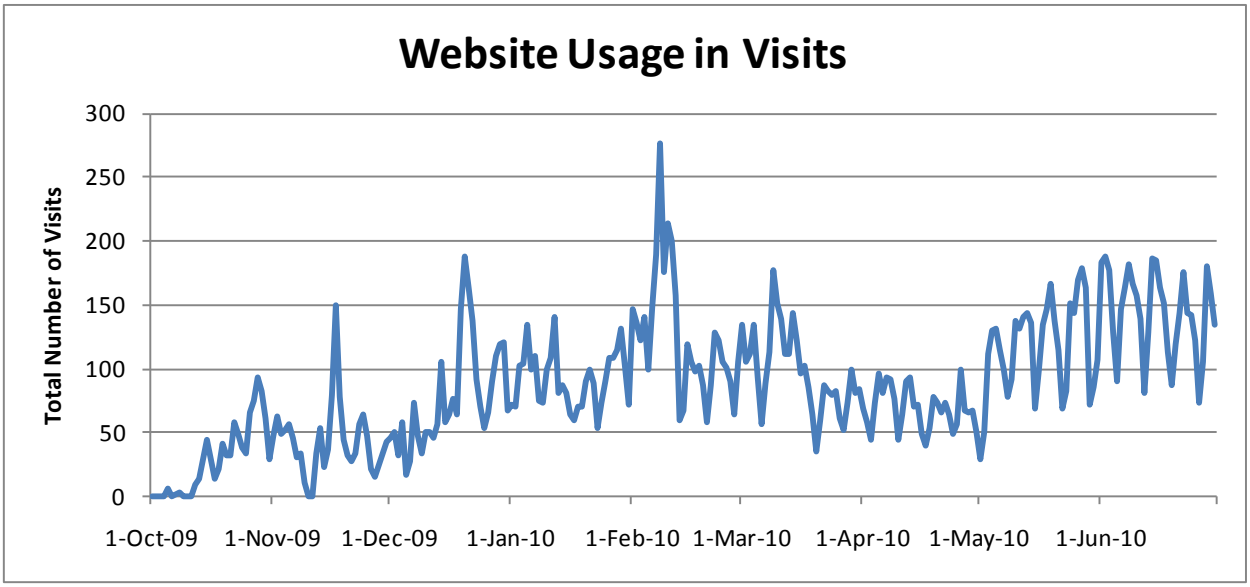


Figure 3-11. Website Usage in Visits by Day, October 2009 – June 2010.

The system was designed to help make airport travelers more aware of all modal options available to/from BWI and the increase in website usage observed during holidays and weather events could possibly be an indication that travelers are seeking out information on new or alternate ground transportation options to BWI Airport when high traffic volumes or bad weather prevents them from taking their normal mode. However, it is also possible that travelers are just simply more interested in trip planning information or traffic information available on the website during these events.

3.4 User Characteristics

In addition to determining the website user base and exploring what establishes and drives website usage, it is equally important to observe the general characteristics and actions of the website users in regard to the usage statistics. This analysis can provide interesting insight into visitors' use of the website such as the frequency by which they visit, the specific tools or pages they use when visiting the website, or the geographic location of website users. The website user characteristics were analyzed for the entirety of the evaluation period, October 2009 through June 2010.

3.4.1 Trends in User Frequency

Determining how frequent visitors use the website is as important to the evaluation as knowing the size of the user base. The following metrics show what percentage of users only visit the website one time versus those who return for additional visits. These measures can serve as key indicators in understanding how useful the website appears to be or how often the users have a need for this type of information. Google Analytics™ breaks down visitor frequency into two different metrics: "loyalty" and "recency."

Visitor loyalty provides a useful assessment of how often users are returning to the website relative to the evaluation period. Figure 3-12, which shows visitor loyalty, clearly displays that only slightly more than 10 percent of website users have returned to the website for additional visits following their first visit.

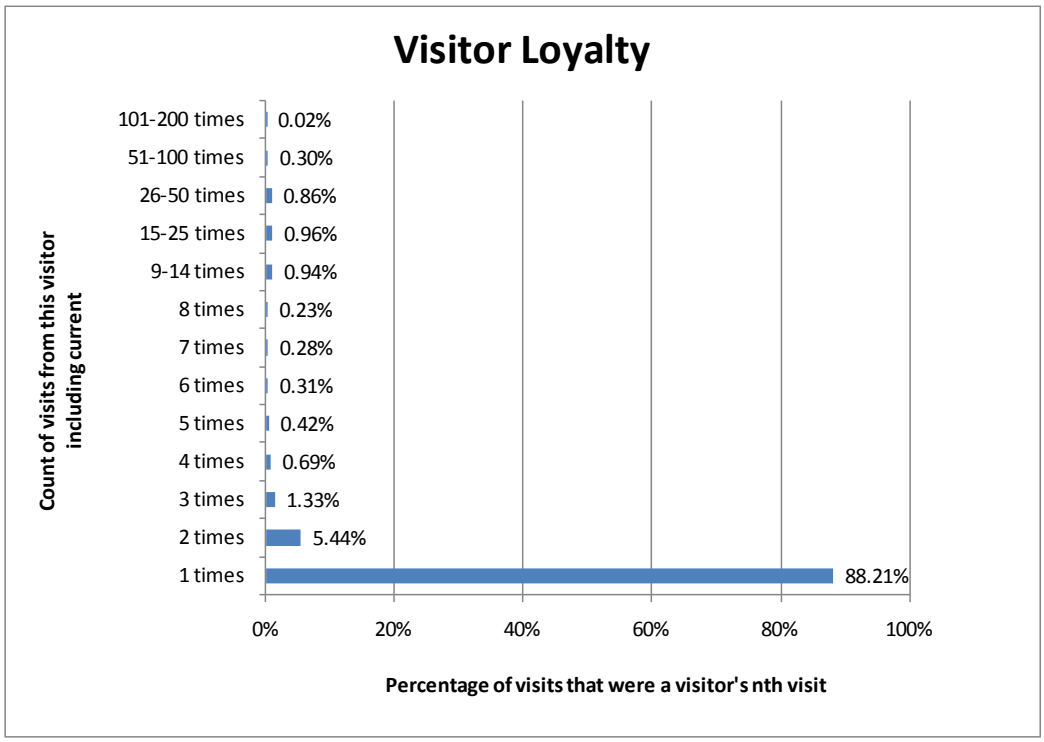


Figure 3-12. Visitor Loyalty, October 2009 – June 2010.

Visitor loyalty can be an indicator of user acceptance and need for a website, but it is difficult to infer why almost 90 percent of first-time website users did not return for another visit. Possible explanations for why user need for the website appears to be so low include:

- **Length of Evaluation Period, Ground Transportation Familiarity, and Travel Frequency.** The website user base could be primarily comprised of infrequent air travelers who did not have a need for repeat use of the website within the evaluation period which was less than a year. This would seem to be the case based on the survey results (presented in further detail in the User Perceptions chapter, chapter 4), which indicate that the majority of respondents rarely travel in or out of BWI (in fact, 30 percent had never traveled in or out of BWI). The information provided on the website may be more useful to infrequent travelers who are not as aware of the options available compared to frequent travelers who already know how they want to travel or who are fully aware of the different ground transportation options.

- **Use as an Information Source versus Use as a Trip Planner.** Although the website provides schedule information for any specific departure time and day selected by the user, the website may be more useful for introducing airport travelers to the ground transportation options that were unknown to them previously since it provides a list of several options for each trip planned. Unless a traveler was seeking schedule information for a specific transit trip, introduction to the various ground transportation options would only require one visit. However, again, it is very possible that infrequent travelers may have visited the website

initially out of curiosity and realized it provided information on options that they were not aware of, but did not have a reason to use the website again within the timeframe of the evaluation period.

- **Perceived Value of Website.** It is possible a large number of initial visitors could have accessed the website quickly for a preview of what information was available on the website, but did not initially find it to be useful enough to warrant a return visit. It is important to note that these one-time visitors are still considered to be part of the website user base.

- **Website Functionality**. First-time visitors may have had problems with website functionality or difficulty using the website and elected not to return for an additional visit.

The web-based user survey, which will be discussed in detail in the following chapter, provides some insight into which of these are factors in whether a user will return to the website.

Figure 3-13 provides additional insight into visitor frequency by showing visitor recency, or how many days typically go by before visitors return for subsequent visits. It is important to note that only the most recent user behavior is recorded in the visitor recency metric. These measurements are all correlated to when the user last visited the website. For example, a user who visited the website for the first time on Day 1, but then did not return to the website until Day 7, would be included in the "6 days ago" category for visitor recency measured on Day 7. However, if this same user returned on Day 8 and visitor recency was recorded on Day 9, the user would then be included in the "1 days ago" category. Therefore, the measure of recency is always relative to when recency is recorded, which is June 30, 2010 for the figure below.

As Figure 3-12 indicated and Figure 3-13 confirms, almost 90 percent of users have only visited the website one time. However, Figure 3-14 shows only the *previous visits tracked* for return visits to the website (i.e., the *first visit* category was removed and percentages were calculated based on the remaining categories). Relative to June 30, 2010, the figure suggests that 67 percent of visits by return visitors to the website were made by users who had already visited the website that same day. Although no conclusions can be drawn about what percentage of website users are represented in this figure because of the significant difference between *visits* and *visitors*, it does show that some users visit the website more than once a day. These data suggest that users prefer to view the information presented on the website several times in one day in order to make the best use of it, which does not seem intuitive to trip planner information. The website provides schedule and fare information for the ground transportation options available to and from BWI, but allows users to input a departure time. It is not clear why users need to return to the website within the same day other than possibly to check the same information they had viewed earlier.

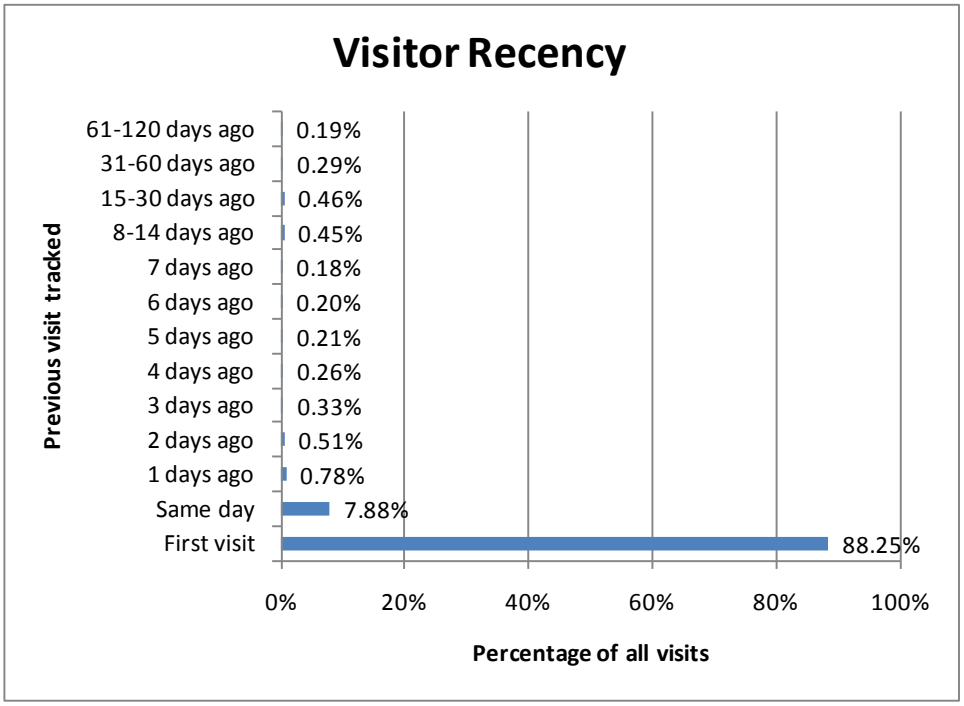


Figure 3-13. Visitor Recency, October 2009 – June 2010.

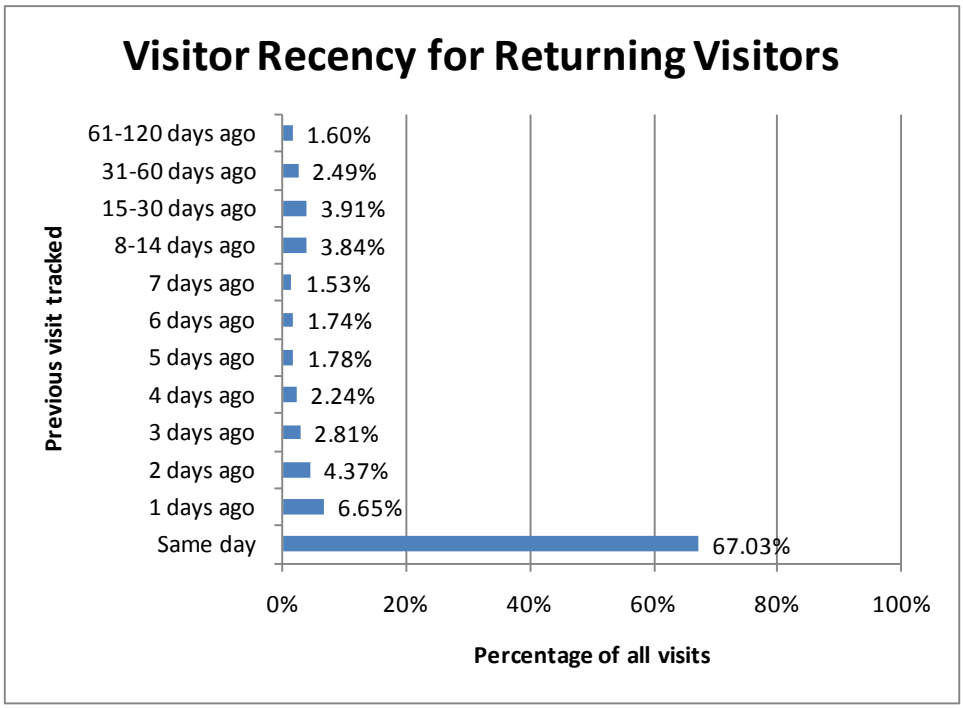


Figure 3-14. Visitor Recency for Returning Visitors Only, June 2009 - March 2010.

3.4.2 Trends in Website Visits

There are several Google Analytics™ metrics that provide a snapshot of the typical user visit to the website. The analyses below give insight into typical user behavior as well as how website visitors generally use the information it provides. Figure 3-15 displays the total number of visits to the website by time of day. Overall, the highest usage is seen between 10:00am and 4:00pm with another small peak at 9:00pm. After steady usage throughout the afternoon, website visits drop at the peak of the typical afternoon rush hour, 5:00pm. This trend suggests that on the whole users find the information available on the website most valuable during the typical workday, 8:00am – 5:00pm, and in the evenings from 8:00pm – 10:00pm. The high mid-day and evening usage could possibly be attributed to the times when the average individual has computer access, during the workday and in the evenings.

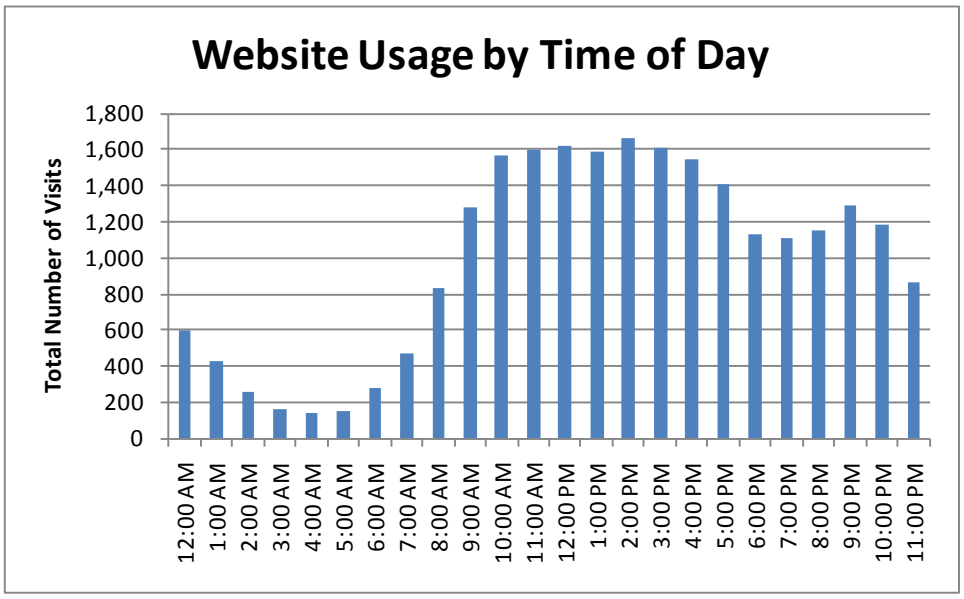


Figure 3-15. Website Usage in Visits by Time of Day, October 2009 – June 2010.

Figure 3-16 displays the total number of visits to the website by day of the week. Monday and Tuesday account for the greatest number of visits to the website in terms of the day of the week. According to BWI Airport staff, the days with the highest arrival levels tend to be Fridays and Sundays while Saturdays and Tuesdays are normally the lightest travel days. The website usage experience by day of week does not seem to correlate with the travel patterns at BWI Airport. Because the website is intended to be a pre-trip planner, it is likely that the time or day that travelers are looking into ground transportation options is not at all related to the time or day of their actual trip as most users likely access the website from their home or work computer several hours or days before their flight.

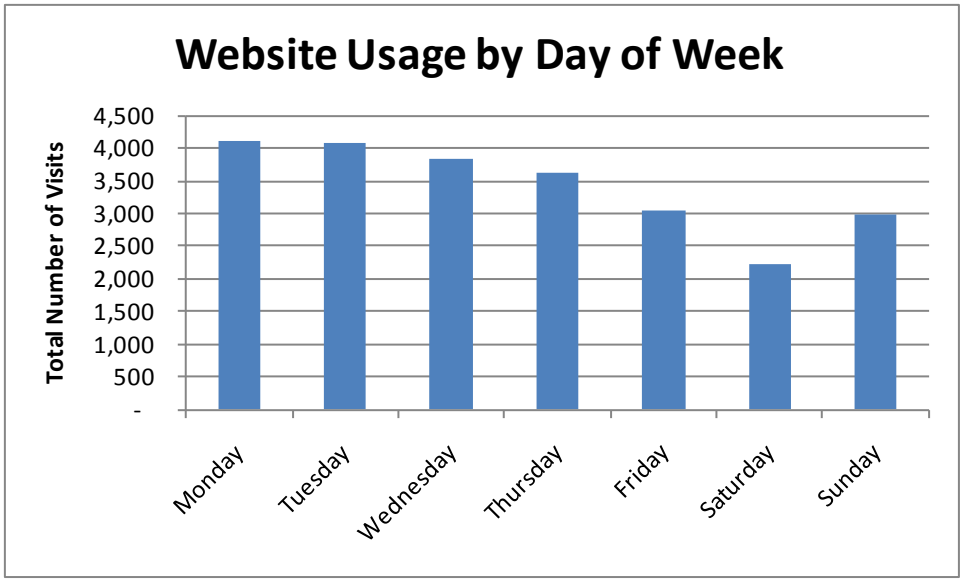


Figure 3-16. Website Usage in Visits by Day of Week, October 2009 – June 2010.

Another important metric to consider when analyzing website user characteristics is the amount of time users spend on the website. Figure 3-17 shows user length of visit, or how long users generally stay on the website when they visit. This figure suggests that users are spending very little time on the website when they are visiting, but it is important to understand how Google Analytics™ calculates this information before drawing this conclusion. This metric is actually recorded relative to the number of pages a user views while visiting the website. The program records the time when a user first arrives on the webpage and can only determine the length of visit when the user actually visits another page on the website. It calculates the length of visit by finding the difference between the timestamp on the new page visited and the initial timestamp recorded on the original page visited. Because of this, a user must visit more than one page in order for a true length of visit to be recorded. Another indicator of how long visitors spend on the website is the average time on site calculated for entirety of the evaluation period, which was 1 minute and 6 seconds.

In comparing the two measures, length of visit and time on site are both measures of visit quality according to Google Analytics. A large number of lengthy visits suggests that visitors interact more extensively with the website. The graph shows the entire distribution of visits instead of simply the average time on site across all visits. Keep in mind that average time on site is skewed by visitors leaving browser windows open when they are not actually viewing or using the site. Length of visit provides insight into whether a few visits are skewing the average time on site upward or whether most visits to the site have a high average time.[8] However, the majority of information available on the BWI Ground Access Information System website is on the home page. Website users would have to navigate to another page on the website in order for Google Analytics™ to be able to calculate an accurate length of visit. Therefore, the length of visit is likely not accurate for the website.

[8] Reference to Time on Site versus Length of Visit on Google Analytics: http://www.google.com/support/analytics/bin/answer.py?hl=en&answer=60127

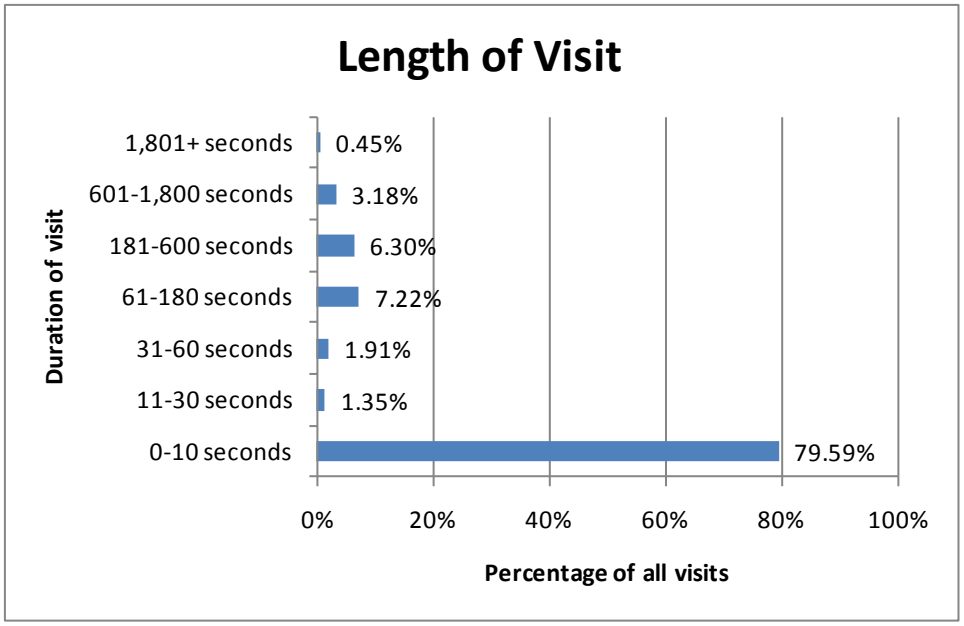


Figure 3-17. Length of Visit, October 2009 – 2010.

3.4.3 Trends in Accessing the Website

Another important factor to analyze when considering the functionality of a website is how users arrive to the website in the first place. This can be done by looking at the breakdown in number of visits by traffic source, or essentially what outlet visitors are using to arrive at the website. Figure 3-18 below shows percentage of visits associated with each type of traffic source. Trends in the way users access the website provide insight into how it is that users came across the website in the first place. With 93 percent of users traveling to the website from a referring site, the remainder of the user traffic arrives by typing in the exact URL or using a bookmark in their browser (7 percent) or by typing keywords into a search engine (0.23 percent).

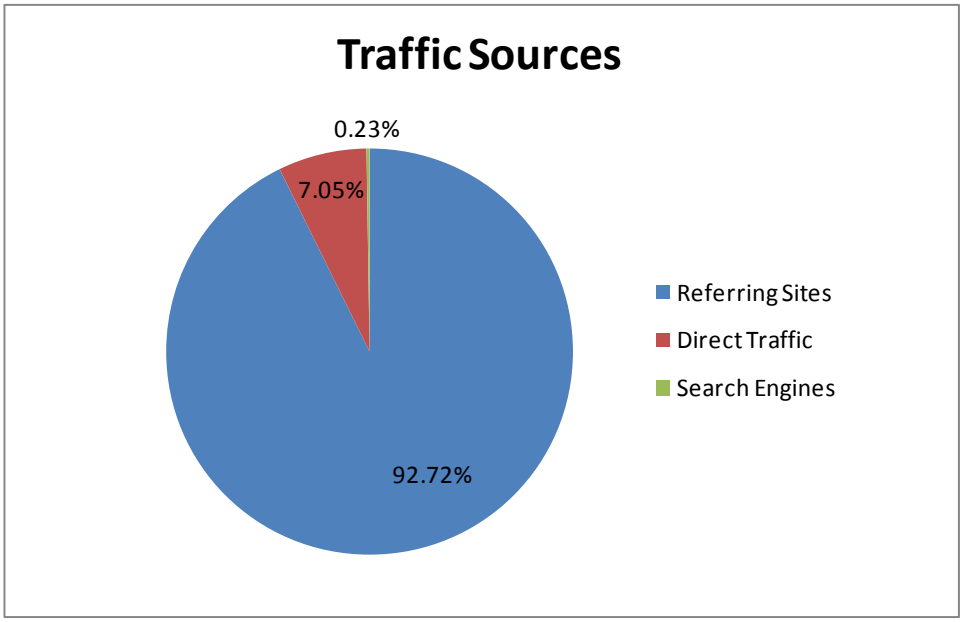


Figure 3-18. Types of Traffic Sources by Number of Visits, October 2009 – June 2010.

Table 3-3 below provides insight into which sources visitors are using to arrive at the BWI Ground Access Information System website. Clearly, the majority of visitors are using the links available on the BWI Airport website to find the BWI Ground Access Information System website. As mentioned above, the 7 percent of traffic that links directly to the website can likely be attributed to visitors who have bookmarked the exact website URL. Very few visitors found their way to the website via one of the search engines listed in the table. It is important to note that Table 3-3 lists only the top five traffic sources by visits and does not include all sources represented in Figure 3-18.

Table 3-3. Traffic Sources by Number of Visits, October 2009 – June 2010.

Sources	Visits	% Visits
Referring site - bwiairport.com	22,146	92.52%
Direct Traffic	1,687	7.05%
Search Engine - google.com	39	0.16%
Search Engine - bing.com	10	0.04%
Referring site - facebook.com	6	0.03%

3.4.4 Trends in Geographic Location of Users

Figure 3-19 and Figure 3-20 display the geographic location of website visitors based on their locations recorded in Google Analytics™, which are determined using visitor IP addresses. In regard to user privacy, it is important to note that the tool does not provide a list of IP addresses; it simply provides a city name and a State name for each visit to the website. The maps below represent density relative to website visits, which again is different from visitors. It is important to note that the densest areas on the map represent where the most use occurs, not necessarily where the most website visitors live.

After retrieving the list of cities from Google Analytics™, the evaluation team used the number of visits per city to create density maps, which group all cities into their corresponding metropolitan and micropolitan statistical areas also commonly referred to as core-based statistical areas (CBSA)[9]. Figure 3-19 displays the website traffic across the entire country[10]. As show in the figure, there are website users from all over the United States. Because the BWI Ground Access Information System website was marketed on the BWI Airport website, any traveler around the country looking for more information about ground transportation options at BWI Airport can be exposed to the trip planner if they go to the airport website. Figure 3-20 provides a greater level of detail in the CBSAs surrounding BWI Airport where people that use the airport as their primary or secondary home airport probably live. As expected, Baltimore, Maryland and Washington, D.C. represent the largest percentage of website visits. This is likely because travelers in these areas use BWI Airport the most and may consistently use the BWI Airport website as a source of information relevant to their air travel.

Figure 3-19. National Website Usage by CBSA Density, October 2009 – March 2010.

[9] See the U.S. Census Bureau website for more information on CBSAs: http://www.census.gov/geo/www/cob/mmsa_meta.html

[10] Note that the time period selected for Figures 3-19 and 3-20 was selected to align with the time period of the survey in order to allow for comparison of the website userbase to the survey respondents. It therefore differs from other charts and tables in this chapter.

Figure 3-20. East Coast Website Traffic by CBSA Density, October 2009 – March 2010.

As shown in the figure above, the ground transportation information on the website can be useful for both travelers flying into or out of BWI Airport. It was designed to help make travelers more

aware of all modal options available to/from BWI. In fact, it is possible that it is useful to those who do not live near BWI Airport because they may be less aware of all of the ground transportation options offered or available. It is possible that it may be useful to those who do live near BWI Airport by providing information about options that they may not have known about previously.

3.5 Summary

In summary, the BWI Ground Access Information System website experienced steady growth in terms of the website user base after its initial launch on the BWI Airport website in October 2009 through the end of the evaluation period in June 2010. The initial launch was effective in growing the website user base and establishing initial airport traveler exposure. The additional targeted marketing efforts including advertisements on the BWI Airport website home page were effective in continuing growth in the website user base and number of visits to the website. Interestingly, while there were several factors that were affecting website usage simultaneously, it appears that using Twitter specifically may have been an effective marketing tool in increasing awareness of the website as well.

The website user base increased throughout the entire evaluation period (in terms of the total number of unique visitors). However, the rate at which it grew changed over time. Positive growth in unique visitors continued from the website launch through the holiday travel and major weather events that occurred, but it was followed by a period of decline in the growth rate before returning to positive growth in the late spring and early summer near the end of the evaluation period. At that time, it became apparent that website usage could also have been affected by the regular variation in amount of travel into and out of BWI Airport that occurs each year.

While it is possible that website usage may follow air travel patterns under normal conditions, it is clear that major events such as historically high travel volume days and significant weather events certainly affect and possibly drive usage on the BWI Ground Access Information System website. In fact, the system was designed to help make airport travelers more aware of all modal options available to/from BWI and the increase in website usage observed during holidays and weather events could possibly be an indication that travelers are seeking out information on new or alternate ground transportation options to BWI Airport when high traffic volumes or bad weather prevents them from taking their normal mode. However, it is also possible that travelers are just simply more interested in trip planning information or traffic information available on the website during these events.

Website user characteristics provided insight into typical user behavior when accessing the BWI Ground Access Information System website. Trends in user frequency, trends in website visits, trends in accessing the website, and finally trends in the geographic location of users all provided valuable insight into the specific characteristics of the website user base. With almost 90 percent of users having only visited the website one time, there were very few regular or return users of the website. User frequency can often be an indicator of user acceptance and need for a website, but a number of factors may explain why recurring user need for the website appears to be so low. Possible explanations for this trend include:

- Length of Evaluation Period.
- User Travel Frequency.
- User Familiarity with Ground Transportation at BWI Airport.
- Use as an Information Source versus Use as a Trip Planner.
- Perceived Value of Website.
- Website Functionality.

There is no definitive way to determine which of these explanations is responsible for the low return rate to the website by users. Regardless, a low visit frequency does not necessarily indicate low user acceptance or usefulness, but may more so be an indicator that air travelers do not need this type of information very often or more than once.

While the mid-day hours and early days of the week saw the highest usage, there do not appear to be any explanations as to why sometimes of day or days of the week experience greater usage than others. Because the website is intended to be a pre-trip planner, it is likely that the time or day that travelers are looking into ground transportation options is not at all related to the time or day of their actual trip as most users likely access the website from their home or work computer several hours or days before their flight. Trends in the way that users access the website provide insight into how it is that users came across the website in the first place. The majority of visitors are using the links available on the BWI Airport website to find the BWI Ground Access Information System website, which indicates that the targeted marketing efforts by the project team are almost entirely responsible for the traffic driven to the website. It appears that there are very few or no other outlets advertising the website.

Lastly, trends in geographic location of users were assessed using density of visits on a map of core-based statistical areas (CBSA). A view of the map from a national perspective showed that usage expanded to several different parts of the United States. Because the BWI Ground Access Information System website was marketed on the BWI Airport website, any traveler around the country looking for more information about ground transportation options could be exposed to the trip planner if they go to the most intuitive source for that information, the airport website. A second view of the map provides a greater level of detail in the CBSAs surrounding BWI Airport where people live that probably use the airport as their primary or secondary home airport. As expected, Baltimore, Maryland and Washington, D.C. represent the largest percentage of website visits. The trends showed that the ground transportation information on the website can be useful for both travelers flying into or out of BWI Airport. It was designed to help make travelers more aware of all modal options available to/from BWI. In fact, it is possible that it is useful to those who do not live near BWI Airport because they may be less aware of all the ground transportation options offered or available. It is possible that it may be useful to those who do live near BWI Airport by providing information about options that they may not have known about previously.

4. USER PERCEPTIONS

To address several of the evaluation objectives, the evaluation team developed and conducted a web-based user survey to collect feedback from actual users of the BWI Ground Access Information System website. The web-based user survey was launched on December 10, 2009 and remained "live" until March 8, 2010.

The evaluation team began discussions about implementing a web-based user survey with the deployment team at an August 20, 2009 meeting. After discussing the evaluation plan and the possible options for surveying website users, the project team worked with the evaluation team to update and finalize a webpage layout that would allow for multiple access points to a web-based survey on the website. The planning and implementation of these access points involved both members of the project team and BWI Airport staff. Figure 4-1 shows how an individual can access the survey from the "Safe Trip" page that provides access to the trip planner.

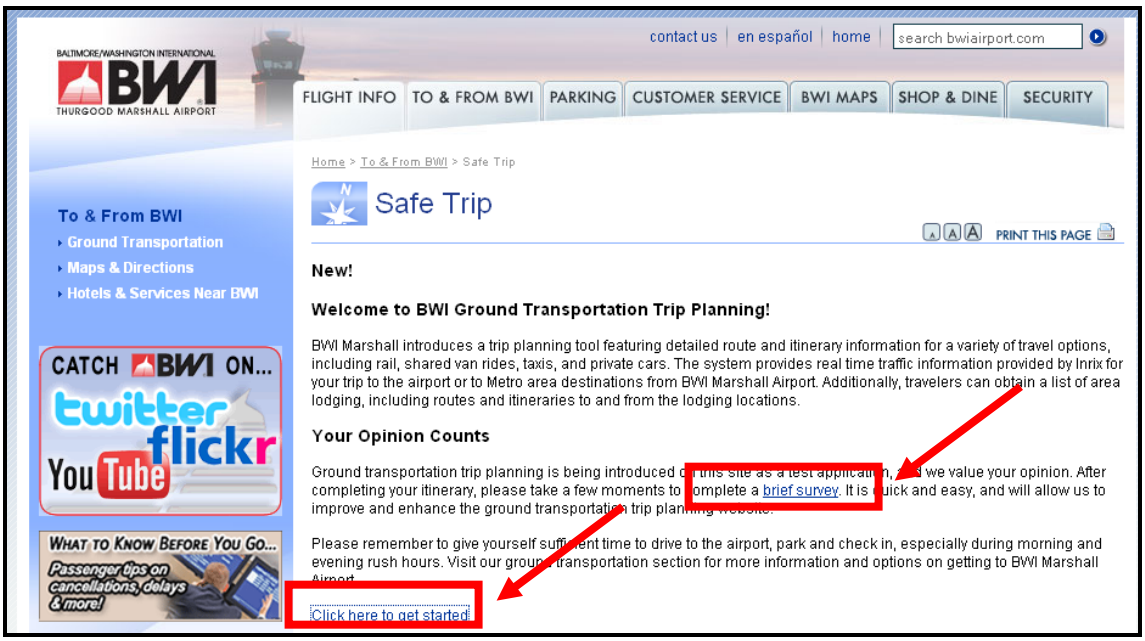


Figure 4-1. Website and Survey Access Point Available on BWI Airport "Safe Trip" Page.

Figure 4-2 and Figure 4-3 show how individuals could access the survey from the actual trip planning website. These two different links to the web-based survey were provided in an effort to capture any visitors to the website. The first view, displayed in Figure 4-2, shows the link to the web-based user survey that any visitor to the website could see upon simply loading the website. This link was intended to capture visitors who chose not to plan a trip or who were simply "checking out" the website for the first time. Figure 4-3 displays the additional access point to the web-based user survey, which appeared when users planned a new trip and an itinerary was provided. In considering these two methods for accessing the survey, it is important to note that respondents accessing the survey via the first access method could take the survey without having used the various features on the website,

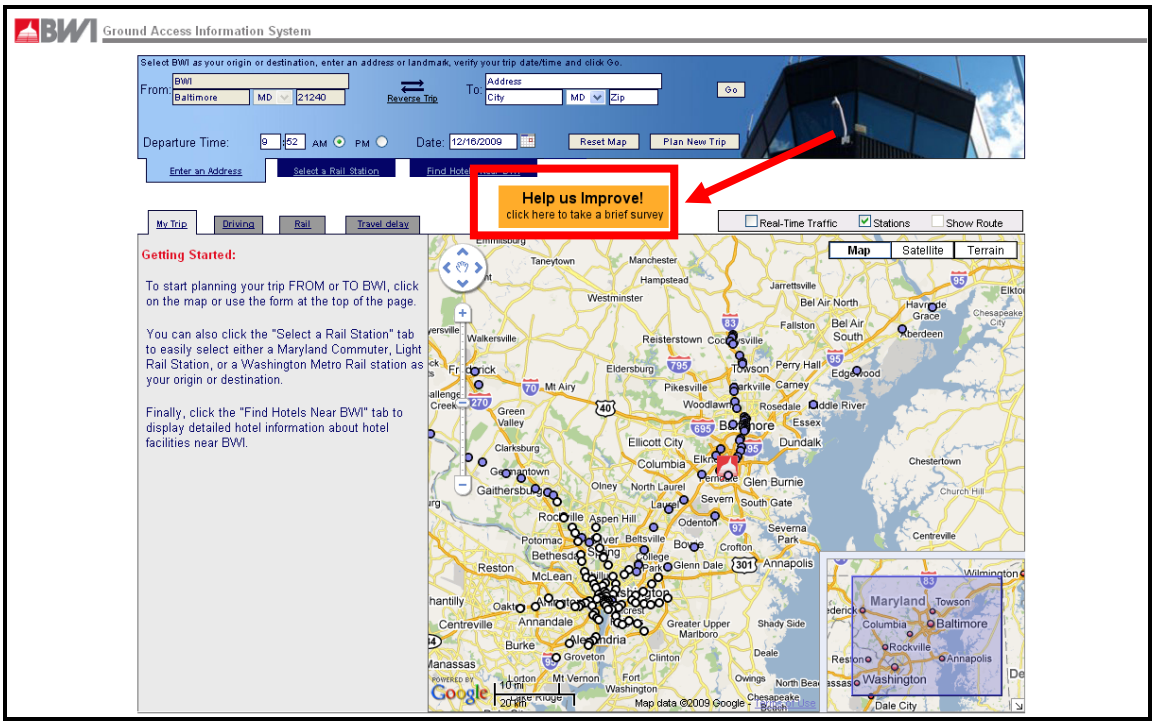


Figure 4-2. One Access Point to the Web-based User Survey without Itinerary on the BWI Ground Access Information System Website.

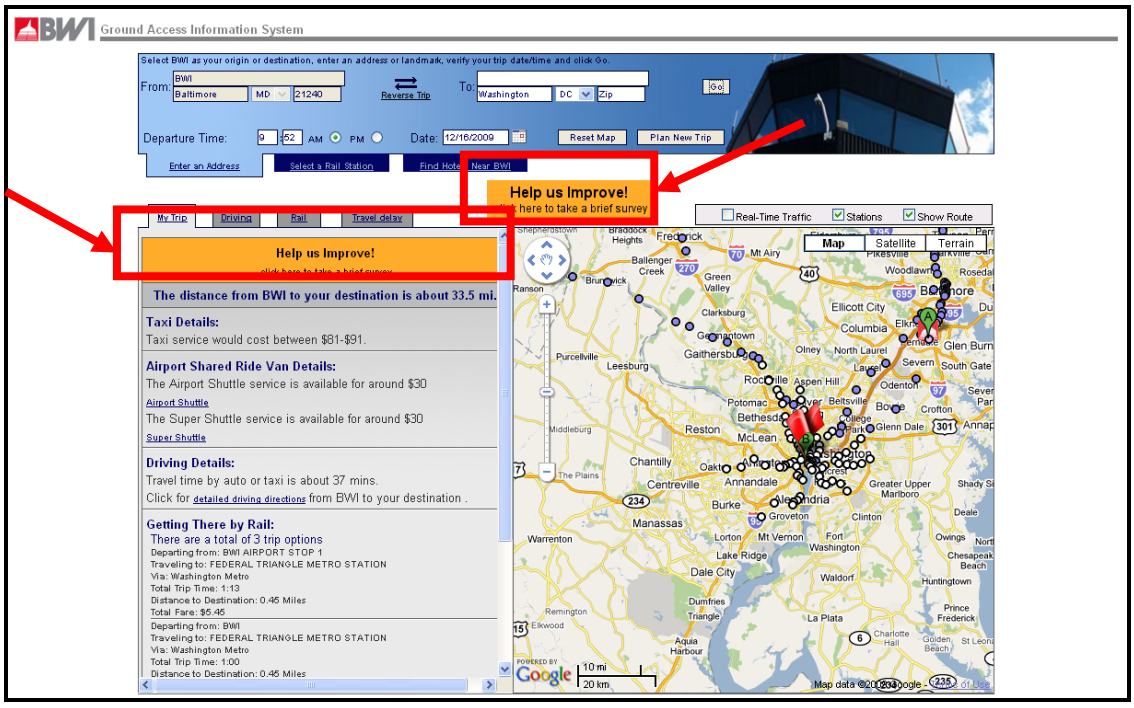


Figure 4-3. Two Access Points to the Web-based Survey with Itinerary on the BWI Ground Access Information System Website.

A final Survey Plan and Survey Instrument were submitted to USDOT on November 30, 2009. These documents described the format, content, and method for the web-based user survey. The final Survey Instrument is presented in Appendix B of this document. The survey approach is described in the following section.

4.1 Survey Approach

The specific evaluation objective addressed by the web-based user survey was to analyze users' perceived accuracy and usefulness of the BWI Ground Access Information System website. Specifically, the survey was designed to:

- Identify website usage characteristics (e.g., features used, frequency of use, reasons for use).
- Identify characteristics of the users of the website (e.g., frequency of travel from BWI – origin, frequency of travel to BWI – destination).
- Identify perceived usefulness and accuracy of modal information for trips to and from BWI (e.g., estimated travel time, estimated cost).
- Determine users' opinions regarding the functionality and usability of the website.
- Identify respondent demographics (e.g., sex, age, occupation, zip code).

The evaluation team implemented the following survey approach for the web-based user survey:

Survey Recruitment—As discussed above, visitors to the trip planner website had multiple options for accessing the user survey. The first avenue was via a button on the "Safe Trip" website, while the second was via two buttons on the trip planner website itself. One button was available to all users as soon as they navigated to the trip planner website, while the other button became available to users once they requested an itinerary. All of these links took users to the same survey on a website hosted by the evaluation team.

Survey Format—The survey was designed to be completed quickly, so that it was straightforward and low burden. The survey was comprised mainly of multiple choice/check boxes with a few opportunities for free response. While users were taking the survey, there was a progress bar along the bottom of the page showing the percent complete to give respondents feedback on where they are in the survey and to encourage them to continue through to the end.

Timeframe—The survey was available to website users December 10, 2009 to March 8, 2010.

There are two factors that are important to note when considering the survey sample. First is that the nature of the survey access points resulted in survey respondents being self-selected, which presents an inherent bias in the responses received. Second, the evaluation team determined going into the survey collection that a total of 342 surveys would need to be collected in order to obtain a statistically valid sample size (the details of this calculation were provided in the Survey Plan[11]). As shown in Table 4-1 below, the evaluation team obtained 85 completed surveys, as well as 47 partially completed surveys, for a total of 132 surveys. Partially completed surveys were defined as those where a respondent began the survey, but only completed a

[11] SAFETRIP-21 Evaluation Final Survey Plan for BWI Ground Access Information System Website: Web-Based User Survey, dated November 30, 2009.

portion or the survey. The lack of a statistically valid sample size was considered throughout the analyses, interpretations, and conclusions that follow.

Table 4-1. Total Survey Responses from November 20, 2009 to March 8, 2010.

Total Complete Surveys Collected	85
Total Partial Surveys Collected	47
Total Number of Surveys Collected	**132**

4.2 Summary of Respondent Characteristics

Survey respondents were asked to provide their home zip code and also to indicate whether they live within 100 miles of BWI airport. Exactly 50 percent of respondents indicated that they lived within 100 miles of BWI airport while the other 50 percent indicated that they live more than 100 miles away from BWI airport. Figure 4-4 presents a summary of the home zip codes of respondents. As expected, respondents are concentrated around the Baltimore area but are also scattered across the United States, much like was seen in the density maps presented in Section 3.4 that were derived from the Google Analytics™ data. This indicates that the respondents are representative of the website users, at least from a geographic perspective.

Figure 4-4. Distribution of Survey Respondents' Zip Codes.

As shown in Figure 4-5 below, the respondents were fairly evenly distributed by age. Close to 25 percent of respondents were represented across each of three categories (18-30, 41-50, and 51-60). Fewer respondents were over 60 or in the age range of 31-40.

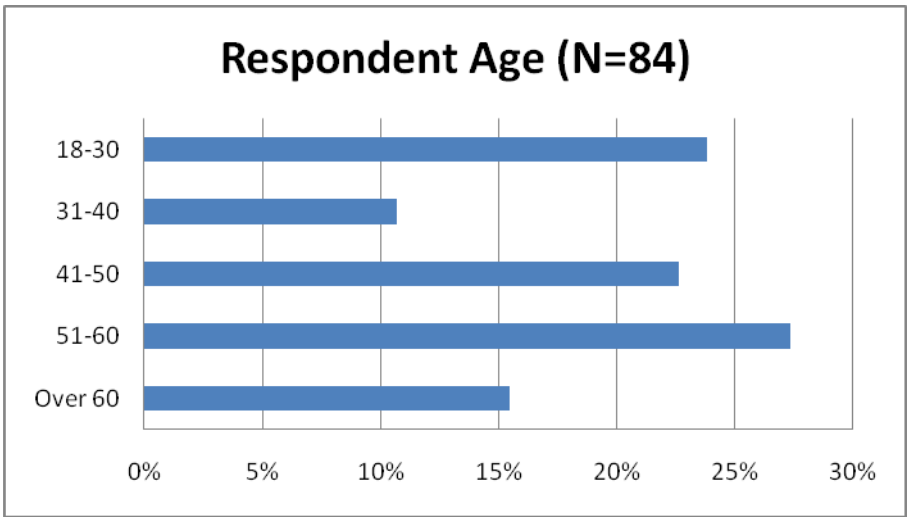


Figure 4-5. Respondent Age Distribution.

Respondents were fairly split by gender, with a greater percentage of respondents (58 percent) being female (Figure 4-6).

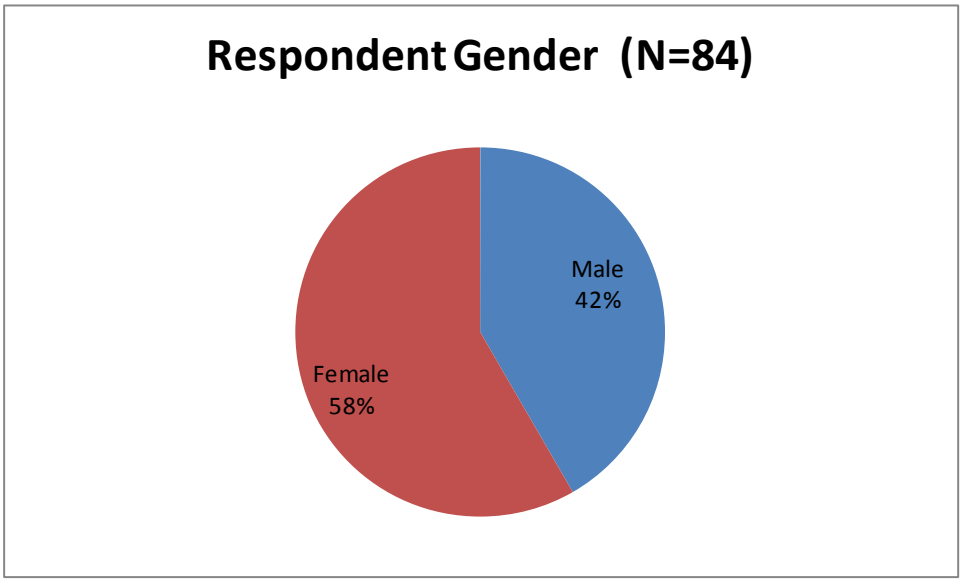


Figure 4-6. Respondent Gender Distribution.

Respondent household income distribution is shown in Figure 4-7. Over one-third of respondents (37 percent) reported a household income of greater than $100,000 per year. The next greatest category was those individuals reporting a household income of $50,000 to $74,999, with 25 percent of respondents in this category. The remaining 37 percent of respondents were fairly evenly distributed between the remaining three income categories of less than $25,000, $25,000 to $49,999, and $75,000 to $99,999.

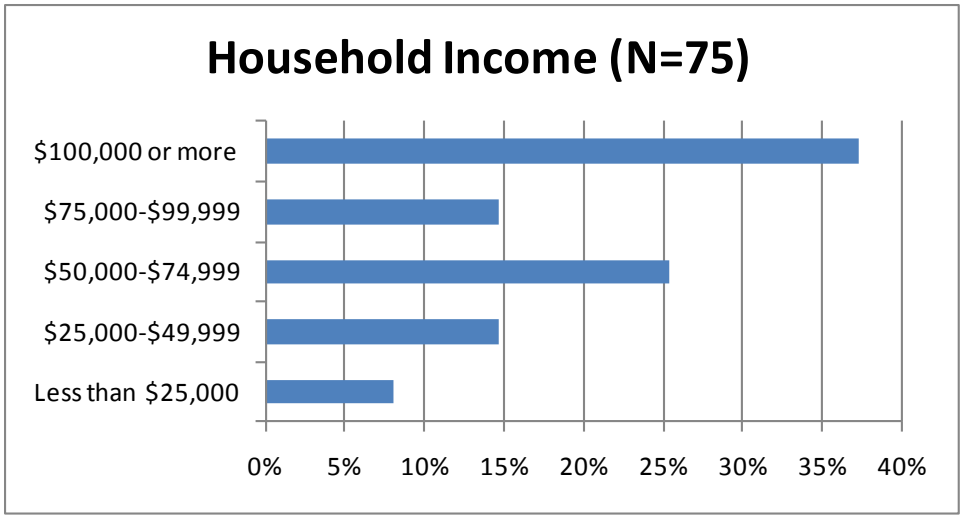


Figure 4-7. Respondent Household Income Distribution.

Figure 4-8 shows how often respondents travel in and out of BWI airport. As can be seen in the chart, the respondents represent a cross section of travelers. Just over 30 percent indicated that they travel in or out of BWI several times a year while 28 percent indicated that they have never flown into or out of BWI. Those who travel through BWI once or twice a week were not well represented (in fact, only 1 respondent out of 131 fell into this category). This is not surprising given that these individuals likely know what their options are and are not seeking out information about travel modes.

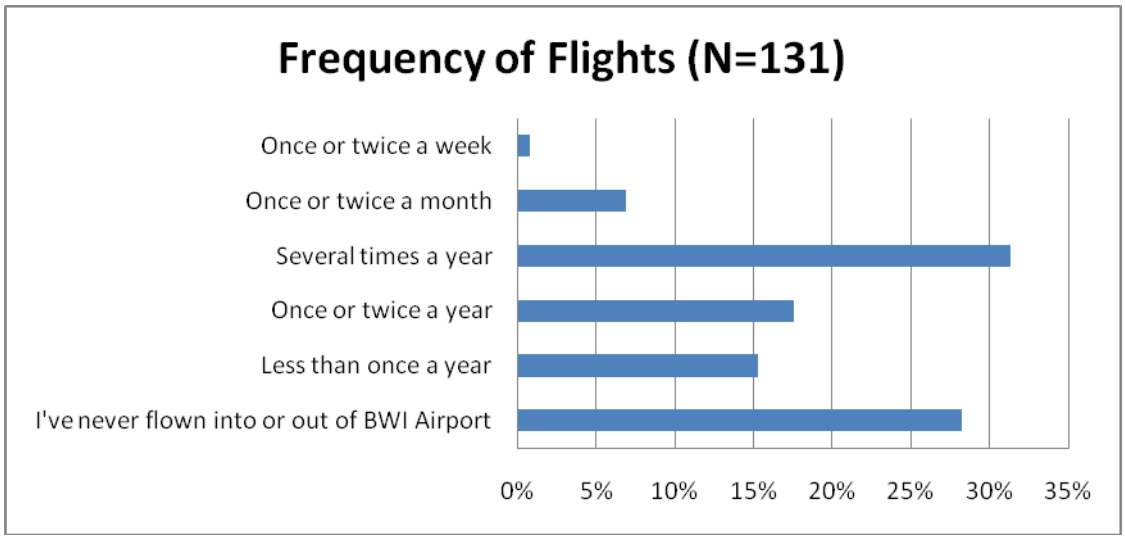


Figure 4-8. Frequency of Traveling in or out of BWI Airport.

Figure 4-9 shows what modes of travel respondents currently use most often when traveling to/from BWI. Fourteen percent indicated that they had not previously traveled to or from BWI; these individuals are not shown on the graph and are not factored into the calculations presented in the graph. Of those who indicated that they had traveled to/from BWI before, over half of respondents indicated that they most often drive and park at the airport or that someone drops them off at the airport (30 and 24 percent of respondents, respectively). Between 4 and 8

percent of respondents each indicated that they take a taxi, use a vanpool, take a hotel shuttle, take Metrorail, use MARC, or rent a car at the airport. Few indicated that they most often take a bus or use Amtrak. Overall, 20 percent of respondents who had traveled to/from BWI airport in the past indicated that they most often use some form of public transit (Metrorail, bus, MARC train, or Amtrak) to do so. Based on mode split numbers available from the airport staff, these numbers would seem to indicate that transit riders are over-represented in the survey responses as compared to the general population of travelers at BWI airport. Although this could be due to the fact that the number of survey responses obtained is not large enough to make the responses to be statistically representative of the population of website users, this is more likely an indication that public transit riders are those who are most likely to seek out this type of multi-modal traveler information.

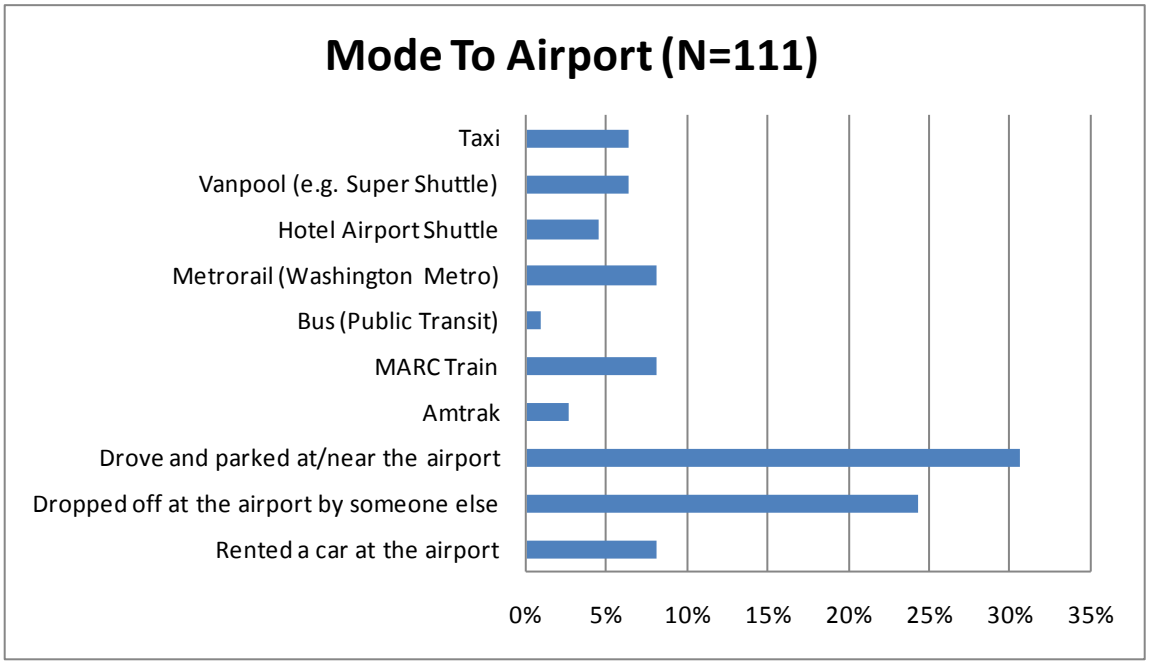


Figure 4-9. Current Mode Use of Respondents when Traveling to/from BWI Airport.

4.3 Findings

This section presents the findings of the web-based survey. Findings are presented in terms of the following:

- Reported use of the website.
- Perceptions of the website.
- Future use of the website.
- Suggestions for improving the website.

Each of these is discussed in more detail below.

4.3.1 Reported Use of the Website

As shown in Figure 4-10, the vast majority of respondents (81 percent) were visiting the website for the first time when they completed the survey. Only 19 percent of respondents reported that they were return visitors to the website at the time they completed the survey. Since the usage statics indicated that 90 percent of website visitors were return visitors, this seems to indicate that return visitors are over-represented in the survey responses. In other words, return users were more inclined to take the survey, likely due to their vested interest in providing feedback.

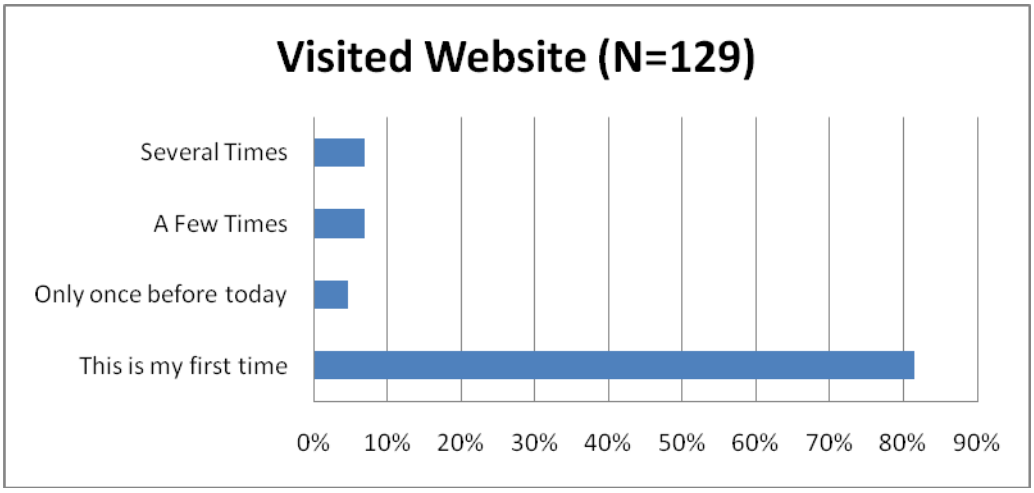


Figure 4-10. Respondents' Previous Use of the Website.

As shown in Figure 4-11 and Figure 4-12, 29 percent of respondents reported that the website informed them of a new travel option for getting to or from BWI airport and 30 percent of respondents reported that they learned of a better travel option.

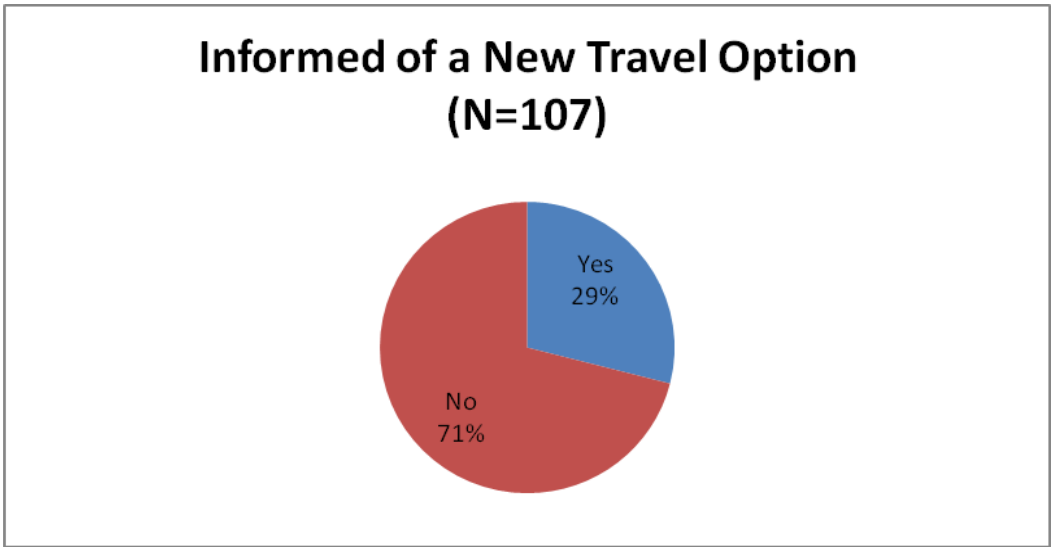


Figure 4-11. Percentage of Respondents who Indicated that the Website Informed Them of a New Travel Option.

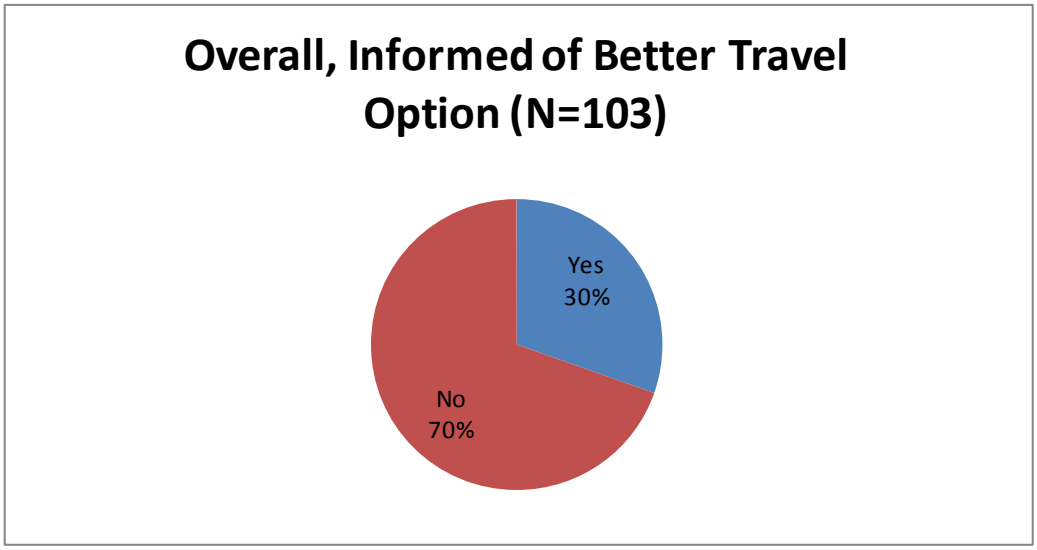


Figure 4-12. Percentage of Respondents who Indicated that the Website Informed Them of a Better Travel Option.

The respondents who either indicated that they learned of a new travel option or that they learned of a better travel option, were then asked to indicate any new mode(s) of travel the website informed them of. The responses to these questions are shown in Figure 4-13 and Figure 4-14. Note that the percentages reflected in these graphs total to more than 100 percent, as respondents were provided the option to select more than one response in order to capture all travel modes that they learned about from the website. When it came to learning about new travel options of which they were not previously aware, responses included MARC service (41 percent), Metrorail (nearly 35 percent), Amtrak (nearly 35 percent), light rail (31 percent), bus routes (21 percent), and airport shuttle buses (15 percent).

When it came to discovering a mode that is better, respondents were slightly less enthusiastic and somewhat more divided. The most common responses included light rail (26 percent), Metrorail (19 percent), MARC service (19 percent), and Amtrak (19 percent).

Of those who indicated that they learned of a new travel option, half of these individuals (11 people) reported that they tried that new option.

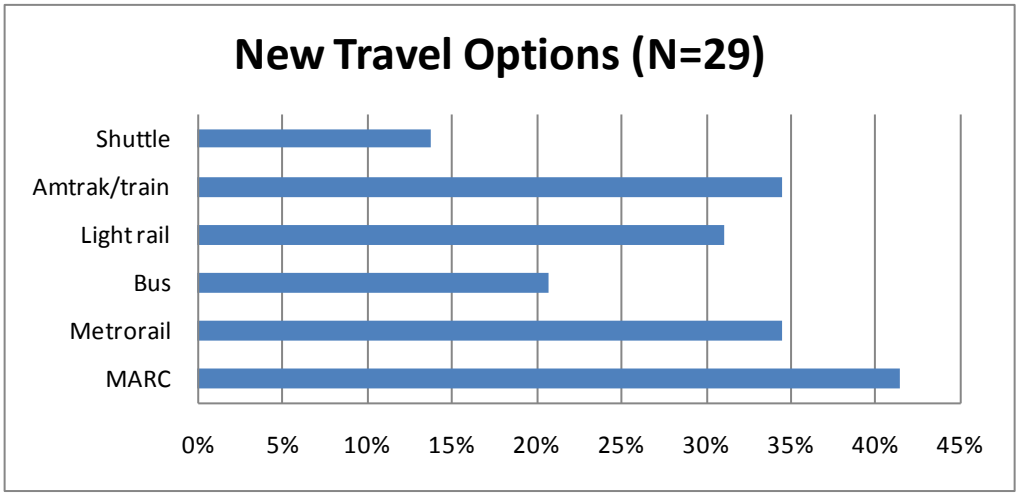


Figure 4-13. Travel Options Respondents Learned About Through the Website About Which They Had Not Known Previously.

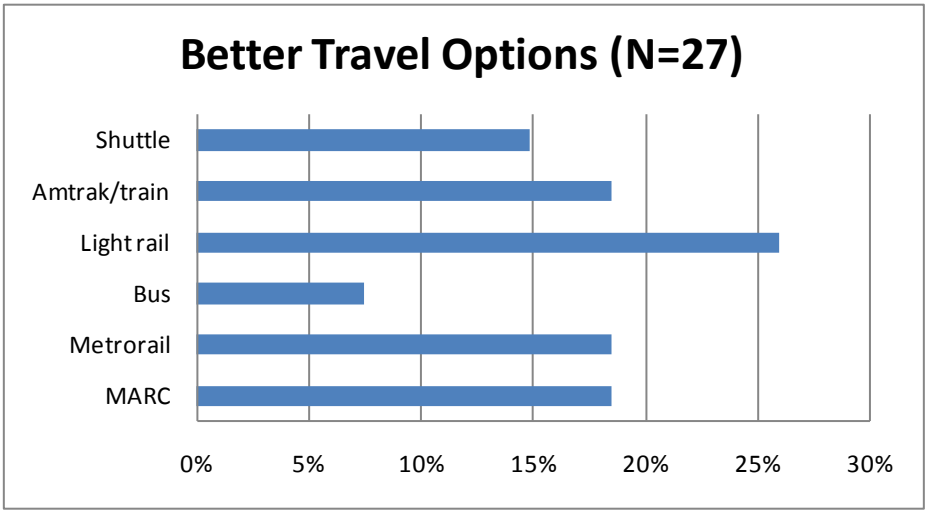


Figure 4-14. Travel Options Respondents Learned About Through the Website That They Felt Were Better Than Modes About Which They Had Known Previously.

4.3.2 Perceptions of the Website

Respondents' general perceptions of the website were explored by asking them to indicate their level of agreement or disagreement with the following six statements about the design and use of the website:

- The website provided me with the information I was looking for.
- The information on the website was well organized.
- It was easy for me to find what I was looking for on the website.
- I did not encounter any problems or frustrations while using the website.
- In my experience the information presented on the website is accurate.
- The website improves my impression of BWI.

Respondents rated each of the statements on a 5-point scale, with 1 being "strongly disagree," and 5 being "strongly agree." Note that the "strongly disagree" and "disagree" responses have been combined, and the "agree" and "strongly agree" responses have been combined. The results are shown in Figure 4-15.

The large majority of respondents agreed that the website provided them with the information that they were looking for, that the website was well organized, that it was easy for them to find what they were looking for on the website, and that the website has improved their impression of BWI airport. Over 60 percent of respondents agreed or strongly agreed with each of these four statements.

The statement that resulted in the most disagreement (40 percent of respondents) was "I did not encounter any problems or frustrations while using the website." The other statement that resulted in a large number of respondents disagreeing was "The information presented on the website is accurate." Thirty (30) percent of respondents disagreed with this statement.

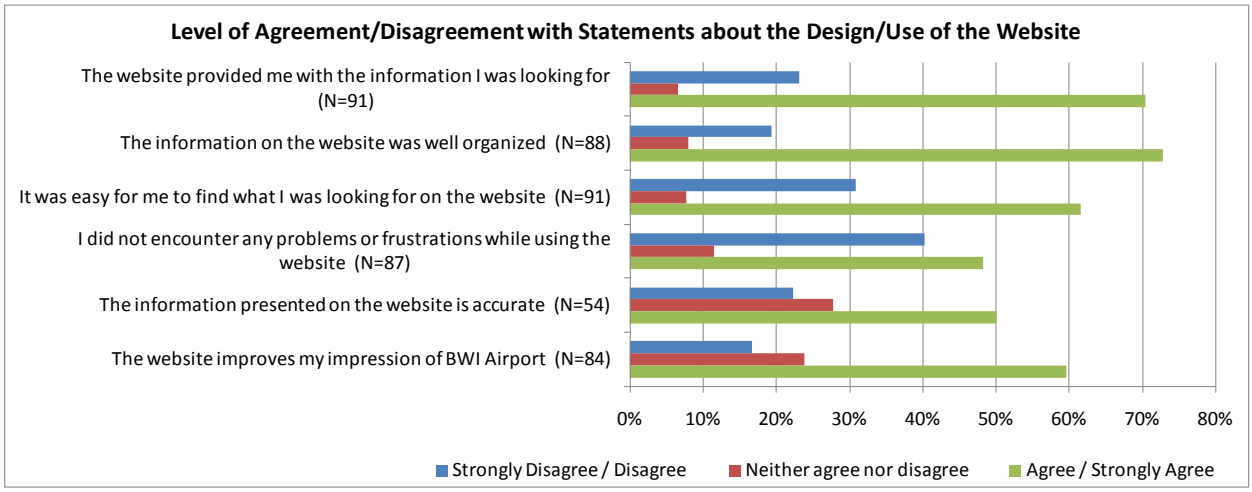


Figure 4-15. Level of Agreement/Disagreement with Statements about the Design and Use of the Website.

Despite these differences in responses to the various questions, all statements resulted in a mean rating between 3.10 and 3.77 (close to neither agree nor disagree, but tending toward agree). A summary of the mean ratings for each group and statement is shown in Table 4-2.

Table 4-2. Mean Ratings of Statements about Design and Use of the Website.

Statements about the Website	Mean Rating
The website provided me with the information I was looking for.	3.70
The information on the website was well organized.	3.77
It was easy for me to find what I was looking for on the website.	3.43
I did not encounter any problems or frustrations while using the website.	3.10
The information presented on the website is accurate.	3.35
The website improves my impression of BWI.	3.69

To assess the value that respondents see in the site was assessed by asking them to indicate their level of agreement or disagreement with the following six statements:

- The information made me aware of a travel option that could make my trip to/from BWI less stressful.
- The information made me aware of a travel option that could save me time getting to/from BWI airport.
- Based on the information, I would change the way I get to/from BWI airport.
- Use of the information has increased my satisfaction with travel to/from BWI airport.
- The ground transportation information on this website is very valuable information to have prior to traveling to/from BWI airport.
- Other major airports across the country should provide this type of ground transportation information.

Respondents rated each of the statements on a 5-point scale, with 1 being “strongly disagree,” and 5 being “strongly agree.” Note that the “strongly disagree” and “disagree” responses have been combined, and the “agree” and “strongly agree” responses have been combined. The results are shown in Figure 4-16.

The large majority of respondents agreed that the ground transportation information on this website is very valuable information to have prior to traveling to/from BWI airport and that other major airports across the country should provide this type of ground transportation information (74 and 80 percent, respectively). About half of respondents agreed that the information made them aware of a travel option that could make their trip to/from BWI less stressful, that the information made them aware of a travel option that could save them time getting to/from BWI airport, and that having this information has increased their satisfaction with travel to/from BWI airport. Although survey respondents were positive about the website in general, approximately one-third (33 percent) did not feel that they would change their mode of travel at BWI in the future, as indicated through their disagreement with the statement, “Based on the information, I would change the way I get to/from BWI airport.”

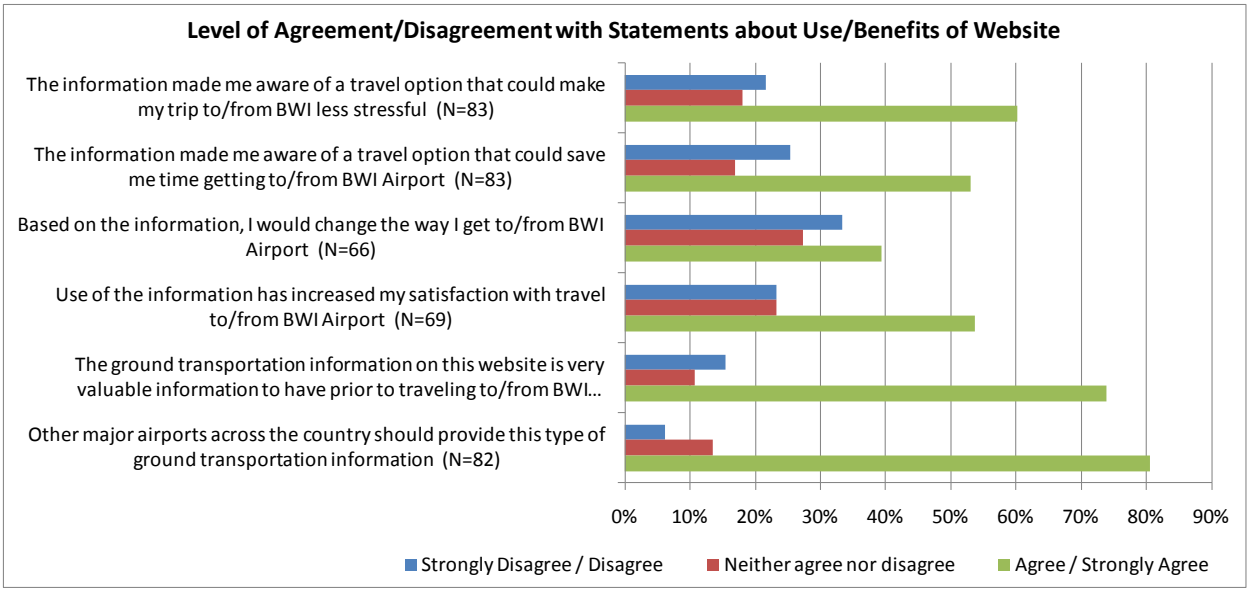


Figure 4-16. Level of Agreement/Disagreement with Statements about Use/Benefits of the Website.

A summary of the mean ratings for each group and statement is shown in Table 4-3. As was reflected in the previous graph, the statement with the lowest overall rating was the statement indicating that the individual would change the way they get to or from the airport. The statement with the highest overall rating was "Other major airports across the country should provide this type of ground transportation information."

Table 4-3. Mean Ratings of Statements about Design and Use of the Website.

Statements about the Website	Mean Rating
The information made me aware of a travel option that could make my trip to/from BWI less stressful (N=83)	3.54
The information made me aware of a travel option that could save me time getting to/from BWI Airport (N=83)	3.42
Based on the information, I would change the way I get to/from BWI Airport (N=66)	3.08
Use of the information has increased my satisfaction with travel to/from BWI Airport (N=69)	3.36
The ground transportation information on this website is very valuable information to have prior to traveling to/from BWI Airport (N=84)	3.98
Other major airports across the country should provide this type of ground transportation information (N=82)	4.30

4.3.3 Future Use of the Website

Respondents were asked to rate their likelihood for the following three actions:

- Use a travel option that you've learned about from this website.
- Visit this website again.
- Start using or continue using this website on a regular basis.

- Recommend this website to a friend or colleague.

Respondents were asked to respond on a 5-point scale, where 1 was "very unlikely" and 5 was "very likely." The results are shown in Figure 4-17. The strongest response came from respondents indicating that they were very likely to use a travel option that they learned about from the website, with 46 percent of respondents answering in this way. Forty (40) percent of respondents indicated that they were very likely (and over 30 percent were likely) to visit the website again or recommend the website to someone else. Very few (15 percent) felt that they would be very likely to start using the website on a regular basis. A large number of respondents did not feel strongly one way or another about this particular statement, with over 40 percent feeling that they were nether likely nor unlikely to start using the website on a regular basis.

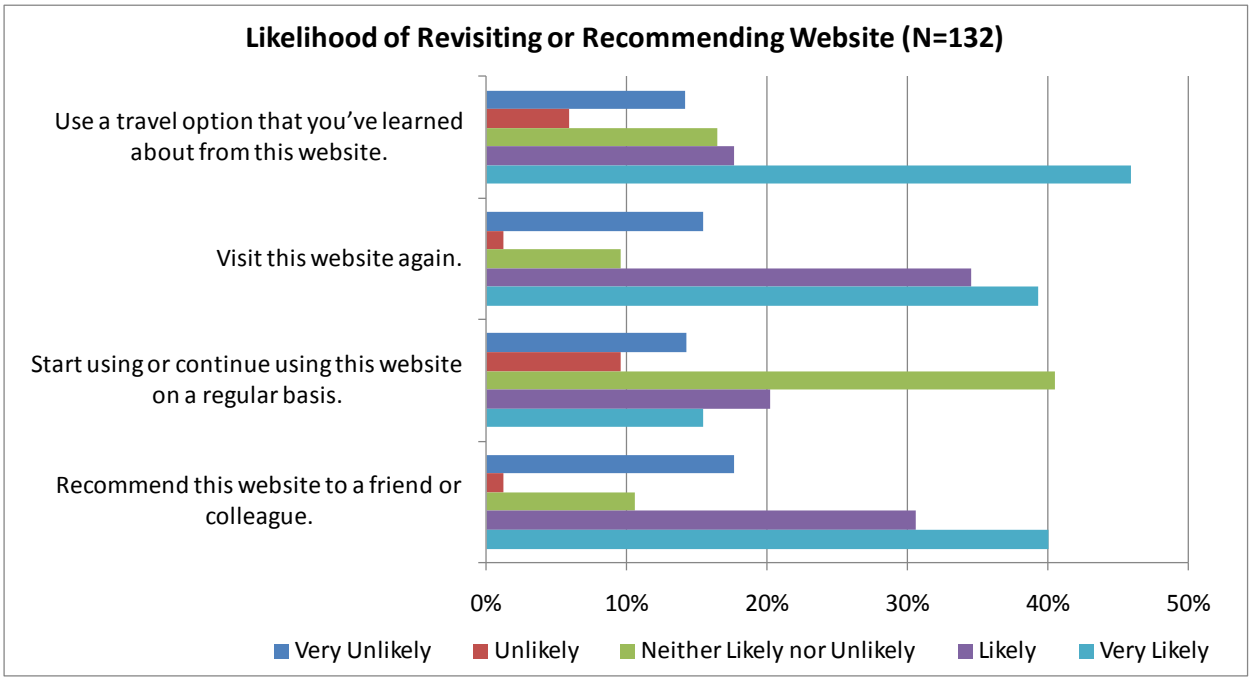


Figure 4-17. Respondents' Likelihood of Revisiting or Recommending Website.

Not surprisingly, those who have never flown into or out of BWI or who do so less than once a year were those who were most likely to respond that they were "very likely" or "likely" to use a travel option that they learned about from the website (81 percent of those who have never flown into or out of BWI or who do so less than once a year, versus 50 percent of those who fly into or out of BWI once a year or more). Similarly, these individuals were those who were most likely to indicate that they would recommend the website to someone they know (86 percent versus 58 percent). Conversely, 27 percent of those who fly in or out of BWI once a year or more indicated that they would be "unlikely" or "very unlikely" to recommend the website to someone they know, versus 8 percent of those who have never flown into or out of BWI or who do so less than once a year answering in this way. A summary of the mean ratings for each group and statement is shown in Table 4-4 for the reader's reference.

Table 4-4. Mean Ratings of Statements about Future Use of the Website Based on Frequency of Traveling in/out of BWI.

Statements about the Website	Frequency of Traveling in/out of BWI			
	Several times per year or more	Once or twice per year	Less than once per year	Never
Use a travel option that you've learned about from this website.	3.13	3.75	4.57	4.13
Visit this website again.	3.56	3.63	4.31	4.00
Start using or continue using this website on a regular basis.	3.03	3.13	3.77	2.91
Recommend this website to a friend or colleague	3.34	3.38	4.50	4.09

When considering where respondents live, less than 30 percent of those who live close to the airport (within 100 miles) were "very likely" or "likely" to use a travel option that they learned about from the website whereas nearly 90 percent of those who live more than 100 miles from the airport responded in this way. A similar pattern can be seen when looking at whether respondents are likely to recommend the website to someone they know, with only 51 percent of those living within 100 miles indicating that they would recommend the website to someone and 85 percent of those who live more than 100 miles from the airport responding in this way. Not surprisingly, those who are not from the local area are presumably not as familiar with the travel options, and are those who are most interested in this type of information. A summary of the mean ratings for each group and statement is shown in Table 4-5 for the reader's reference.

Table 4-5. Mean Ratings of Statements about Future Use of the Website Based on Where Respondents Live.

Statements about the Website	Where Respondents Live	
	Within 100 miles of BWI	Greater than 100 miles from BWI
Use a travel option that you've learned about from this website.	2.81	4.48
Visit this website again.	3.38	4.15
Start using or continue using this website on a regular basis.	2.89	3.32
Recommend this website to a friend or colleague	3.08	4.25

4.3.4 Suggestions for Improving the Website

Survey respondents were asked to provide feedback on how the website could be improved. Visitors to the traveler information website also had the opportunity to provide feedback through a link available on BWI's "SafeTrip" page, linking to the traveler information website. In total, 39 individuals elected to provide more detailed feedback in their survey response. A summary of the suggestions is shown in Table 4-6.

Table 4-6. Summary of Respondent Suggestions for Improving the Website.

Suggestions	Number of Respondents
The mechanics or design of website is inadequate	12
Allow the user to select either desired arrival time or desired departure time (instead of only having departure time) / allow the user to input flight departure or arrival time	8
Expand the coverage area (4 respondents specifically requested coverage into PA)	6
Provide enhanced information (include more public transit options, include specific directions to access buses, include rail schedules, include more detailed fare information)	6
Provide links to partners/different websites (e.g., add links to specific transit routes listed in itineraries)	4
Allow the user to plan trips far in advance of travel date	4

Aside from complaints about specific issues they encountered with the website, the most common requests were to either allow the user to input their flight departure or arrival time (and have the system automatically plan based on that), to provide the user the option to input either their desired arrival time or departure time (rather than only having the option of inputting the desired departure time), to expand the website's coverage (most often requests specifically mentioned Pennsylvania), to provide additional information such as specific directions on how to access particular bus routes, to provide links to other relevant websites, and to allow users to plan trips far in advance of their travel date.

Regarding the mechanics or design of the website itself, specific suggestions included,

- "I would like to save a trip. I'd like to be able to go back to it once I get closer to my planned travel."
- "If the Getting Started section would have said 'click your destination on the map' instead of just 'click the map' it would have saved me much frustration."
- One commented that it would be helpful to be able to select just one option among the options presented when getting ready to print the itinerary at the end of the session: "When searching on the BWI Ground Access Information System, I like how multiple options appear. It would be nice to select the option that I want and print."
- Another commented that it would be helpful to have the option to reverse the trip to plan their return trip immediately after planning the outbound trip: "The map did not allow you to readily see your return trip to BWI--I fly in, I take the train to DC, then I need it back. I had to exit the app to [do this]."

4.4 Summary

The list below summarizes the findings of the web-based survey:

- Overall respondents seem to be satisfied with the website. The large majority of respondents agreed that the website provided them with the information that they were looking for, that the website was well organized, that it was easy for them to find what they were looking for, and that the website has improved their impression of BWI airport. Over 60 percent of respondents agreed or strongly agreed with each of these four statements. Many respondents (40 percent), however, reported that they encountered

problems or frustrations while using the website and 30 percent did not feel that the information presented on the website is accurate.

- The large majority of respondents agreed that the information provided on the website is very valuable information to have prior to traveling to/from BWI airport and that other major airports across the country should provide this type of ground transportation information (74 and 80 percent, respectively). About half of respondents agreed that the information made them aware of a travel option that could make their trip to/from BWI less stressful, that the information made them aware of a travel option that could save them time getting to/from BWI airport, and that having this information has increased their satisfaction with travel to/from BWI airport.
- Nearly half of respondents (46 percent) felt that they were very likely to use a travel option that they learned about from the website. Seventy (70) percent of respondents indicated that they were likely or very likely to visit the website again or recommend the website to someone else, although very few (15 percent) felt that they would be very likely to start using the website on a regular basis. Those who have never flown into or out of BWI or who do so less than once a year were those who were most likely to respond that they were likely or very likely to use a travel option that they learned about from the website (70 percent). Similarly, these individuals were those who were most likely to indicate that they would recommend the website to someone they know.

5. DEPLOYMENT EXPERIENCE ASSESSMENT

The evaluation team interviewed the project partners in October and November 2010 about their deployment experience with the project, and this section of the report includes the findings of these interviews.

5.1 The Design and Development of the System

The design and development of the system began with the application for funding. By late December 2008, shortly after funding was approved, the I-95 Corridor Coalition had already prepared a presentation that described the proposed system and included prototype screenshots, similar to that shown in Figure 5-1.

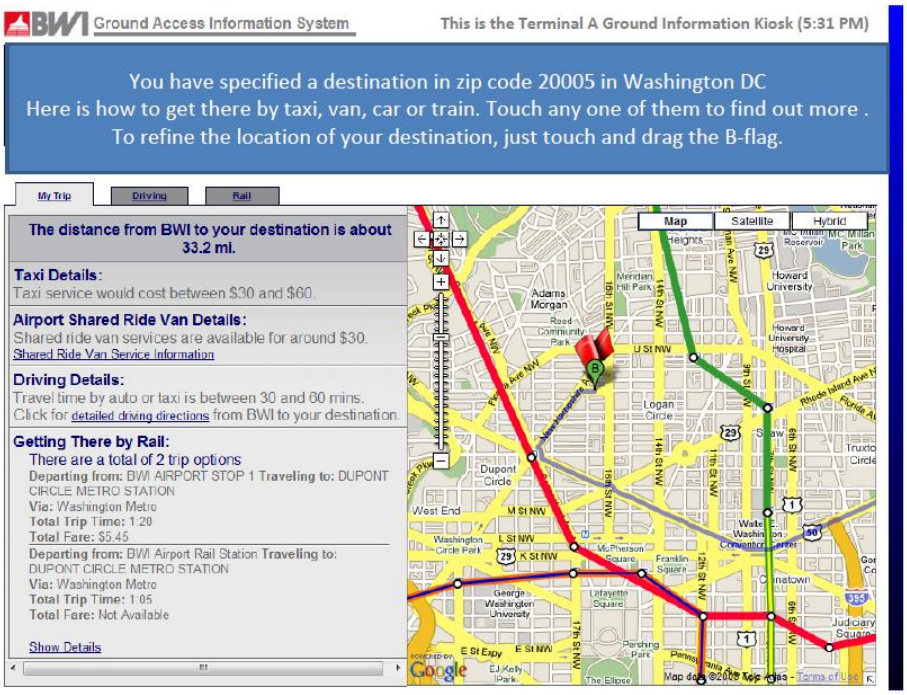


Figure 5-1. Prototype Screenshot for a Presentation in December 2008.[12]

At this early date, most of the key attributes of the proposed system were already present:

- The use of Google® maps to depict locations and travel routes.
- A panel on the left side of the interface displaying travel options for a selected destination (or origin, if traveling to BWI).
- Travel options, including taxi service, airport shuttle service, personal vehicle, and rail.
- Tabs on the left side of the interface that can be used to get additional information about any of the travel options presented.

While some of these features changed during development (e.g., the method for specifying the trip destination), the general concept and the look-and-feel of the user interface did not change.

[12] Source: http://www.i95coalition.org/i95/Portals/0/Public_Files/pm/reports/2008_1222_I95CC%20SafeTrip.pdf

In March 2009, a Software Functional Requirements document was completed. Most of these requirements were translations of functionality that was apparent in the screen prototypes from the presentation into testable, text requirements. For example, the regional map display in the prototype screen was converted into the following five requirements:

- Standard map interactions shall include Zoom In.
- Standard map interactions shall include Zoom Out.
- Standard map interactions shall include Panning.
- The map shall determine latitude and longitude for points selected on the map by mouse clicks.
- Map layers will be provided to display rail stops, start and end points and proposed driving routes.

The requirements identified differences in the functionality that would be provided by the three versions of the system – the public website, the kiosk, and the mobile devices website. The requirements also specified capabilities for tracking website usage and for administering surveys of site users.

The next step in the development process was the Design Specification. This document provided a detailed description of the system design, including specification, assumptions, constraints, architectures, activity flows, class diagrams, sequence diagrams, and database schemas. It was a very detailed description of the system design. Development based on these designs led to launch of the website on October 14, 2009 and activation of a link from the BWI Airport website to the system. This website included all of the planned system functionality. The remaining tasks were tailoring the system for display on mobile devices and developing the kiosk system.

At approximately the same time, US DOT conducted a review of the potential for the planned SafeTrip applications to result in distracted drivers. In February 2010, changes to the mobile device application were requested to reduce the potential for site usage to result in distracted driving. These modifications included:

- Inclusion of a message warning against using the system while driving.
- Change of the activity flow by presenting current delay information before allowing request of itinerary information.
- Removal of the turn-by-turn directions from the mobile application.
- Removal of the ability to pan or zoom on the map and the real-time traffic information, so that users could not use the application to navigate roadways or view traffic congestion while driving.

The kiosk was deployed in April 2010, but was removed in June 2010 for the following reasons:

- A desire to move the kiosk to a location with higher foot traffic. The original site selection was made, in part, because of the availability of power and internet connectivity at the selected location. While this reduced the cost of deploying the kiosk, it also limited usage since the location that was selected was not in an area with particularly high foot traffic (relative to other locations within the airport).
- Concerns about security and safety. In particular, there were concerns that the kiosk was top-heavy and had the potential to tip. There were also concerns about the potential for

users to circumvent the system and use the kiosk to access the Internet, potentially accessing inappropriate content.

- Concerns about kiosk maintenance. It was unclear who was responsible for maintaining the kiosk. Maintenance was required to (a) replenish printer paper, (b) clear printer jams, and (c) restore power if the kiosk was unplugged.

In July 2010, the link from the BWI Airport website to the Airport Ground Access Information System website was removed following a request from BWI airport staff to update the BWI Ground Access Information System to include additional information about the various bus routes that serve the airport.

5.2 Keys to Providing Multi-Modal Trip Planning Capabilities

A key feature of the Airport Ground Access Information System was the integration of traveler information for many different travel modes into a single system. In fact, this system is one of the first multi-modal airport planning tools ever to be developed.

Integrating data from numerous sources can present challenges in terms of the amount of customized software development that is required to receive the data in various formats and manipulate it to incorporate it into one system. In the case of the Airport Ground Access Information System many of the data sources did require development of custom routines. For example, taxi and shuttle service cost information was obtained from BWI and the shuttle services, and was loaded into the database to support the system. Custom routines were then developed to estimate the costs of trips to and from BWI. Similarly, service routes and schedules for Amtrak and MARC services had to be coded into the system databases to provide users with information about Amtrak and MARC services.

What is key to a project such as this where multiple data sources must come together seamlessly is to look for opportunities to make use of any synthesized data already available from other systems. In many cases the exact data may already be available, eliminating the need to receive and manipulate raw data. Many agencies and organizations are moving toward open source data, making this an even easier feat. The Airport Ground Access Information System leveraged the following tools and data available from other systems:

- The system leveraged the Google® map service to display maps to users and provide turn-by-turn navigation.
- The system provided real time delay information by using travel time data that was already available to the I-95 Corridor Coalition through other projects.
- The system provided information about Metrorail through an Application Program Interface (API) that allowed requests for rail information to be made directly to WMATA systems.

5.3 Keys to Deploying A Kiosk in an Airport Environment

Most of the issues related to the airport kiosk can be traced to the focus on the normal operations of the Airport Ground Access Information System itself rather than the potential for non-normal operations. This is an important aspect to consider given the fact that the system would be physically integrated into a high traffic airport environment.

For example, the requirements document for the system described the system functional requirements. It did not define operational requirements, such as the need to periodically replace

paper and to prevent users from bypassing the planned information system to access the Internet directly. Project staff identified the following lessons learned regarding deploying a kiosk in an airport environment:

- Vet the system design with various departments within the airport including the marketing department to ensure that the plans are consistent with airport contracts for advertising transportation services.
- Design the system such that it prevents tampering or bypassing the planned functionality to access the Internet.
- Plan to stabilize the kiosk in some fashion to avoid any risk of the kiosk tipping over. This can be accomplished either by weighting the bottom of the kiosk or by bolting it in place.
- Plan to either place the kiosk directly in front of or above the power outlet. It is important that the power cord not present a trip hazard and that it not be easily unplugged. If possible, the kiosk should be placed directly in front of the power outlet or over a floor outlet so that the cord is not exposed and the system cannot be unplugged without moving the kiosk. Also, if possible, the electrical supply should be secured within the wall such that it cannot be unplugged.
- Develop plans for maintaining the kiosk (e.g., replacing paper, clearing paper jams, rebooting a hung system) and assign a responsible party including the organization and the responsible party within that organization.
- Establish a formal written agreement or memorandum of understanding between all involved parties, including those who will maintain the unit.

For a remote system that is not easily monitored by a staff person, it is important that the system requirements address potential system failures. Considering ways in which a system might fail and how the system will respond to those failures can result in a more robust system. Some examples related to the Airport Ground Access Information System are:

- Ensure that the system design covers how the system should behave if there is a loss of internet access. An appropriate response might be to display a message to a user asking them to report the problem.
- Ensure that the system design covers how the system should behave if there is a loss of electrical power. In this case, the challenge is identifying that a problem exists since the kiosk site is not staffed. One approach would be to have the kiosk periodically ping the system server to indicate that it is still operational. If the server did not receive this ping, the server could transmit an error message to a system administrator.
- Ensure that the system design covers how the system should behave if it runs out of paper. Some printers report printer problems to the system to which they are connected. The kiosk software could then transmit this information to the system server for reporting to a system administrator.

5.4 Summary

Thanks to the cooperation of the I-95 Corridor Coalition Field Operational Test project team, the evaluation team was able to contact the project stakeholders to obtain detailed feedback regarding the design, deployment, and operation of the BWI Ground Access Information System. The Deployment Experience Assessment resulted in the collection and documentation of best practices and lessons learned for each phase of the project.

This particular field test application of the I-95 Corridor Test Bed did not go as smoothly as the other I-95 field test applications. The primary reasons for this can be attributed to the numerous complexities associated with deploying a physical piece of equipment on airport property, and in particular, not having a formal written agreement between the airport and the deployment team. Although all elements of the project may not be viewed as a success, the challenges the project stakeholders faced during the course of this project serve as valuable lessons learned for practitioners considering similar deployments in the future.

6. SUMMARY AND CONCLUSIONS

This document has presented the evaluation strategies and objectives, the data collection methodologies, and the results of the evaluation of the BWI Ground Access Information System, a system which was designed to provide trip planning information via a website, mobile website, and airport kiosk, for individuals traveling to or from BWI airport.

6.1 Summary

The results are summarized below according to three categories:

- Understand the institutional issues associated with making airport ground transport information available to the public.
- Understand perceptions of the system and use of the system.
- Analyze the changes in airport ground transportation mode usage.

6.1.1 Understand the institutional issues associated with making airport ground transport information available to the public

The first objective of the evaluation was to understand the technical and institutional issues associated with deploying an airport ground transportation information system. A number of interesting findings were uncovered through the evaluation that will provide lessons learned for future deployments. Findings are discussed below.

One key to success with the Airport Ground Access Information System is that the project team looked for opportunities to make use of any synthesized data already available from other systems. In many cases the exact data needed for the system may already be available, eliminating the need to receive and manipulate raw data. For a multi-modal trip planner there is a particular need for multiple data sources to come together seamlessly, and making use of already developed tools that compile these data can save a large amount of time and money. Many agencies and organizations are moving toward open source data, meaning that this will be a more common occurrence in the future.

When deploying equipment in an environment like an airport, there can be many challenges not encountered when deploying ITS technologies in other environments. For example, the stakeholders who need to be involved to deploy a piece of technology in an airport can be quite diverse. Not all players may be obvious at first and all are not likely to have a background or interest in transportation. As a result it is important to work with the airport staff early on to identify all potential stakeholders and to have a formal written agreement or memorandum of understanding between all involved parties, including those who will maintain the unit. Involving all stakeholders early can allow them to voice opinions up front for inclusion in the system requirements.

Another challenge with an airport environment is that it may not be possible to identify a location that can be monitored by a staff person. In the case of this project, the kiosk was not able to be regularly monitored, and the system designers found that it was important to plan for any possible problems. For example, it is important to consider the need to periodically replace paper and to prevent users from bypassing the planned information system to access the Internet directly. Considering ways in which a system might fail and how the system will respond to those failures can result in a more robust system.

6.1.2 Understand Perceptions of the System and Use of the System

Three of the evaluation objectives tie to gaining an understanding of perceptions of the system and use of the system:

- Analyze the perceived accuracy and usefulness of the three interfaces of the airport ground transport travel information.
- Determine whether airport ground transport travel information improves awareness of travel options out of the airport.
- Understand the needs of customers with respect to airport ground transport travel information.

Findings related to each of these objectives follow.

Assessing Perceptions of the Accuracy and Usefulness of the Airport Ground Transport Travel Information System

Usefulness can be gauged in part based on whether visitation to the website increases over time. The BWI Ground Access Information System website experienced steady growth after its initial launch in October 2009 followed by periods of ups and downs in growth through the end of the evaluation period in June 2010. The initial launch was effective in growing the website user base and in establishing initial airport traveler exposure. The additional targeted marketing efforts including advertisements on the BWI Airport website home page were effective in continuing growth in the website user base and number of visits to the website. Interestingly, while there were several factors that were affecting website usage simultaneously, it appears that using Twitter specifically may have been an effective marketing tool in increasing awareness of the website as well. Severe weather events also drove up website usage, which indicates that travelers looked to the website for alternate transportation options at times when driving may not be a desirable option for getting to/from BWI Airport.

The number of return visitors to a website is typically another indicator of the perceived usefulness of the site. However, in the case of the BWI Ground Access Information System website, this may not be the best indicator. A low visit frequency may instead be an indicator that air travelers do not need this type of information very often or more than once. Furthermore, it could be argued that the website provides the most value to those who travel less often and who are therefore not as familiar with the airport and the various travel options there. With nearly 90 percent of users having only visited the website one time, there were very few regular or return users of the website. This is further supported by the survey data. Those who travel through BWI once or twice a week were not well represented (in fact, only 1 respondent out of 131 fell into this category).

Overall respondents seem to be satisfied with the website. The large majority of respondents agreed that the website provided them with the information that they were looking for, that the website was well organized, that it was easy for them to find what they were looking for on the website, and that the website has improved their impression of BWI airport. Over 60 percent of respondents agreed or strongly agreed with each of these four statements. Many respondents (40 percent), however, reported that they encountered problems or frustrations while using the website and 30 percent did not feel that the information presented on the website is accurate.

The large majority of respondents agreed that the information provided on the website is very valuable information to have prior to traveling to/from BWI airport and that other major airports across the country should provide this type of ground transportation information (74 and 80 percent, respectively). About half of respondents agreed that the information made them aware of a travel option that could make their trip to/from BWI less stressful, that the information made them aware of a travel option that could save them time getting to/from BWI airport, and that having this information has increased their satisfaction with travel to/from BWI airport.

Nearly half of respondents (46 percent) felt that they were very likely to use a travel option that they learned about from the website. Seventy (70) percent of respondents indicated that they were likely or very likely to visit the website again or recommend the website to someone else, but very few (15 percent) felt that they would be very likely to start using the website on a regular basis. Those who have never flown into or out of BWI or who do so less than once a year were those who were most likely to respond that they were likely or very likely to use a travel option that they learned about from the website (70 percent). Similarly, these individuals were those who were most likely to indicate that they would recommend the website to someone they know.

Assessing Ability of Airport Ground Transport Travel Information System to Improve Awareness of Travel Options to/from BWI Airport

Respondents were directly asked whether the website informed them of a new travel option for getting to or from BWI airport or whether it informed them of a better travel option (as compared to the modes of which they were previously aware). Approximately one-third of respondents (29 percent) reported that the website informed them of a new travel option for getting to or from BWI airport and 30 percent reported that it informed them of a better travel option. The most common travel option that respondents learned about was the MARC service at the airport (41 percent). Other common responses were: Metrorail (nearly 35 percent), Amtrak (nearly 35 percent), light rail (31 percent), bus routes (21 percent), and airport shuttle buses (15 percent). Respondents were slightly less enthusiastic and somewhat more divided when indicating the travel options they learned about that were better than the modes of which they were previously aware. The most common responses included light rail (26 percent), Metrorail (19 percent), MARC service (19 percent), and Amtrak (19 percent). Of those who indicated that they learned of a new travel option, half of these individuals (11 people) reported that they tried that new option. With approximately one-third of the website visitors having learned about a new or better travel option, and with the “new” or “better” options spanning the variety of modes available at BWI, the survey results seem to indicate that the website does, in fact, increase awareness of alternate travel options.

Assessing Customer Needs with Respect to the Airport Ground Transport Travel Information

Customer needs can best be accessed through the suggestions for improvement that they offered on their survey responses. Suggestions included:

- Allow the user to input their flight departure or arrival time (and have the system automatically plan based on that).
- Provide the user the option to input their desired arrival time (rather than only having the option of inputting the desired departure time).
- Provide enhanced information (e.g., allow for more origins/destinations, include more public transit options, and include specific directions to access buses).
- Provide the opportunity to save a trip for later reference.

- Provide the opportunity for the user to select one option once presented with itinerary options to facilitate printing the itinerary of choice.
- Provide the option to reverse the trip to plan a return trip immediately after planning an outbound trip.
- Expand the site to allow for trips to/from Pennsylvania.

6.1.3 Analyze the changes in airport ground transportation mode usage

The final objective of the evaluation was to explore changes in mode use to/from the airport as a result of the trip planning system. Although the evaluation team obtained mode usage data with the intention of comparing mode usage before and after the system was deployed to determine any impact, that analysis is not presented as it was determined that any slight change in mode usage as a result of the system would not be discernable due to the extremely high number of travelers that travel through BWI airport each day and due to the limited duration of the test period. The airport sees approximately 2 million travelers during an average month while the website only experienced 2,400 visitors per month on average for the 9 months that it was available to the public. Additionally, the mobile website and kiosk were only available for a short time.

Based on travel data obtained from BWI airport, fewer than 5 percent of BWI travelers use public transit or an airport shuttle to get to or from the airport. Only 9 percent of survey respondents indicated that they tried a new mode after learning about it from the website. If it is conservatively assumed that the survey responses are representative of the population of website users, and if it assumed that website usage would remain constant over time, this would only account for a total of 7 individuals taking an alternate mode each day (after having learned about it from the website), or a 0.26 percent increase in ridership on alternate modes. Given the variability in the ridership on any given mode from day to day, a change of this magnitude would not be discernable.

6.2 Conclusions

Based on the evaluation results, the following conclusions are made:

- It appears that the additional targeted marketing efforts including advertisements on the BWI Airport website home page were effective in continuing growth in the website user base and number of visits to the website. In particular, it appears that using Twitter specifically was an effective marketing tool in increasing awareness of the website.
- Severe weather events drove up website usage, indicating that travelers looked to the website for alternate transportation options at times when driving may not be a desirable option for getting to/from BWI Airport.
- With nearly 90 percent of users having only visited the website one time, there were very few regular or return users of the website. This may be an indicator that air travelers do not need this type of information very often or more than once. This may also be an indication that those who travel less often, and who are therefore not as familiar with the airport and the various travel options there, perceive more value in the information. This is further supported by the survey results which indicated that 70 percent of respondents were likely or very likely to visit the website again or to recommend the website to

someone else, but very few (15 percent) would be very likely to start using the website on a regular basis.

- Website visitors seem satisfied with the website overall. The large majority of respondents agreed that the website provided them with the information that they were looking for, that the website was well organized, that it was easy for them to find what they were looking for on the website, and that it has improved their impression of BWI airport. Over 60 percent of respondents agreed or strongly agreed with each of these four statements. Many respondents (40 percent), however, did report encountering problems or frustrations while using the website and 30 percent did not feel that the information presented on the website is accurate.
- The large majority of respondents agreed that the information provided on the website is very valuable information to have prior to traveling to/from BWI airport and that other major airports across the country should provide this type of ground transportation information (74 and 80 percent, respectively).
- The website did succeed in informing some users of new travel options for getting to/from BWI airport. Approximately one-third of respondents (29 percent) reported that the website informed them of a new travel option and 30 percent reported that it informed them of a better travel option. Of those who indicated that they learned of a new travel option, half of these individuals (11 people) reported that they tried that new option. Overall the survey results seem to indicate that the website does, in fact, increase awareness of alternate travel options.
- Nearly half of respondents (46 percent) felt that they were very likely to use a travel option that they learned about from the website. Those who were less familiar with BWI (i.e., those who have never flown into or out of BWI or who do so less than once a year) were most likely to respond that they were likely or very likely to use a travel option that they learned about from the website (70 percent).

From an institutional perspective, much can be learned from this pioneering effort to deploy a multi-modal traveler information system that includes deploying a kiosk in an airport environment. The airport environment itself poses challenges not encountered in other locations. Due to the fact that the kiosk is not staffed, it is critical that the system requirements address how the system will function during non-normal operating modes to reduce the likelihood for failures (or to at least reduce down-time if failures occur). Working with an airport, it is important to identify all potential stakeholders within the airport early on and also to establish a formal written agreement or memorandum of understanding between all involved parties, most important those who will maintain the unit. Another key institutional lesson is to look for opportunities to make use of any synthesized data already available. This is especially important when pulling diverse data sets from multiple organizations, as is the case with a multi-modal traveler information system. As more and more agencies and organizations move toward open source data, there will be increasing opportunities for this type of cost savings in the future.

APPENDIX A: EXAMPLE BWI GROUND ACCESS INFORMATION SYSTEM ITINERARIES

Driving tab Itinerary – Example Trip – BWI Airport to Washington, D.C.

ITINERARY PREVIEW

Print Page

BWI Airport (BWI), Linthicum Heights, MD 21090

33.5 mi (about 51 mins)

1. Head northeast on Elm Rd toward Gov Harry R Hughes Dr	0.7 mi
2. Continue onto I-195 W	1.5 mi
3. Take exit 2B for MD-295 S/Balt/Wash Pkwy toward Washington	0.3 mi
4. Merge onto MD-295 S/Baltimore-Washington Pkwy	23.7 mi
5. Take the exit onto US-50 W/New York Ave NE toward Washington Entering District of Columbia	5.2 mi
6. Turn left at 6th St NW	0.8 mi
7. Turn right at Constitution Ave NW	0.9 mi
8. Turn right at 16th St NW Partial restricted usage road	194 ft
9. Turn left at Ellipse Rd NW Restricted usage road Destination will be on the right	0.3 mi

Ellipse Rd NW

Map data ©2010 Google

Rail tab Itinerary – Example Trip – BWI Airport to Washington, D.C.

Print Page

ITINERARY PREVIEW

Option 1
Departing from: BWI AIRPORT STOP 2
Traveling to: FEDERAL TRIANGLE METRO STATION
Total Trip Time: 1:18
Walk to final Destination: 0.45 Miles
Total Fare: $9.00

Depart at BWI AIRPORT STOP 2 at 11:39 AM. Arrive at GREENBELT STATION & BUS BAY D at 12:09 PM.	B30 Metro Bus	
Depart at GREENBELT METRO STATION at 12:18 PM. Arrive at L'ENFANT PLAZA METRO STATION at 12:46 PM.	Green Line	
Depart at L'ENFANT PLAZA METRO STATION at 12:53 PM. Arrive at FEDERAL TRIANGLE METRO STATION at 12:57 PM.	Orange Line	

Option 2
Departing from: BWI Airport Rail Station (Accessed by MARC shuttle)
Traveling to: PENNSYLVANIA AVE & 13TH ST
Total Trip Time: 1:12
Walk to final Destination: 0.45 Miles
Total Fare: $7.70

Depart at BWI Airport Rail Station (Accessed by MARC shuttle) at 11:56 AM. Arrive at Washington Union Station - MARC at 12:35 PM.	MARC 425 Penn Line	
Depart at COLUMBUS CIRCLE NE & FIRST ST NE at 12:54 PM. Arrive at PENNSYLVANIA AVE & 13TH ST at 1:08 PM.	D6	

Option 3
Departing from: BWI Airport Rail Station (Accessed by MARC shuttle)
Traveling to: PENNSYLVANIA AVE & 13TH ST
Total Trip Time: 0:59
Walk to final Destination: 0.45 Miles
Total Fare: Not Available

Depart at BWI Airport Rail Station (Accessed by MARC shuttle) at 12:30 PM. Arrive at Washington - Union Station at 12:59 PM.	Amtrak 141	
Depart at COLUMBUS CIRCLE NE & FIRST ST NE at 1:15 PM. Arrive at PENNSYLVANIA AVE & 13TH ST at 1:29 PM.	D6	

- **No Line**
Disruption at Stadium-Armory. Fri Nov 5, 10pm thru closing Sun Minnesota Ave, Deanwood, Cheverly, Landover & New Carrollton will close due to scheduled track maintenance.

- **No Line**
Disruption at Stadium-Armory. Fri Nov 5, 10pm thru closing Sun no Blue Line train service btwn Stadium & Benning Rd. Free shuttle provided. Add 40 minutes to travel time.

- **Marc**
Attention MARC Commuters: The Passenger Warning System at the Rockville and Germantown MARC Stations have been taken out of service. They are being replaced with signage to caution pedestrians. Please use extreme caution when crossing the tracks as you normally would.

- **Marc**
REMINDER-Attention West Baltimore Commuters:

The parking lot closest to the station at West Baltimore will begin hosting a Farmers' Market every Saturday starting Saturday, June 19, 2010 and continuing until Saturday, November 20.

APPENDIX B: SURVEY QUESTIONS – WEB-BASED USER SURVEY

1. How many times have you visited the BWI Ground Access Information System website?

    1. Several times
    2. A few times
    3. Only once before today
    4. This is my first time

2. How frequently do you take a round trip flight either into or out of BWI airport?

    1. Once or twice a week
    2. Once or twice a month
    3. Several times a year
    4. Once or twice a year
    5. Less than once a year
    6. I've never flown into or out of BWI. I'm using this website today to plan an upcoming trip into/out of BWI.

3. Do you live within a 100-mile radius of BWI airport?

    1. Yes
    2. No

4. Before you were aware of this website, which of the following modes of transportation did you most often use to get to or from BWI Airport?

    1. Taxi
    2. Vanpool (e.g., Super Shuttle)
    3. Hotel airport shuttle
    4. Metrorail (Washington Metro)
    5. Bus (public transit)
    6. MARC train
    7. Amtrak
    8. Drove and parked at the airport / someone else drove me to the airport
    9. Dropped off at the airport by someone else
    10. Rented a car at the airport
    11. I have not previously traveled to BWI Airport

5. Did the website inform you about a travel option(s) that you did not know existed?

    1. Yes
       Please specify the travel option(s):_____
    2. No

6. Did the website inform you about a travel option(s) that was more feasible or practical than you had previously thought?

   1. Yes
      Please specify the travel option(s):_____
   2. No

7. Overall, would you say that you've learned about a travel option(s) that is better than the way(s) you normally get to/from BWI Airport?

   1. Yes
      Please specify the travel option(s):_____
   2. No

8. Have you tried any of the travel options that you learned about from the website?

   1. Yes
      Please specify the travel option(s):_____
   2. No

9. Please indicate to what extent you agree or disagree with each of the following general statements about the use of the Ground Access Information System website. (Use a scale of 1 to 5, where 1 is s*trongly disagree* and 5 is s*trongly agree*).

	Strongly Disagree 1	Disagree 2	Neither Agree nor Disagree 3	Agree 4	Strongly Agree 5	Don't have enough information to respond
The website provided me with the information I was looking for.						
The information on the website was well organized.						
It was easy for me to find what I was looking for on the website.						
I did not encounter any problems or frustrations while using the website.						
The information presented on the website is accurate.						
The website improves my impression of BWI.						

10. Please indicate to what extent you agree or disagree with each of the following statements about the information provided on the Ground Access Information System. (Use a scale of 1 to 5, where 1 is *strongly disagree* and 5 is *strongly agree*).

	Strongly Disagree 1	Disagree 2	Neither Agree nor Disagree 3	Agree 4	Strongly Agree 5	Don't have enough experience with site to respond
The information made me aware of a travel option that could make my trip to/from BWI less stressful.						
The information made me aware of a travel option that could save me time getting to/from BWI.						
Based on the information, I would change the way I get to/from BWI.						
Use of the information has increased my satisfaction with travel to/from BWI.						
The ground transporation information on this website is very valuable information to have prior to traveling to/from BWI.						
Other major airports across the country should provide this type of ground transportation information.						

11. Please indicate how likely you are to do each of the following. (Use a scale of 1 to 5 where 1 is *very unlikely* and 5 is *very likely*).

How likely are you to…	Very Unlikely 1	Unlikely 2	Neither Likely nor Unlikely 3	Likely 4	Very Likely 5
…use a travel option that you've learned about from this website.					
…visit this website again.					
…start using or continue using this website on a regular basis.					
…recommend this website to a friend or colleague.					

12. Is there any type of information you would like to see added to the website to make it more useful to you?

    1. VERBATIM (OPEN ENTRY)

13. What is your age?

    1. 18-30
    2. 31-40
    3. 41-50
    4. 51-60
    5. Over 60

14. What is your gender?

    1. Male
    2. Female

15. What was your household income for 2009?

    1. Less than $25,000
    2. $25,000-$49,999
    3. $50,000-$74,999
    4. $75,000-$99,999
    5. Greater than $100,000

16. What is your home zip code?

    1. VERBATIM (OPEN ENTRY)

Thank you for taking the time to complete the survey. Your responses are very important to us, and we know your time is valuable. If you are interested in further helping us improve the quality and content of this website, you can do so by providing more detailed feedback at a later date (via telephone or internet). If you're interested, please provide your first name along with either your telephone number or e-mail address below so that we can contact you. Thank you again for your time.

First Name:_____

Phone Number:_____

Email Address:_____

**We respect your privacy and will not share your information with any third party vendors.*