THE USE OF PUBLIC PARTICIPATION IN THE DESIGN OF EFFECTIVE INTERNET-BASED ADVANCED TRAVELER INFORMATION SYSTEMS

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THE USE OF PUBLIC PARTICIPATION IN THE DESIGN OF EFFECTIVE INTERNET-BASED ADVANCED TRAVELER INFORMATION SYSTEMS

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LIST OF SYMBOLS AND ABBREVIATIONS

ATIS	Advanced Traveler Information System
GDOT	Georgia Department of Transportation
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users

SUMMARY

This thesis examines three methods of public participation and their potential application to the design of internet-based Advanced Traveler Information Systems (ATISs). ATISs have the ability to reduce congestion by providing their users with real-time traffic information that can affect their travel decisions to avoid areas of high traffic. This study first uses a website evaluation method to determine a baseline of ATIS website quality. It then uses three forms of public participation, a survey, a future's workshop, and a feedback website to determine user preferences for Georgia's traveler information website, NaviGAtor. The results of the participation are then analyzed for their strengths and weaknesses and their applicability to ATIS development. The study concludes that the feedback website is the most applicable form of participation for ATIS design, followed by surveys that should be used periodically, and future's workshops that should be used rarely.

CHAPTER 1

INTRODUCTION

Congestion remains one of the most significant issues facing transportation planners today. U.S. citizens spend approximately $101 billion a year on extra fuel and wasted time alone. [1] Hundreds of billions more are spent on roadway expansion for congestion relief. Indirect costs linked to congestion include increased air pollution, which cause a substantial amount of monetary and social costs due to its negative health impacts. For these reasons, there is a great need for congestion relief in our major cities. Advanced Traveler Information Systems (ATISs) can help provide that relief. ATIS is defined as "the systematic application of information and communications technologies to the collection of travel-related data and the processing and delivery of information of value to the traveler." [2] In lay terms, ATISs use various types of travel data to provide traveler information through many different mediums, including the internet, telephone, smart phones, and other media outlets.

ATISs can help relieve congestion by providing the user of the ATIS with enough detailed information that they will be able to make the efficient travel decisions. Some travel decisions that can be changed through traveler information are: route choice, mode choice, travel destination, time of travel, and trip cancellation. An ATIS allows traveler information to change its users' travel behavior by giving them real-time or probable information on conditions such as congestion level. ATIS users then change their behavior to avoid any areas of congestion. Therefore, the more users of the ATIS there are, the faster congested areas will be cleared due to drivers' avoidance of congestion.

For long term congestion relief, multimodal ATISs can make riding transit easier for users by providing easy to understand transit information, increasing transit ridership and decreasing car use.

The effectiveness of ATISs can vary dramatically across systems. This is mostly due to the variability of ATISs themselves. Currently, there is no regulation or standards on how to execute an ATIS. The Real-Time System Management Information Program is a federal mandate held in the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) requiring all states to have the ability to monitor, in real-time, the traffic and travel conditions on major roadways, as well as share those data with state and local governments and the public. [3] However, while this mandate requires the information be provided, it leaves the implementation of the information distribution up to state and local governments. This means that there is a wide variety of ATISs, some of which are more effective than others. The objective of this research is to determine what technologies, features, and information work to build effective ATISs from the perspective of their users.

The objective of this research is to study the most effective methods to disseminate traveler information. The focus will be on Georgia's Department of Transportation's ATIS and particularly on its NaviGAtor website. This will be done through a review of top ATIS websites across the U.S. using evaluation standards found in the literature, as well as various public outreach methods including a survey, forum, and online feedback tool directed at users of the NaviGAtor website. The resulting analysis will provide a rough outline of the traveler information priorities of the users of the Georgia traveler information system, as well as a review of the methods used and

their possible application by state and local Departments of Transportation in internet-based ATIS development.

This thesis will describe the methods used to evaluate both ATIS websites and public participation as applied to ATIS design for the first time. It will also display the results of the public participation methods, and their meaning to ATIS development. Finally, this thesis will make recommendations to the Georgia Department of Transportation for its future ATIS design and to the Departments of Transportation nationally for the recommended use of public participation in ATIS design.

CHAPTER 2

BACKGROUND/LITERATURE REVIEW

Traveler information is far from new. Before the advent of radio and television, when the news media took up much of the responsibility of reporting traffic conditions, individuals relied on informal verbal communication of traveler information. However, the dawn of the information age has made traveler information more accessible than ever before. A wide range of new technologies exist to collect more travel data, as well as to deliver data in greater quantities, with greater accuracy, and through more mediums than ever before. One problem with all of this information is that, while it has greater potential to be useful, it also has greater potential to be more confusing. For instance, research shows that providing transit information effectively can counteract many negative perceptions about how difficult it is to take transit rather than drive, whereas, an ineffective transit information website can actually reinforce those negative perceptions. [4] Humans only have so much cognitive power that they are willing to spend on deciphering complicated traveler information. It is important to use the most convenient format for the most pertinent information on the most appropriate technologies.

Types of Traveler Information Data

ATIS can use many different types of data to provide information, including static data, dynamic data, and real-time data. Static information is made up of any information that infrequently changes including directional information and transit schedules. These types of information is helpful to travelers, but does not accurately portray the current travel conditions. Dynamic data is made up of planned deviations from the norm, historic

information, observed conditions, and predicted conditions. Examples of this information include construction reports, planned bus rerouting, travel time averages for different times of day, incident reporting and travel time estimates. This type of data is very common in traveler information and is closer to providing users with an accurate picture of current travel conditions than static data. Real-time information is the only type of data that can fully inform travelers about the current travel conditions. Real-time data have the ability to give the actual location and arrival time of transit vehicles, as well as provide information on the actual location and amount of congestion. These are the most difficult data to provide to travelers because it can have many technical difficulties that cause inaccuracies and are more expensive to collect than other data types. [5]

Typically, an ATIS will include several or all of these different types of data. This is one reason why ATISs can be difficult to execute. It is important to build a system in which all of these data types can be used and understood together to effectively communicate information to the ATIS user.

Degrees of Integration in Traveler Information

Three degrees of integration available in traveler information systems include unimodal traveler information, multimodal traveler information, and integrated multimodal traveler information. Unimodal traveler information (UTI) is currently the most common and least integrated type of traveler information. UTI contains only information on one mode of travel, such as auto or transit. Multimodal traveler information (MTI) contains information on at least two modes of transportation, usually auto and transit, but the information is kept separately, each in a similar format to UTI. Integrated multimodal traveler information (IMTI) also contains information on at least

two types of transportation modes. However, instead of just keeping the information in one place, IMTI also contains features that use both types of information at the same time. For instance, an IMTI website might have a real-time information map that included both traffic disturbances and transit disturbances. [5]

The hypothesized advantage of an IMTI system is that it has a greater propensity to change its user's mode choice. For instance, if a user regularly used the system for auto travel, but could not use a car one day, their familiarity with the system could make it easier to find an alternate mode, such as transit. Thus, this type of system would increase their chances of using transit. However, more research needs to be done on the effectiveness of this type of ATIS in changing mode choice decisions.

Types of Advanced Traveler Information System Technologies

ATISs typically encompass several different traveler information sources. The most popular of these are variable message signs, the telephone, radio and television, and the internet including websites and mobile applications. These information sources are described in more detail below.

- Variable Message Signs (VMSs): VMSs display traveler information on the side of major roadways. For this reason, they are particularly useful for providing en route information when unexpected congestion occurs. However, permanent installations of these signs can be costly and often require substantial maintenance in order to be reliably functional. [6]
- In-Vehicle Navigation System: Many cars are now available with GPS enabled navigation systems. Many of these systems also include traffic data from a variety of sources. The major benefit of in-vehicle navigation systems

is its ability to provide alternative routes when unexpected congestion occurs. However, this technology can be expensive and many individuals do not have access to them.

- Telephone Advisory Services: In 2000, the Federal Communication Commission designated 5-1-1 as the national calling number for traveler information. [3] As of May 2008 there were 43 active 511 systems including 33 state-wide and 10 regional systems. [7] Telephone services can provide information based on any type of data and use menus to direct callers to their desired information. The 511 call-in system can also function adaptively by adjusting what traveler information is heard upon first answering based on the number calling. For example, an adaptive 511 system will recall previously requested roadway segments from a specific number and will provide information on them the next time that numbers calls into the system. [8]
- Radio/Television: Using radio and television is a very popular way for the public to obtain traveler information. Because both of these devices are typically available to all income levels and frequently used for recreational purposes, it is very common for the public to own these technologies. [5] As of 1998 98.3% of U.S. households have access to a television and 99% have access to a radio. [9] The convenience of these technologies is expanded by the passive nature of the devices. These devises are valued by the public because the user has the ability to gain traveler information though listening, which allows for multi-tasking. [5] Television specifically offers information

pre-trip, while the radio's portability allows it to, also offer en route information.

- Internet: The internet offers many more features than the other types of technologies mentioned. The internet can offer both pre-trip information via a computer and en route information via an internet enabled device. It is also the most cost-effective method of disseminating information. [5] The internet, along with radio and television, is one of the most popular types of technology used by the public for traveler information. Not only is this one of the most popular mediums for users to seek traveler information, but it is also the technology with the largest propensity to change travel decisions. [6]

  As of 2010, the U.S. Department of Commerce National Telecommunications and Information Administration found that over 70% of U.S. households have access to the internet and there are current initiatives to increase this percentage, particularly for segments of the population in rural and low income areas. [10] The popularity and potential effectiveness of the internet heightens the importance of proper execution of websites and mobile apps.

Effective Website Design

There are many possible reasons that internet resources are the most effective mediums for changing travel decisions. One difference inherent in using the internet, as opposed to listening to the radio to obtain information, is that it is a predominantly active behavior. Unlike merely having a radio on in the background, using the internet to find traveler information requires conscious effort. This required effort could mean that

internet users are more predisposed to using the information they find to better inform their travel decisions. [6] Therefore, the traveler information users who are most likely to be affected by traveler information can be targeted through this specific technology, making the importance of proper implementation of internet-based ATISs more crucial to ATIS effectiveness than any other type of ATIS technology.

As described earlier, internet-based ATIS technologies are primarily made up of websites and internet enabled mobile applications. Because mobile phone traveler information applications are relatively new, relatively little research has been done on their proper implementation. ATIS websites, on the other hand, have been studied for the past decade for their effectiveness and proper design. According to the literature, the building blocks of an effective website are functionality and reliability, accessibility, and usability. Functionality and reliability refers to the functionality of the software. It is important for the public to be able to trust a website to work properly for them to use it frequently. While, some technical problems are inevitable, it is important that they are fixed promptly and that the users are kept up-to-date about any changes to give the website credibility. Another way of establishing credibility with users and demonstrating proper functionality is through time stamping relevant information and displaying the date of the site's last update. Maintaining this type of currency is especially important in traveler information, because the information is dynamic. [11, 12]

Website accessibility refers to its accessibility to those with disabilities. For example, green and red should not be used on top of each other, as those who are color blind will not be able to see the contrast. Other features that fall under this category are

the ability to display an HTML version of the site, the ability to convert the text to a different language, and the use of graphics for lower reading levels. [11]

The usability of a website encompasses many different aspects. For instance, ease of navigation makes the website easier to understand and use. One rule of thumb for creating easy, quick navigation is to use the "three click" rule. [12] As the title suggests, this means that it should take no more than three mouse clicks to get to any pertinent information. Consistency is another quality of usability. The website should remain consistent within itself, and within general internet convention, such as using blue underlined hyperlinks that turn purple after use. Keeping these types of features consistent will also help new users with navigation. [11]

While the quality of information itself is one of the most important aspects of an ATIS website, it is argued by the Transit Cooperative Research Program (TCRP) that a very important part of a transit website is the homepage. [12] The importance is similar to the importance of a first impression. If the homepage loads quickly, is easy to navigate, and is attractive, the user is more likely to remain in the website. The user will also have confidence that the website will be pleasant to use and meet their needs. The TCRP suggests the three previously mentioned criteria as a way to create effective home pages: quick load time, ease of navigation, and aesthetic quality. TCRP also suggest that while alerts are appropriate for the home page, its main purpose is to be a portal for the rest of the site. Therefore, it should be kept clean and simple. [12]

Demand for Traveler Information

Traveler information's effectiveness is always constrained by the level of demand from the public. There have been many studies on this topic and so far the results seem

inconclusive. The conventional school of thought on traveler information was that humans are rational decision makers who make their decisions based on an internal cost benefit analysis, Rational Choice Theory. [13,14] According to this theory, people are prone to seeking information that will better prepare them to make the best decision. In terms of travel decisions, it has generally been believed that an individual will always choose the least congested or most efficient route, unless they are working with imperfect or incomplete information. It is also assumed that they will make use of any and all information that is available to them to make this decision. [5, 15] However, in recent years more focus has been placed on the psychology behind individuals' decision making and how it affects demand for traveler information, as well as traveler information's ability to change individual's travel decisions. [5, 15]

Studies have found that most people do not make decisions as stated in Rational Choice Theory. Instead, it is theorized that they use habitual behavior or satisficing behavior to make decisions. An individual demonstrating habitual behavior would not seek out traveler information to make a travel decision. Instead, they would favor a commonly used route or their preferred transportation mode. Studies have shown that most people choose their travel route based on past experience and familiarity. [5,15] Additionally, it is thought that most individuals have a 'primary' mode of transportation that they habitually use and a 'default' mode of transportation that they will use in the event that they are unable to use their primary mode. This means that individuals are not actively seeking information on alternative routes or transportation modes. [16] However, traveler information can change these habits when unfamiliar trips are required. [5]

Satisficing behavior is an approach to decision making that assumes individuals have a minimum set of requirements for any decision. Once the minimum requirements have been met by an alternative, no further information is needed; that alternative is used, even if it is not the most efficient. Satisficing behavior is demonstrated frequently with fatalistic attitudes. For example, commuters who have accepted longer travel times as a fact of life are less likely to seek out traveler information or change their travel decision. [5, 18-17]

Despite these behavioral tendencies, there are certain conditions and demographics that show a higher demand for traveler behavior. Lyons [5] found three significant attributes that contributed to travelers using traveler information in the Los Angeles and Seattle regions: 1. those who were exposed to the greatest amount of congestion and volatility in traffic conditions, 2. those whose arrival times were more sensitive, and 3. those whose arrival times had more variability or uncertainty. Also in high demand in these regions was en route information when unexpected congestion occurred.

Simply providing traveler information is not enough to effectively change travel decisions. One solution could be to reach out to potential users through features like automatic alerts. [5] ATIS effectiveness is more important given the low level of demand for traveler information. Effective systems can be created by knowing who the users are and what they want.

Effectiveness in Changing Travel Decisions

In the literature, the demonstrated ability of traveler information to affect travel decisions has been mixed. However, many of the studies that found the effects to be

negligible or inconclusive were done in the late 1990's and early 2000's. [19-24] This was a time when new types of traveler information, such as internet-based traveler information, had not yet become popular. Also, the technological breakthroughs since have made information of all kinds much more accessible. For example, the Apple iPhone was released in 2007, marking a breakthrough in mobile internet-enabled devices and the newest medium through which, travelers can receive information en route. It is very possible that the full potential of traveler information's ability to affect travel decisions is yet unknown. However, through the more recent studies, it is clear that many variables play a significant role in determining the effectiveness of an ATIS.

Khattak, et.al. in northern California, analyzed associations between the number of traveler information sources an individual reported using and the probability of their reported travel behavior adjustments. Their research, which used data from the 2006 Greater Triangle Household Travel Survey, found that 22% of the respondents that used traveler information used an alternative route when one information source was accessed, but the chances jumped to 54% when an additional source was used, and adding a third source increased the chances of a route change to 83%. [6] Meaning that these respondents allowed traveler information to change their travel decisions more often when that information was coming from multiple sources.

Khattak, et.al. also found many other variables significant to the likelihood of travel decision changes. One of the significant variables was trip type. Work-related travel time had a stronger effect on travel decision changes than non-work related travel time. Also, accessing traveler information five days a week, as opposed to at least once a

week, changed the chance of travel decision changes from 22% to 65%. Additionally, those using internet sources were also more likely to adjust their travel decisions. [6]

One of the other findings of Khattak, et.al. was that 49% of respondents reported using no traffic information at all. The data for this study had come from a 2006 survey, so this is further evidence that more research needs to be done today on how travelers access ATISs. New research is needed because of the availability of new technologies that could presumably change traveler information demand, but also because it is important to stay up to date with the public's information needs in order to develop a truly effective ATIS.

Other studies have continued to increase the understanding of the variables associated with traveler decision changes due to traveler information. For instance, Wang's study [25] explored if spatial patterns existed in the effectiveness of an ATIS to change travel behavior. This study, unlike Khattak's, found that the purpose of the trip, work-related or non-work-related, was less influential than the distance being traveled. In this case, the travel time of the trip was more strongly associated with travel decision changes. [25]

A User-Based Approach to ATIS Development

Due to the large number of variables and the ever changing technological landscape, creating an effective ATIS requires a user-based approach. However, this is an under-researched aspect of ATIS development. While many surveys have been done to find if and how travelers use ATISs and their satisfaction with these systems, very few comprehensive studies have been done on what it is travelers want out of an ATIS system.

Public participation methods are procedures designed to involve the public to allow those affected by decisions have input into how they are made. [22] There are many different methods of public participation. The three used in this study range from common, a survey, to uncommon, a future's workshop. Since feedback websites are a relatively new method of participation, no research has been done on their effectiveness relative to other participation methods. However, Rowe and Frewer [23] discuss the relative effectiveness of surveys and focus groups in their 2000 study. Rowe and Frewer created two sets of criteria to evaluate the methods: acceptance criteria, whether or not the public accepts the decisions made, and process criteria, how efficient the method is to complete. The survey and focus group methods differed in their representativeness of citizens with surveys likely to reach a higher number of participants. The survey was also thought to be less well defined than a focus group. However, most of the criteria such as cost effectiveness and the influence on the final product are equal across the methods. [23] Therefore, given this equal footing and the lack of research on feedback websites as a form of participation, these three methods were chosen.

CHAPTER 3

METHODOLOGY

To study user-based approaches to effective ATIS development, a variety of ATISs had to be evaluated for typical attributes and general quality. There are many ways this evaluation could be done, considering all of the different forms ATISs can take. Websites were chosen to be the main focus of evaluation because this research was conduct at GDOT while it was in the process of a major redesign of its 511 website. The use of a previous study by Currie and Gook [11] led to a website evaluation rubric specific to traveler information websites.

Once the Georgia website was evaluated with respect to other similar ATIS websites, the user perspective of traveler information could be ascertained. The three strategies used in this regard were a survey, a forum, and a feedback website. The survey was used to study the demographic and usage characteristics of the users, the forum was held as a future's workshop, which is a way to find creative solutions to complex problems. [32] The purpose of this forum was to allow the ATIS users to share and brainstorm creative solutions for the system from their prospective. The feedback website is an online discussion board where users can submit their own ideas for the ATIS or vote on other users' ideas. These techniques were chosen based on their different strengths and weaknesses.

When studying the user perspective of ATIS, it is important to be able to identify the demographic and usage characteristics of its current users. This identification is one of the key strengths of survey results. A survey is able to gather detailed information and reach the greatest number of people, at the same time. The detailed information that was

particularly important for this study is how users currently access the site and what information they use most frequently, in comparison to how they would most like to access the site and what information they would most like to use. However, surveys are restricted to a set of answers provided by the researcher. Surveys fail to adequately provide room for the creative thinking required to achieve elegant solutions to any user problems. Also, with no opportunities to ask for explanations, the full meaning of the respondent's answers might be misinterpreted.

The forum and feedback website were chosen to supplement the survey results with more creative and in-depth responses from the public. These two techniques also have different strengths and weaknesses. A forum, because it is a facilitated small group, has the potential to result in creative ideas that are targeted to specific problems. On the other hand, a feedback website provides a public arena for ongoing discussion, where a breadth of ideas can be proposed and a wide array of people can participate.

The type of forum used in this study is called a future's workshop. [32] This style of workshop is used to identify the root of problems and find innovative solutions. In the past, the workshop has been primarily used to solve complex social and environmental problems. [31] However, today the workshop's use in varying fields has been increasingly common. The advantage of a future's workshop is its structure. A future'd workshop begins with a critique phase, which allows the participants to identify the main problems they experience in the ATIS. After problem identification, utopian futures are imagined and described in the fantasy phase, as a way to identify goals and interests. Finally, implementation strategies are proposed as a way to reach the major goals uncovered in the fantasy phase. Through this structure, the entire experience of ATIS

usage is explored from the current problems, to the ideal system, to the ways in which the public would like the problems to be addressed.

A feedback website also inspires creative problem solving from users, but it has the capability of reaching a much greater number of participants than a future's workshop. The way in which most feedback websites work is through a tab on the participating organization's website. Once clicking on the tab, labeled "feedback", the user is shown ideas from fellow users and has the opportunity to vote for one of the ideas already proposed, or to propose their own. The primary advantage to this participation method, besides its widespread distribution, is the ability of the participants and the organization to see and respond to each other's ideas. This increases dialogue between the organization and its users, which could make ATIS development much more transparent. Also, the participating organization automatically receives a prioritized list of ideas directly from the system's users, because of the ability for participants to vote on ideas.

In the following chapters, individualized methodologies and results from each of the methods described here will be explained in further detail in four separate chapters. Then, they will be examined together in a combined analysis of their affect on ATIS development. Finally, conclusions and recommendations, first for Georgia, then nationally, will be presented.

CHAPTER 4

WEBSITE EVALUATION

Methodology

The websites that were evaluated in this study were chosen based on a preliminary review of all of the state traveler information websites, as well as 12 regional 511 websites. During the preliminary evaluation, general notes were taken on usability, and features. Based on these initial categories, websites were given a rating of 0-10. The top 5 state traveler information websites and the top 5 regional websites were selected to be evaluated using the evaluation rubric created for this study. Table 1 shows the preliminary ratings of the state and regional traveler information websites used in thie study. Georgia's 511 website was also included, creating a total of 11 websites to be evaluated.

Table 1: Preliminary ratings of state and regional traveler information websites

State	**Rating (0-10)**
New Jersey	9
New York	9
Arizona	8
Colorado	8
Florida	7
Regional	
San Francisco-Oakland-Fremont, CA	10
Los Angeles-Long Beach-Santa Ana, CA	9
Houston-Sugar Land-Baytown, TX	8
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	7

Many studies have been done on evaluating websites, including those that focus on user satisfaction [26] and those that focus on the website itself [11]. The rubric used

for website evaluation in this study is focused on the website itself and is based on previous research done by Currie and Gook [11] on measuring the performance of transit passenger information websites. While the method and some of the criteria included in their study are directly utilized here, some of the content and scoring mechanisms were changed due to the broader context of traveler information and technological improvements since their study was published in 2009. Also, the Currie and Gook study focused primarily on the usability, accessibility, and consistency of the website. The features included in their study were primarily targeted to these areas of interest. This study, on the other hand, is more concerned with the features and functionality of traveler information and has therefore added more to these categories. Table 2 below contains the criteria for both reports.

Table 2: A comparison of criteria used between Currie and Gook and Roell

Currie and Gook	**This Study**
Criteria	Criteria
Accessibility	
Home page accessibility (Etre.com)	Home page accessibility: Etre.com score
Journey planner input page (etre.com)	Traffic Map accessibility:Etre.com score
Good home page load speed	Home page load time pingdom.com
	Traffic map load time pingdom.com
Languages available	
Text available in HTML and plain text format	
Images, graphics, and PDF have alternative text	
Print quality	
	Internet Explorer, Firefox, Chrome Capability

Table 2: continued

Usability	
Colored lines to denote routes on map	
Appropriate font style	Aesthetics: fonts, colors, page balance
Appropriate font size	
Appropriate font color (Etre.com)	Brightness: Etre.com
Appropriate background color	Color contrast: Etre.com
Number of clicks to find desired information	3 Click Rule
Current location within site shown clearly	
homepage link available on all pages	Navigation pane content
information currency	Time Stamps
Hyperlink identification	Hyperlinks conventionality
Navigation tools (pane) consistency	Navigation Pane consistency
Colors and fonts consistency	
Wording consistency	
	Direct link from home page to most accessed information
Javascript is unobtrusive	
Minimal usage of frames	
Information located on the left side of home page	
Features	
	Trip Planning
	Real-Time Traffic Map features/ layers
	Personalized Account
	Integration Level
	Streaming Video
Feedback form	Feedback Tool
Search function	
Frequently asked questions	
Links	
Site description	
Site map	
Contact details	

Most of the criteria added were functions or features that are available on traveler information websites today, such as a trip planning tool. The level of sophistication of these tools is also considered. Another area that has greater emphasis in this study is the navigation of the website, such as navigation pane content and direct links from the home

page to the most accessed information. This increased emphasis was added in place of some of the usability and consistency criteria used by Currie and Gook including search function and site map, which were considered a given for most websites today. Also, it was decided that while features such as a site map make navigation easier, it is more important for information and navigation to be made obvious without the assistance of such tools. A description of each criterion used in this study can be found in Table 3 below.

Table 3: Descriptions of criteria used in this study

Website Evaluation Rubric Descriptions	
Criteria	Description
Functionality	
Internet Explorer Capability Firefox Capability Chrome Capability	How well the website functions in all of the major browsers used today. Each test (plan a trip, view camera, move traffic map) is given separate values and averaged together. If a website doesn't have the function needed for the test (ie. no trip planner) then that test is skipped and the other two are averaged for the final score.
Time Stamps	Looked for on all data (incidents, cameras, etc). Accuracy and existence are factored into the final score.
Home page load time Traffic map load time pingdom.com	Three times were logged for all sites and averaged together to get the final score.
Accessibility	
Etre.com score Home page accessibility Traffic Map accessibility	Etre is a web development consulting firm specializing in usability and accessibility. One of their online tools checks the script of a specific webpage for common accessibility errors, which are coded in terms of severity; Priority 1 errors must be fixed, whereas Priority 3 errors can be fixed. The homepage and traffic map scores are both considered for this assessment.
Brightness: Etre.com Color contrast: Etre.com	Etre.com also offers checks for brightness and contrast of text color by selecting colors that are closest to those on the webpage in question.

Table 3: Continued

Usability	
Navigation Pane consistency	This criterion refers to the navigation pane's placement and wording on all pages in the website.
Navigation pane content	This criteria refers the content of the navigation pane and is specific to how much information can be consistently reached throughout all of the pages of the website
Hyperlinks conventionality	Hyperlinks are a main tool for navigation. The internet convention of hyperlinks (underlined, blue, purple after use)is assessed by how many of the common elements exist.
3 Click Rule	The 3 Click Rule was tested by counting the number of clicks necessary to get to the traffic map, incidents, and construction and averaging the number of clicks together.
Direct link from home page:	The navigation from the homepage required the listing of all information given on the homepage and directly linked to the homepage. This information was checked against the most common and most useful information for a traffic information website, such as those listed.
Aesthetics	Aesthetics were critiqued based on font, color use, overall visual balance and any other visual interruptions of the homepage.
Features	
Integration Level	A general range of one mode to integrated multimodal was used.
Trip Planning	Trip planning tools included any tool which could be used to specify origin and destination. A range based on the elements included in the trip planner and possible options was used.
Real-Time Traffic Map	The traffic map was judged based on the ease of using features, such as zoom and different layers
Map Layers: road network, cameras, incidents, construction, traffic (colors), changeable message signs, arterial level data, weather	The average of scores for each of these layers in the traffic map was also considered. Existence and proper functioning was given a 3 on the 0-5 scale to account for the few instances where a tool was made exceptional by some account, either by providing different traffic colors for the color blind, or some other means of functionality.
Personalized account	Only the existence of these tools were considered
Streaming video	
Feedback tool	The feedback tool was given a range: supplying an email address to having a public forum type of feedback for the public to discuss new ideas.

The scoring system applied to each criterion, shown in Table 4, replicates Currie and Gook's study. Each item is scored on a 0-5 scale and is given a weighted multiplier of 1-3 to give priority to those criteria that are more important to a traveler information website. Minor adjustments to the scales and weights have been made to Currie and Gook's original methodology. For example, the webpages loaded much more quickly than Currie and Gook's previous webpage load time scale would account for, so the scale was changed to account for the range present in the data.

Also, due to the greater emphasis on features, the maximum number of points possible for this category is greater than the rest. In this study, the functionality category constitutes 75 possible points, the accessibility and usability categories are 70 points each, and the features category makes up 95 possible points, totaling 310 possible points. The disparity between the categories is acceptable in this study because the quality of features on traveler information websites greatly affects the sites effectiveness.

One of the areas where this scoring rubric departs from Currie and Gook's is in the accessibility category. The erte.com test that runs through a website's script was originally scored at 5 points for 0 errors, 4 for 1-3, 3 for 4-6, 2 for 7-9, and 1 for 10 or more errors. However, some the websites had a total of errors that were well outside of this range. In the results, a break occurred, at which sites had more than 60 errors. A new scoring scale was created to account for this break, which gave 1 point for 10-60 errors and 0 points for over 60 errors.

Several items are made up of averages in this scoring rubric, including the compatibility of the website with different browsers, the amount of clicks it takes to get to certain features, and the scores of each layer on the traffic map. In the case of the map

layers, the scores are averaged in order to keep the maximum points possible for each category relatively even. Otherwise they were averaged to ensure the quality of the result. This type of scoring system is used in spite of its inherent problem of subjectively quantifying unquantifiable data. The subjective nature of this system is necessary, however, in order to compare different websites.

Table 4: Scoring system applied to each criterion

Website Evaluation Rubric		
Criteria	Score system	Weight
Functionality		
IE Capability - Plan a trip - View camera - Move traffic map	0- no functionality 3- text/graphics skewed 5- no change	3
Firefox Capability - Plan a trip - View camera - Move traffic map	0- no functionality 3- text/graphics skewed 5- no change	3
Chrome Capability - Plan a trip - View camera - Move traffic map	0- no functionality 3- text/graphics skewed 5- no change	3
Time Stamps	0- no time stamp 1- inaccurate times 5 accurate times	1
Home page load time pingdom.com (average of three)	1- more than 4 seconds 2- 3-4 seconds 3- 2-3 seconds 4- 1-2 seconds 5- less than 1 second	3
Traffic map load time pingdom.com (average of three)	1- more than 4 seconds 2- 3-4 seconds 3- 2-3 seconds 4- 1-2 seconds 5- less than 1 second	2

Table 4: Continued

Accessibility		
Home Page: Etre.com Priority 1 Error	0- over 60 1- 10-60 errors	3
Priority 2 Error	2- 7-9 errors	2
Priority 3 Error	3- 4-6 errors	1
	4- 1-3 errors 5- 0 errors	
Traffic Map: Etre.com Priority 1 Error	0- over 60 1- 10-60 errors	3
Priority 2 Error	2- 7-9 errors	2
Priority 3 Error	3- 4-6 errors	1
	4- 1-3 errors 5- 0 errors	
Brightness: Etre.com	1- score = <50 2- score = 50-74 3- score = 75-99 4- score = 100-124 5- score = >125	1
Color contrast: Etre.com	1- score = <200 2- score = 200-299 3- score = 300-399 4- score = 400-499 5- score = >500	1
Usability		
Navigation Pane consistency	1- inconsistent, wording/ placement 3- Consistent, but not on all pages 5- consistent throughout website	2
Navigation pane content	1- not useful, 5- prolific	3
Hyperlinks conventionality (underlined, blue, purple after use)	1- unconventional 3- have some elements but not all 5- conventional	1
3 Click Rule - To traffic map - To incidents - To construction	1- more than 3 clicks 2- 3 clicks 3- 2 clicks 4- 1 click 5- 0 clicks	3
Direct link from home page to: incidents, construction, traffic map, cameras, trip planner	1- no crucial info linked 2- Some of crucial info linked 3- Most crucial information linked 4-All crucial information linked 5- All crucial info, plus extras	2
Aesthetics	0- inappropriate - 5-exceptional	3

Table 4: Continued

Features		
Integration Level	1- Unimodal 2- Unimodial; connection to other modes 3- Multimodal 4- Partially integrated multimodal 5- Integrated Multimodal	3
Trip Planning directions, alternatives, trip times, alt modes, origin/destination	1- Most basic, least amount of features 3- provides some of optimal features 5- provides all optimal features	3
Real-Time Traffic Map	1-difficult to use 5- exceptional	3
Map Layers		3
road network	0- not available - 5-exceptional	
camera	0- not available - 5-exceptional	
incidents	0- not available - 5-exceptional	
construction	0- not available - 5-exceptional	
traffic (colors)	0- not available - 5-exceptional	
changeable message signs	0- not available - 5-exceptional	
covers arterials	0- not available - 5-exceptional	
weather	0- not available - 5-exceptional	
Personalized Account	0- not available - 5-exceptional	3
Streaming Video	0- not available - 5-exceptional	1
Feedback Tool	0- not available - 5-exceptional	3

To evaluate the websites, two online tools were utilized, Etre.com and pingdom.com. Etre is a web design consulting firm that specializes in website usability and accessibility. Two of its online tools were used in this study, including an accessibility tool and a color brightness and contrast tool. The accessibility tool is given a website url and runs through the script of a website looking for common errors. A brief report is then given stating the number of Priority 1 errors that must be fixed, Priority 2 errors that should be fixed, and Priority 3 errors that may be fixed. [27] Etre.com's color brightness and contrast tool allows two colors to be selected from their given array (one for background and one for font) and the values of the colors are then scored on brightness and level of contrast. [28] The World Wide Web Consortium, which establishes web design standards, recommends that color brightness should be 125 or

greater, and color contrast should be 500 or greater. These standards were created as a resource for web designers to create legible websites. [29]

Pingdom is a company that specializes in maintaining a website's uptime, or the time in which it is operational. Pingdom offers an online tool that measures how long a webpage takes to load. A detailed report is then given cataloguing each element's load time and suggestions for increasing the loading speed. The speed itself is gathered by loading the page several times on Google's Chrome browser in Dallas, Texas and recording the data. [30] For this study, three separate tests were done for each page and averaged together, in case of any technological interference.

The rest of the evaluations in this section of the study were made based on the researcher's best judgment. This was primarily executed by order of comparison. For example, after having examined all of the chosen websites extensively, most of the differences between them became increasingly obvious and were used in creating the scoring scales. One such example is seen in the traffic map layers. The layers originally had a binary scoring system, 5 points if it was available and 0 points if it was not available. However, after scrutinizing all of the websites it became clear that some of these features, while present, were not as detailed or as functional on some websites, as compared to the others. In this way, the range of quality in each criterion provided the scoring ranges.

The final score for each website was calculated by multiplying each individual score with its criteria's weight. The sum of the products was divided by the sum of the weights. The formula to the overall score of each website is shown in the equation below. The resulting scoring scale is then 0-5.

$$\frac{N_i W_i + N_2 W_2 + N_3 W_3 + \cdots + N_f W_f}{\sum W}$$

Results

A table of all of the numeric results for the website evaluations can be found in Appendix A. A description of each category's results, as well as the overall result of the rubric is provided below.

Functionality

The most important metric in the functionality category was the website's compatibility with the three most common browsers used today, Internet Explorer, Mozilla Firefox, and Google Chrome. Most of the websites did very well with all of these browsers with the exception of Colorado, Los Angeles, and Houston. These three sites' traffic maps were much slower loading in Internet Explorer than the other two browsers. However, because they did eventually function, they were each given a score of three.

The other metrics in the functionality category included the presence and accuracy of time stamps, and the load times of the home pages and traffic map pages for each website. About half of the sites earned the full amount of points for time stamps. Most of the other websites lost points for not including time stamps on all time sensitive information. However, neither New Jersey nor Philadelphia included any timestamps, only providing the dates of planned construction.

The load times of the different websites had a much greater range. The shortest load time of any webpage was Houston's home page at 0.110 seconds and the longest was Arizona's traffic map at 5.140 seconds. Most of the websites maintained similar load times for their homepages and their traffic map pages. However, Arizona's load

times were 1.353 and 5.140 seconds for its homepage and traffic map, respectively and Colorado's load times were 0.506 and 4.730 seconds for its homepage and traffic map, respectively. The two fastest websites overall were Houston and Florida and the slowest website overall was Arizona.

Scores of all evaluated websites for the functionality category are shown in Figure 1 below. The graph shows that all of the websites scored high in this category with Florida earning a perfect score of 5.

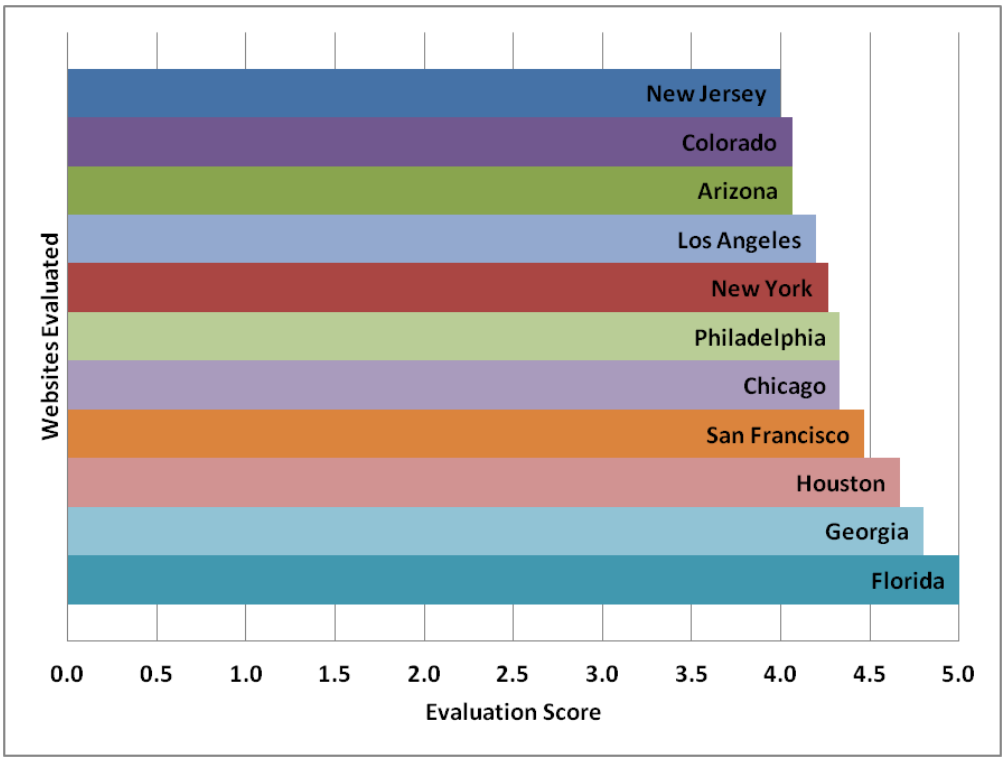


Figure 1: Scores of all evaluated websites for only the Functionality Category

Accessibility

The accessibility category was made up of the Etre.com online tools. The accessibility tool runs through a website's script to find common accessibility errors such as a scripts incompatibility with common screen reading software. Two of the websites, New Jersey and Los Angeles, were not able to participate in the etre.com accessibility

test. However, the tool was used successfully for all of the other websites. Since this test has the highest weighting in the accessibility category, the averages of the other website's errors were used for New Jersey and Los Angeles for the final scoring.

None of the tested websites had any Priority 1 errors with the exception of Georgia's NaviGAtor site, which had three on its home page. The Priority 2 errors demonstrated much more variability. The only site without any Priority 2 errors was Florida. The rest of the tested websites had a range of Priority 2 errors from 6 (Arizona) to 104 (New York). The Priority 3 errors were not nearly as varied. Most websites had 0 errors; the rest had a range of errors from 1 to 11.

Etre.com also offers a color brightness and contrast tool. This tool did not require the use of the website URL so every website was able to be tested. The only website that did not pass this test was the Georgia NaviGAtor site. Its use of a bright blue background and white text failed both the brightness and contrast test. Most of the other websites used black text on a white field and therefore, passed both of these categories. It should be noted, however, that the colors used for the test are chosen from a set of provided colors, not a continuous spectrum. The colors that were chosen for the test for the NaviGAtor website were the closest colors available, but may not have been exactly the same color combination. It is suggested that the NaviGAtor website make use of a darker color of the text and a lighter color for the background.

Scores of all evaluated websites in the accessibility category are shown below in Figure 2. This category produced much greater discrepancies between the websites than the functionality category. Through this graph it is clear that Florida was much more accessible than the rest of the sites tested.

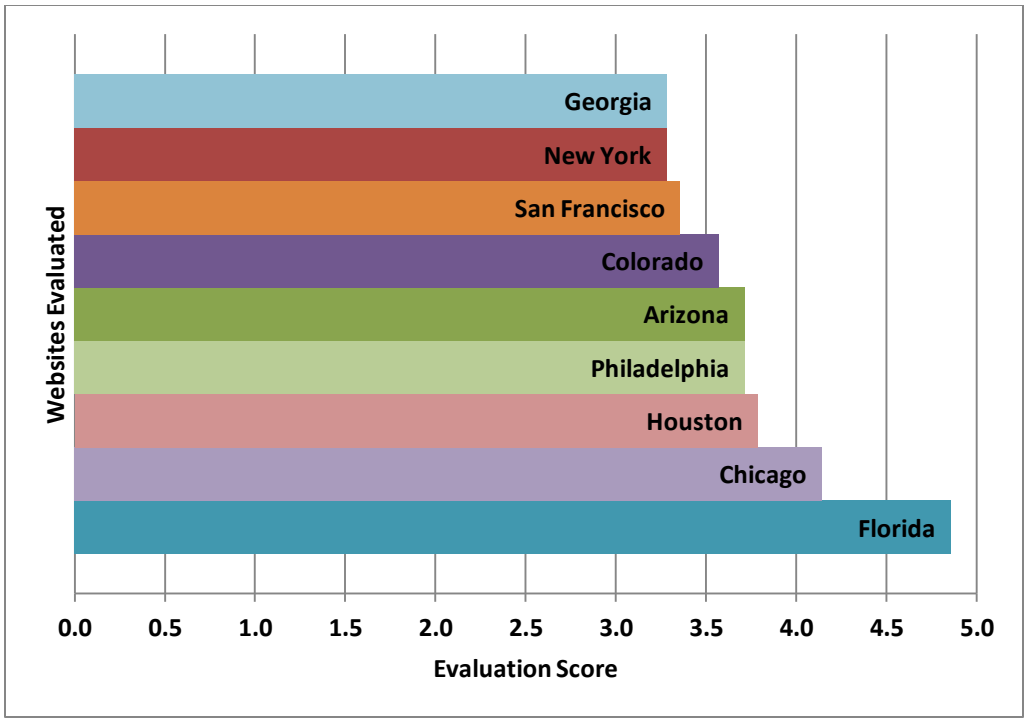


Figure 2: Scores of all evaluated websites for only the Accessibility Category with Los Angeles and New Jersey removed due to lack of data

Usability

The usability category contains criteria related to consistency, navigation, and aesthetics. Consistency was tested in the website's navigation pane and its hyperlinks. Consistency of the navigation pane was present for most of the websites with the exception of Houston's site, which had tabs that were generally consistent, but disappeared on several pages. Likewise, most of the websites had hyperlinks that were consistent with internet convention, although only New Jersey used every element of conventional hyperlinks.

The navigation metric for each of the pages consists of the content available in the navigation pane, compliance with the 3 Click Rule, and the amount of information linked directly to the homepage. There was more variability in the navigation pane content, then in its consistency. New Jersey, San Francisco, and Los Angeles's websites all

demonstrated excellent navigation panes. In their sites, the use of drop-down menus significantly increased the amount of information that could be found from any page. In contrast, Houston and Philadelphia's websites' navigation panes contained the least amount of information. The Philadelphia website's navigation pane content was limited because the website itself has much less information than any of the other websites evaluated. The Houston website's navigation pane, on the other hand, consisted solely of a link to the home page, their contact information, and an about section. This is the least frequently used information on traveler information websites and makes their website significantly more difficult to navigate.

The number of mouse clicks it takes to get to important information is also a navigational concern. All of the websites abided by the 3 Click Rule, none needed more than three clicks to get to any of the three tools tested. Most of the time, two clicks were necessary it was because the information required some amount of sorting such as by information type or roadway. San Francisco had a high number of clicks because of the large amount of information available on the site. San Francisco's homepage works as a portal to get to transit, traffic, rideshare, bicycling, and parking specific homepages, which then lead to more direct navigation opportunities for information specific to each.

The amount of content linked directly to the home page also helps with navigation. This criterion also had a lot of variation among the websites. Georgia, Chicago, and Philadelphia's websites did the worst in this category. Philadelphia's website scored poorly because of the site's lack of content, Chicago's homepage was a full screen traffic map, which made it difficult to make many direct links outside of the navigation pane, and Georgia's NaviGAtor homepage was mostly ads, limiting the space

that could be used for information. Most of Georgia's website's information was also kept in lists of roads that had to be individually selected, so that direct links to information could not exist, with the exception of the traffic map.

The aesthetics criterion contained all of the visual elements of the homepage for each website and was also quite variable. San Francisco's website had the only perfect score for this criterion because the homepage had a very simple and clear layout. San Francisco's used appropriate fonts, creating an obvious navigation flow. Georgia had the lowest score for this criterion because the NaviGAtor website used distracting colors, inappropriate fonts, and confusing graphics, such as a picture that looks like an interactive traffic map. It was also difficult to distinguish the boxes that contain important information from the boxes that contain ads. The inappropriate, large size of the agencies' icons along the top of the screen also caused an imbalance in the page, which makes navigation more difficult. Houston's webpage had many issues, the biggest of which is using appropriate font styles to create information flow. Instead, lists of many types of information and destinations were displayed without visual distinctions.

The final scores for all of the evaluated websites in the usability category are shown below in Figure 3. This category has a greater range of scores than the previous two categories. Also, websites that had low scores in the other two categories achieved much higher scores in this category, such as San Francisco and New York. There are two possible reasons for some of these switches. Firstly, the increased usability in these websites may cause a more complicated script, which could affect usability. Alternatively, it could be that usability is simply a higher priority to these sites, than

accessibility. The reason for the discrepancy is most likely different for each site based on the web designer and the agency's priorities.

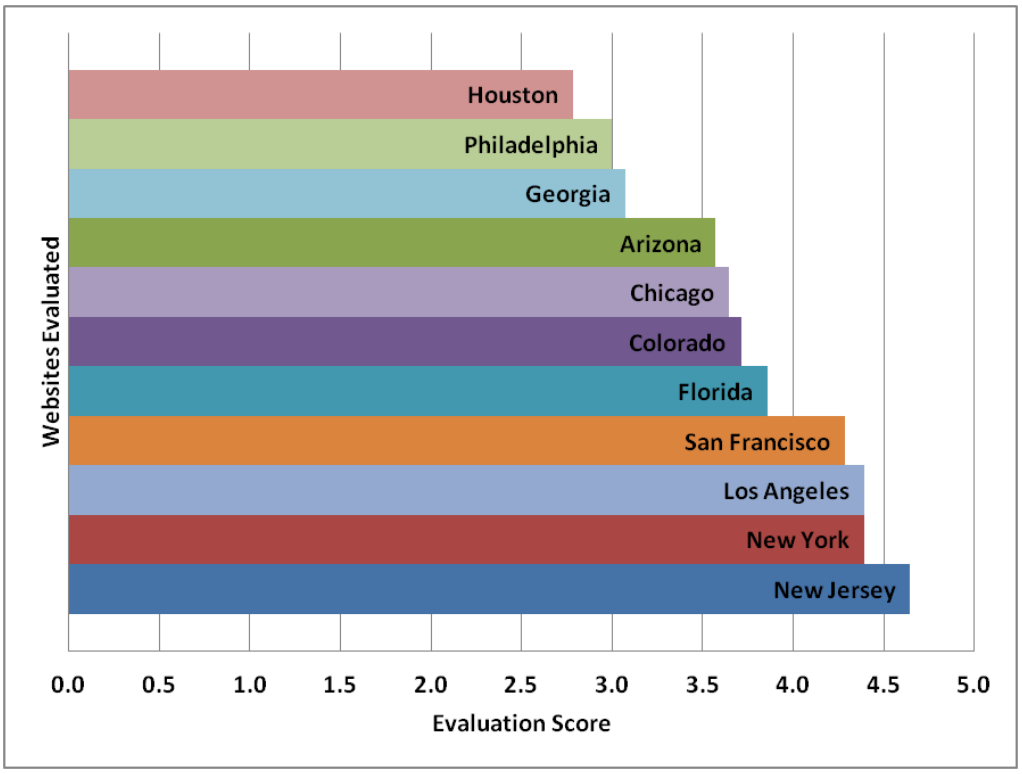


Figure 3: Scores of all evaluated website for only the Usability Category

Features

The features category is focused on the content of the website and includes six main features: level of integration, real-time traffic map, traffic map layers, trip planning, streaming video, personalized account, and a feedback tool. Most of the websites evaluated were unimodal. However, New York was partially integrated multi-modal due to its addition of transit information on its real-time traffic map. San Francisco and Los Angeles were also considered partially integrated multimodal, although not as strongly as New York, because their trip planners allowed for some multimodal options.

All of the websites contained a real-time traffic map. Some of the functionality varied across websites. For instance, Florida's map does not show half of is data layers

unless it is almost fully zoomed in. However, most of the websites presented well-functioning traffic maps. Also, many of the websites offered almost all of the data layers included in this evaluation, with the exception of Philadelphia, which only includes traffic congestion. Several websites, however, produced above average data layers. For example, San Francisco and Los Angeles provided color-blind options for their traffic congestion colors. Also, Colorado's camera format allowed the user to tab through multiple directions of stills provided from the same location. The ability to roll-over or click data icons for more information on the map was also standard for most of the websites.

Trip planning, streaming video, and personalized account tools across the websites were either non-existent or of low quality with a few exceptions. The New York and San Francisco sites both had fully-developed trip planners. Streaming video was used extensively in New Jersey and Los Angeles, and New Jersey, New York, Florida, and San Francisco all had personal account abilities.

A full feedback tool, such as the one utilized in this study, was not available on any of the websites, with the exception of Georgia's. New York and Chicago both provided surveys for satisfaction and suggestions, however, most of the websites only provided a "contact us" page. Florida's website only provided an email address and Philadelphia's website did not provide any contact information.

The final scores for all of the websites in the features category are shown below in Figure 4. This was by far the lowest scoring section for all of the websites overall. This category was set up to find which websites were utilizing some of the new opportunities present with today's technologies such as trip planners. Some of the items were fairly

new concepts, such as a feedback tool, so it was expected that no website would have all of the elements included in the rubric.

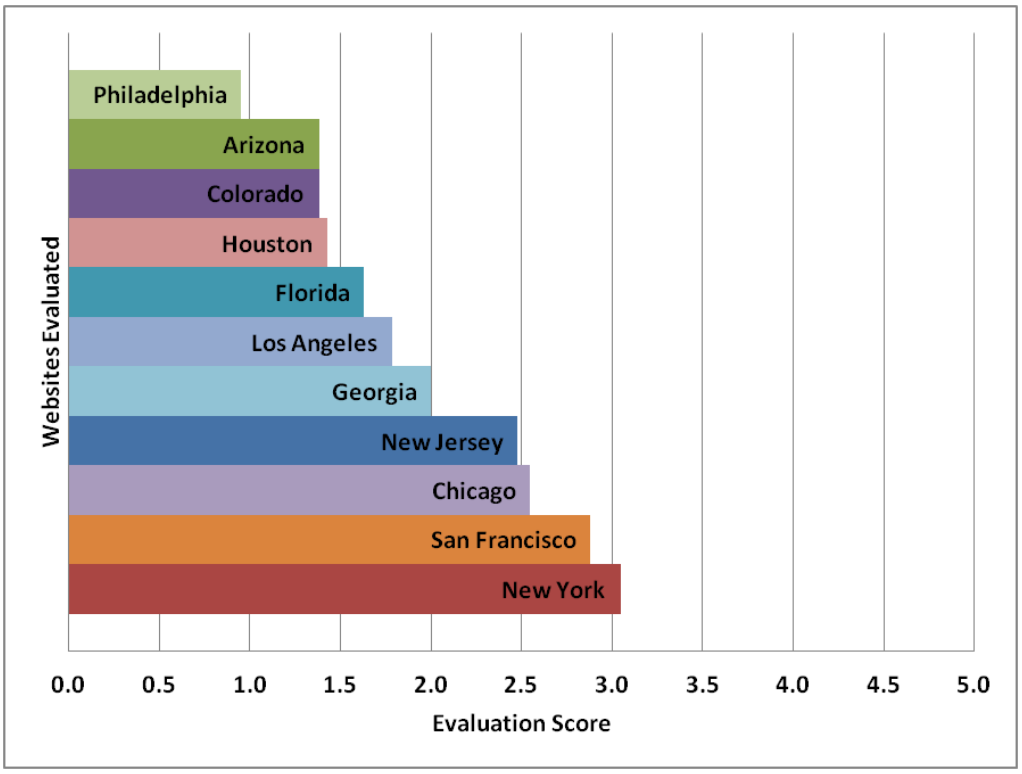


Figure 4: Scores of all evaluated websites for only the Features Category

Overall

Figure 5 shows the scores of all of the evaluated websites. While most of the criteria had plenty of variability between sites, this graph shows that the final scores were fairly evenly distributed. This suggests that each website has its own strengths and weaknesses. Philadelphia's lower score can be attributed to its lack of information availability. Most of the information that is standard for traveler information websites was not offered of Philadelphia's such as any information on incidents in or a data layer on its traffic map for construction. The score increase between Georgia and Chicago represents an overall quality departure. Georgia and Houston lost many of their points in the usability section for poor navigation.

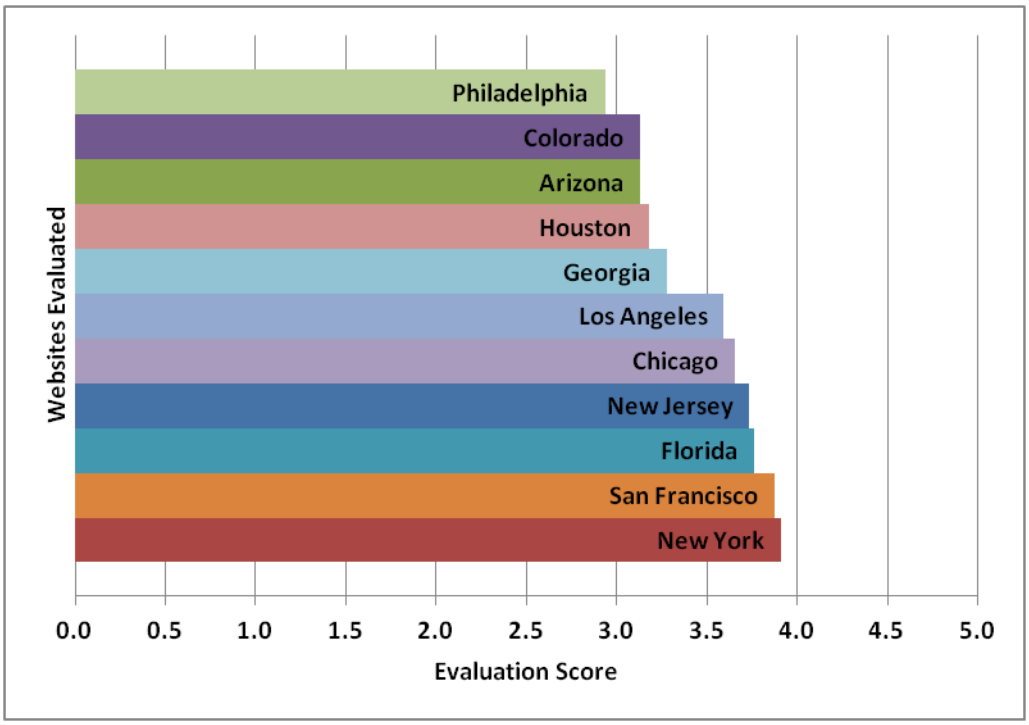


Figure 5: Scores of all evaluated websites; Scale = 0-5

Overall the website evaluation shows that there are many different aspects of traveler information websites that can be focused on in their design. However, they are all important to the overall quality and effectiveness of the website. Many of the websites evaluated displayed strong quality in one or two aspects, but fell below in the other aspects. None of the websites evaluated exhibited excellence in every category. However a website with all of these qualities would most likely have a higher quality and be more effective in reducing congestion.

CHAPTER 5

SURVEY

Methodology

The survey used in this study was designed to be administered online through Georgia Tech's School of Civil and Environmental Engineering's online survey platform. A link to the survey was posted on the alerts page of the NaviGAtor website and was also visible on the alerts section on the homepage, making all of the respondents self-selected. This format and distribution method was used to obtain as many respondents who were familiar with the NaviGAtor website as possible. Since no contact information was known about the website's users, a link on the website itself was the best way to survey that group.

The content of the survey included demographic, traveler information technology and access, current available features, possible future features, and satisfaction questions. The main purpose of the survey was to ascertain how most people use and access the information, what information they most typically use, how satisfied they are with the website, and if they would prefer different methods for access or different capabilities. The survey questions can be found in Appendix B.

The survey was finalized and IRB certified in early July 2012. As part of the certification, no minors under the age of 18 were allowed to complete the survey. The survey officially went live on August 10th 2012 and collected data for 33 days until September 12th 2012.

Results

During the month that the survey was online, 65 NaviGAtor users responded. However, retention of respondents slowly declined throughout the survey. Question 1 retained 94%, question 5, 80%, question 6, 78%, question 9, 51%, and question 13, the second to last question, retained 48% of the original respondents. Therefore, the total number of completed surveys is 31, less than half of the original respondents. The high dropout rate is, in part, due to question 8, where the number of respondents dropped from 51 to 33. This question involved ranking 11 potential new tools for the website in order of importance. However, the process of clicking each individual button, as well as reading each description, may have been a factor some of the respondents to drop out.

The total estimated number of visitors to the NaviGAtor website daily is 20,000. Given the high percentage of dropouts and the small sample size, this survey is not representative of the user population. The error values for such a small sample size would be too wide for most statistical testing to be considered significant. However, the trends it does show have the potential to offer some insight into some of the population's opinion of Georgia's ATIS.

Demographics

Figure 6-Figure 8 show the age of all of the respondents, their primary mode of transportation, and their income level. Figure 6 shows that very few respondents were under the age of 25. However, the other age ranges had a pretty even response rate with a slightly higher rate of respondents in the 25-35 range and a slightly lower rate of response from users 55 and older. Also, Figure 7, shows that almost all of the respondents stated that their primary mode of transportation is driving alone. This is not surprising since the

NaviGAtor website is currently unimodal and only provides traffic information on major highways. Finally, Figure 8 shows that most of the respondents were at an income level of over $75,000. The clear over sampling of high income individuals is considered to be a major flaw in the survey results.

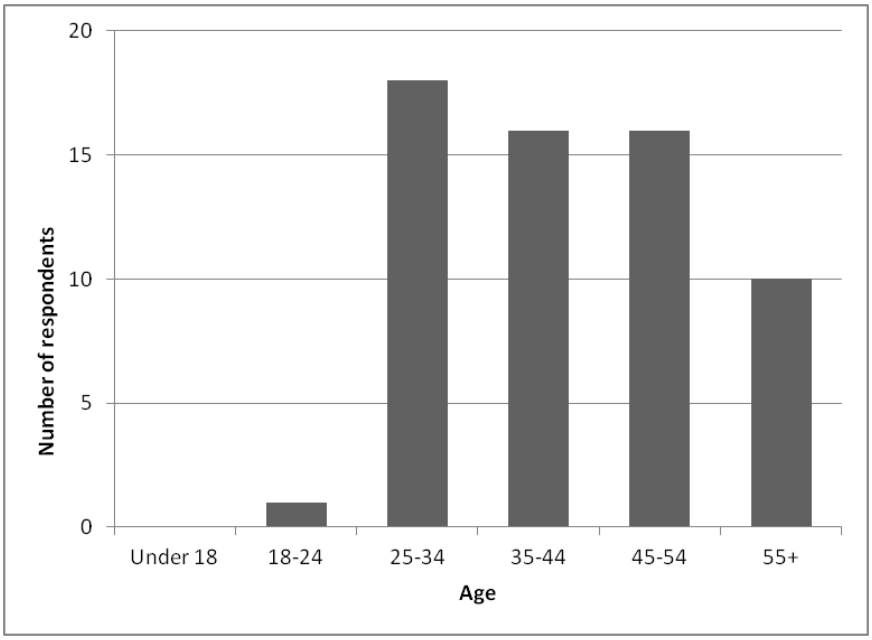


Figure 6: Age of respondents

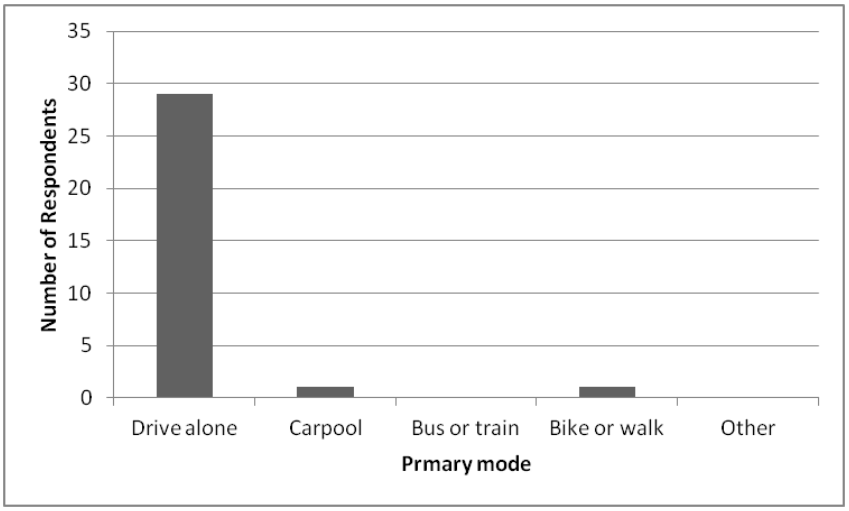


Figure 7: Primary mode of transportation of respondents

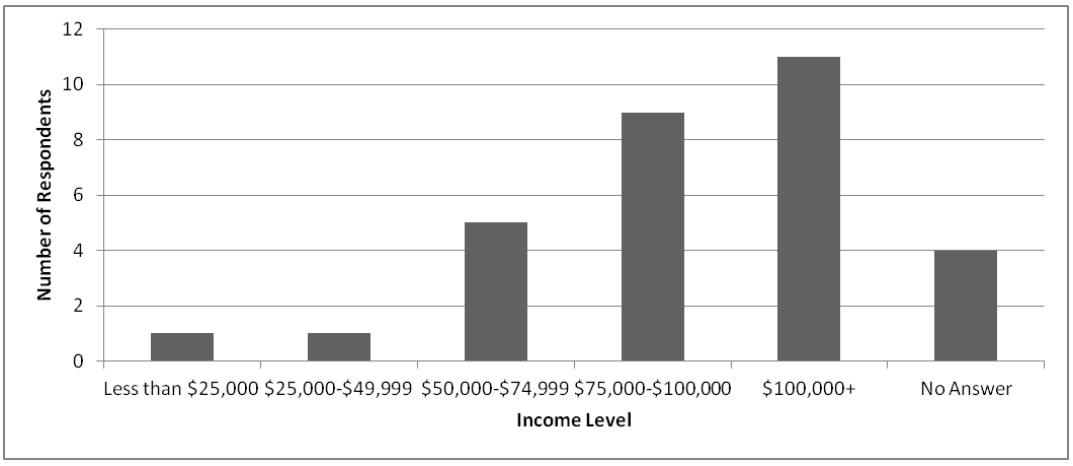


Figure 8: Income level of respondents

Access

One of the major goals of this study was discovering how the users of NaviGAtor access the site and if they would prefer a different method of access. Figure 9 shows the ways in which respondents currently access the Navigator website. This question allowed the respondents to check all that applied. The table in the top right hand corner of the chart displays the number of respondents who reported one, two, and three current sources. Of those who responded, most access NaviGAtor's traveler information through the website on their computer. The second most used source is a mobile device and calling is the least used method of access for those taking the survey. This is not surprising since the survey itself was online, so the users of the website had a much higher chance of seeing the survey.

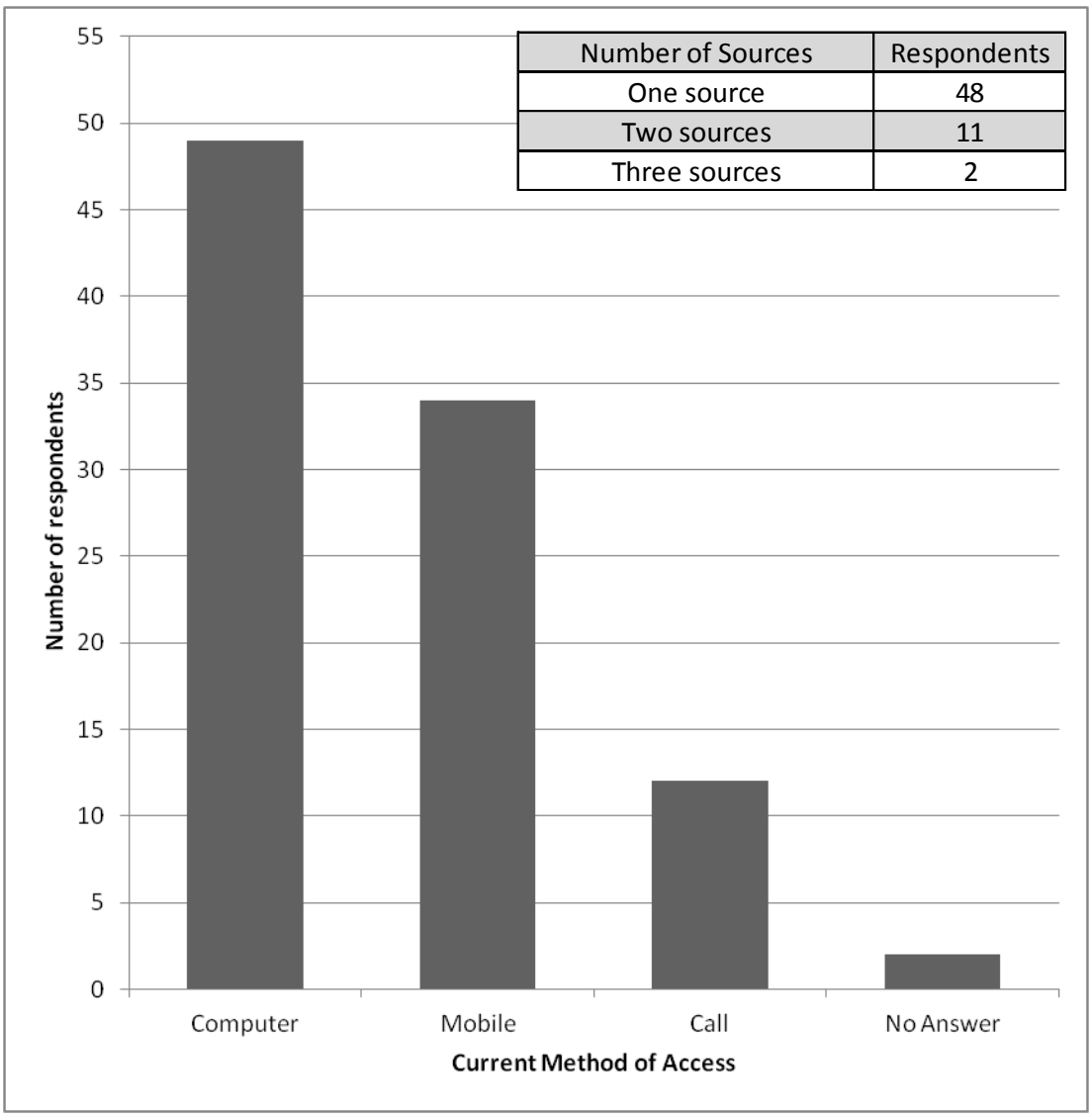


Figure 9: The ways in which respondents currently access the NaviGAtor website

In comparison, Figure 10 shows the ways in which respondents would prefer to access the NaviGAtor traveler information. This question was a single answer question and mobile-optimized website and smart phone specific application were broken out into two separate methods of access. However, if they are combined to resemble Figure 9, such as they are in Figure 11, then the difference between the current method of access and the preferred method is abundantly clear. Most of the respondents currently use their computer to access NaviGAtor, but would like to use their mobile. The higher

socioeconomic status of the respondents could be a factor in the apparent desire for mobile access.

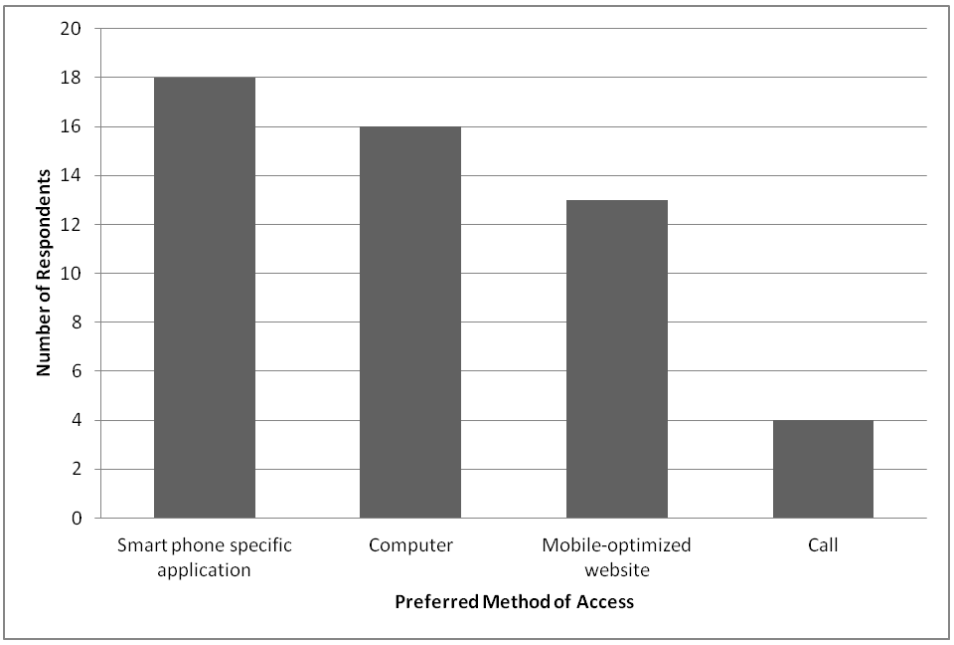


Figure 10: The ways in which respondents would prefer to access the NaviGAtor website

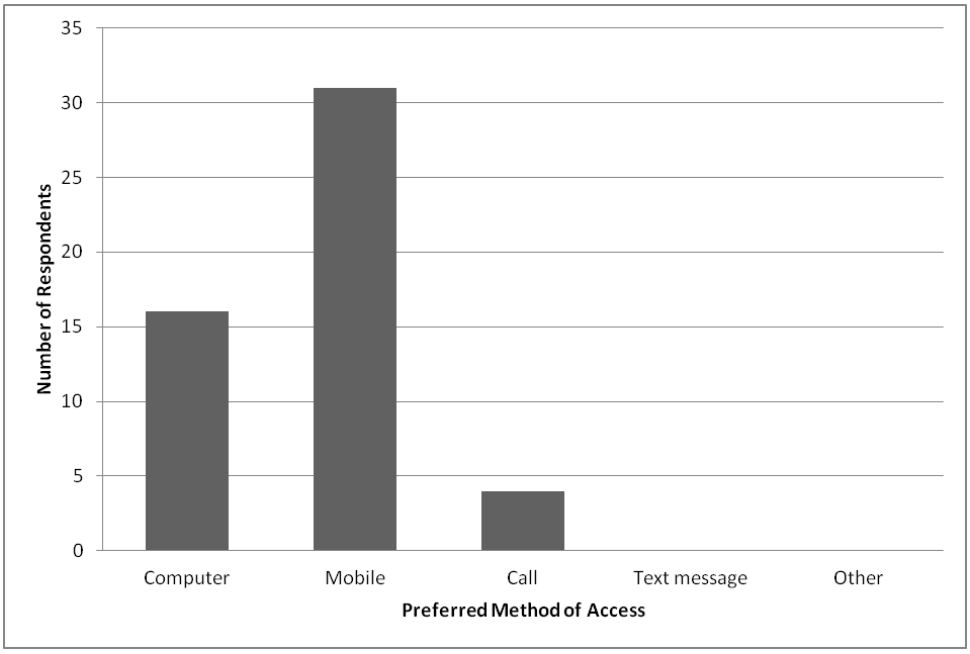
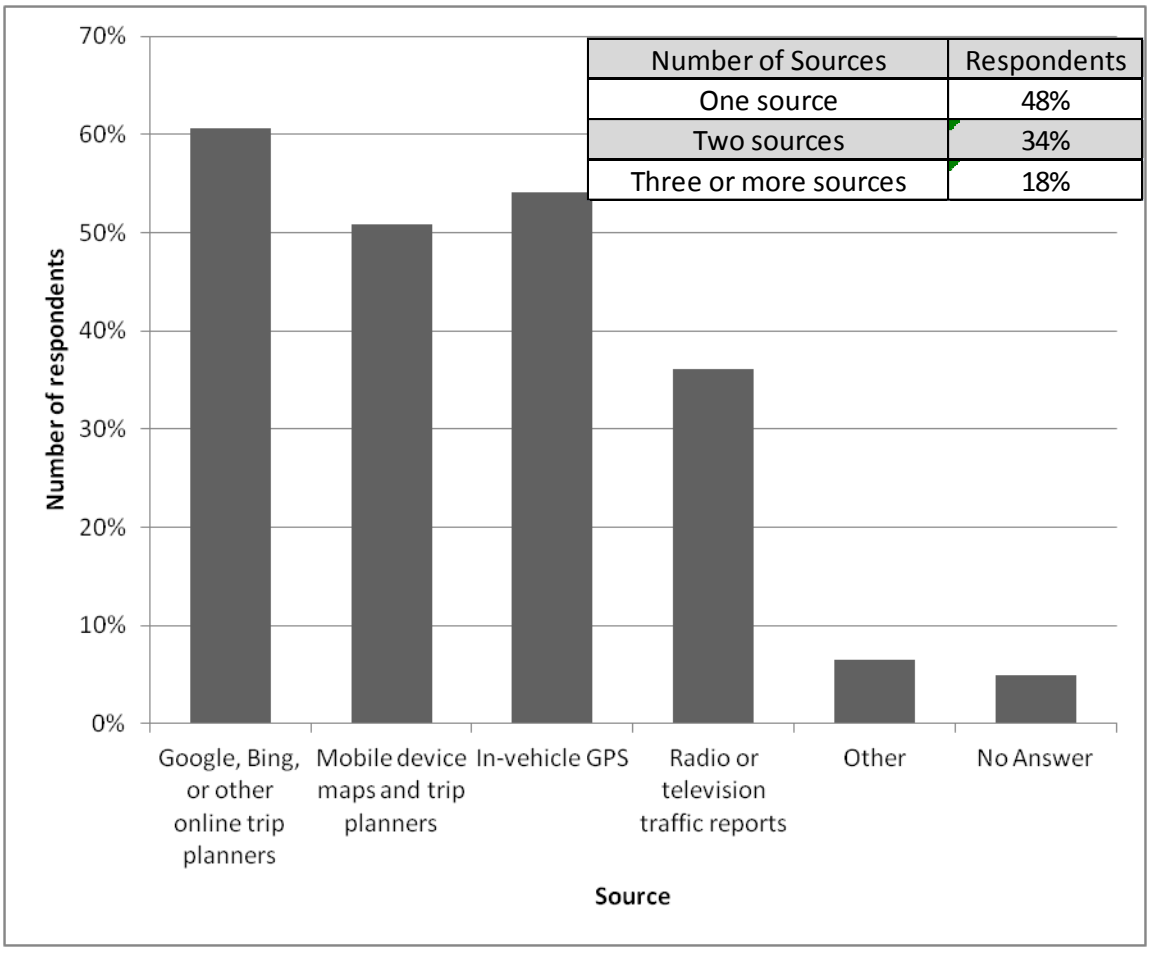


Figure 11: Combined mobile methods of access

Outside Sources

Other sources were also considered. Figure 12 shows the other sources respondents use outside of GDOT. It also includes a table of the number of respondents who reported one, two, and three or more additional sources. Most of these sources are trip planners or can be used as trip planners, a tool that the NaviGAtor system does not offer. Based on these results it appears that most NaviGAtor users are supplementing NaviGAtor with additional sources.



Number of Sources	Respondents
One source	48%
Two sources	34%
Three or more sources	18%

Figure 12: Use of other sources outside of GDOT

Frequency of Use

The frequency at which respondents use NaviGAtor at different points in their trip is shown in Figure 13. The responses for frequency of use when first planning a trip and during the trip are mostly unvaried. However, over half of the respondents reported to check NaviGAtor shortly before leaving, every time they make a trip. The high use of NaviGAtor shortly before leaving suggests that the survey respondents are a group more likely to change their travel decisions based on traveler information, because they are only seeking the information shortly before making their travel decisions.

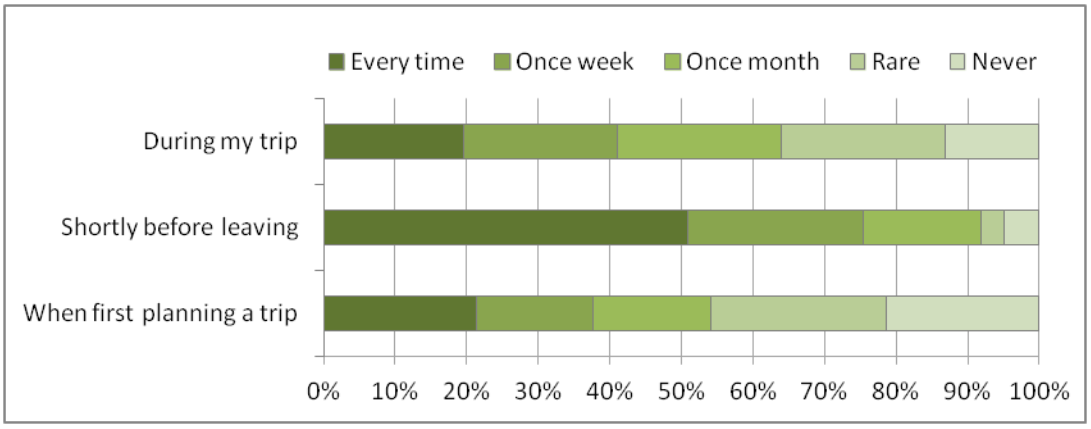


Figure 13: The frequency at which respondents use NaviGAtor at different points in their trip

Satisfaction

Another major goal of the survey was to ascertain what information the users of NaviGAtor were most interested in and whether the current tools provided were meeting their expectations. These questions used range answers, such as very important, important, neutral, unimportant, not at all important, and no answer. These options were weighted with values from 5-0 respectively. The results were then averaged for each tool. Figure 14 shows the average satisfaction rating by tool and Figure 15 shows the average importance rating. Ideally, the tools considered to be most important would also be most satisfactory. Comparing these two graphs, it becomes clear that this is not the

case. Several tools, including traffic map, which is considered the most important, are found at much lower satisfaction ratings than their respective importance rating. This may be because the tools that are thought of as more important are likely held to a higher standard than those tools that are not as important or not used as often.

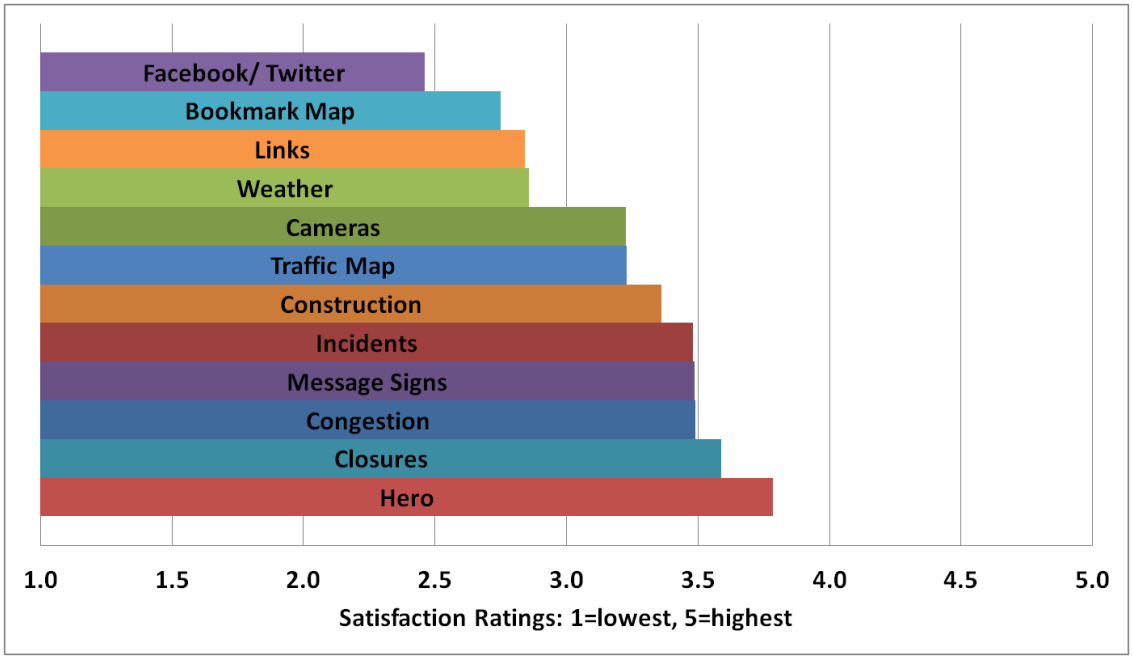


Figure 14: Average satisfaction rating by tool

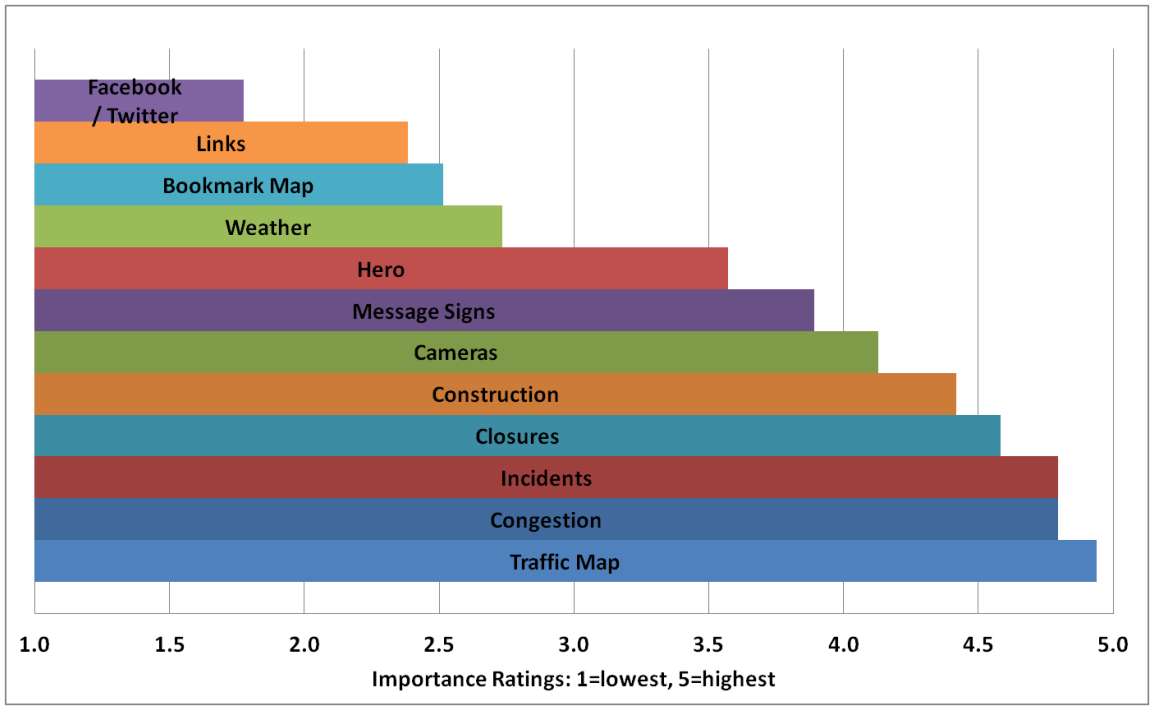


Figure 15: Average importance rating

Figure 16 shows the distribution of responses for level of importance and satisfaction for each tool on the NaviGAtor website. Each individual graph has a satisfaction scale increasing from left to right and an importance scale increasing from bottom to top. The shading of the color indicates the number of data points, the darkest having the most data points, the lightest only having one. Therefore, a darker color represents increasing agreement across respondents. For example, almost every data point lies in the top importance level for the traffic map, yet they are evenly spread across satisfaction. This distribution would indicate that while most respondents find the traffic map to be of top most importance, only about half of the respondents are satisfied with its current abilities. From this graphic we can see that the most important tools are traffic map, congestion, incidents, and closures. However, the most satisfactory tools are much harder to determine because they are less concentrated. This could mean that while most

users are looking for the same information, their expectation of how the information will be displayed varies.

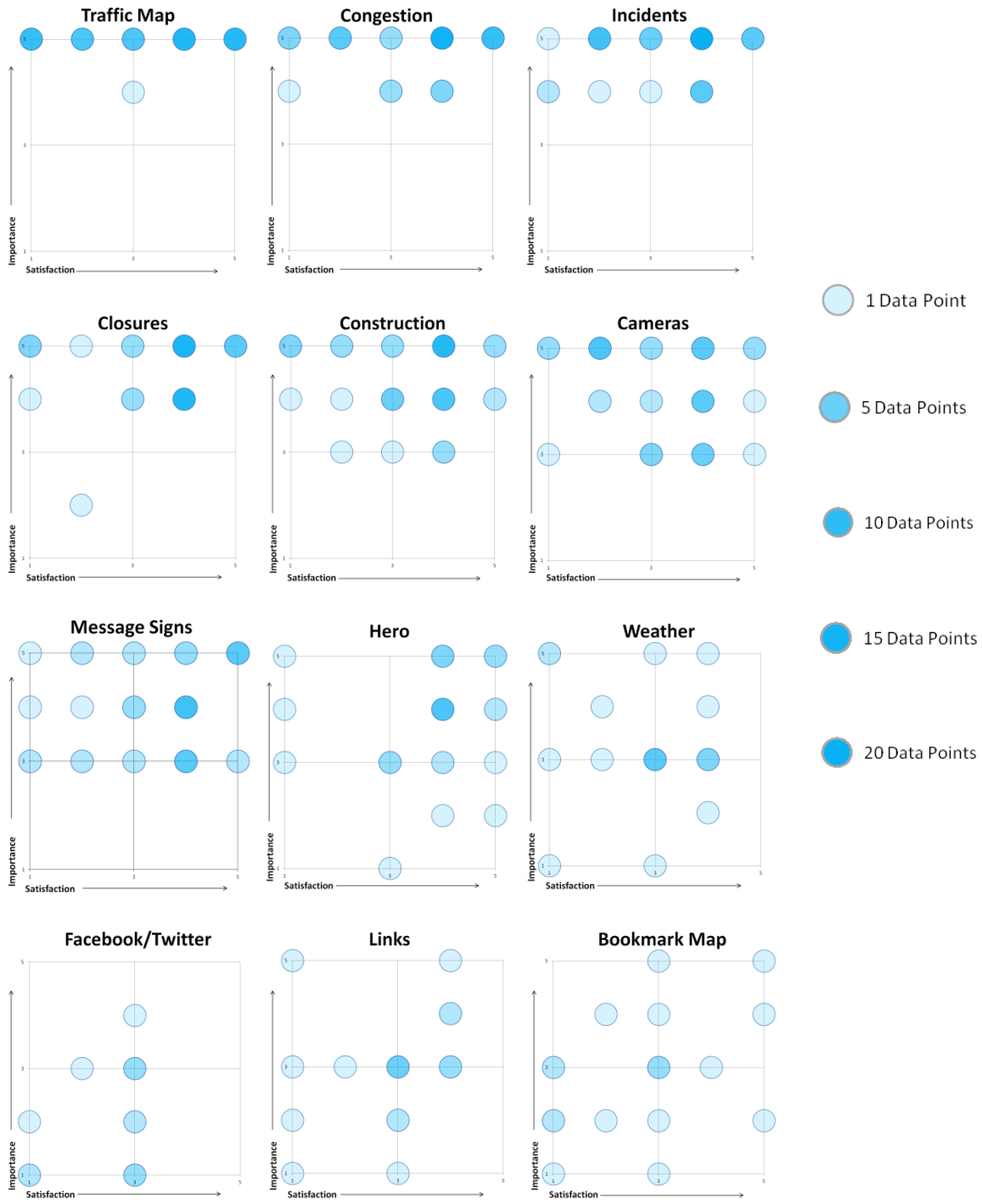


Figure 16: Distribution of responses for level of importance and satisfaction for each tool on the NaviGAtor website

The importance and satisfaction ratings for each tool were averaged to show how the tools compare to each other in Figure 17. This graphic also plots each tool along an importance scale (y-axis) and a satisfaction scale (x-axis). If the tools exhibited a linear pattern it would indicate that the ATIS developer was putting more effort into all of the most important tools, as opposed to the less important tools. This graph demonstrates this effect to some extent as all of the data is clustered in either the unimportant/dissatisfied or the important/satisfied quadrants. However, tools such as the traffic map and incidents should be improved since they are the top most rated tools for importance and are not found to be as satisfactory as other tools.

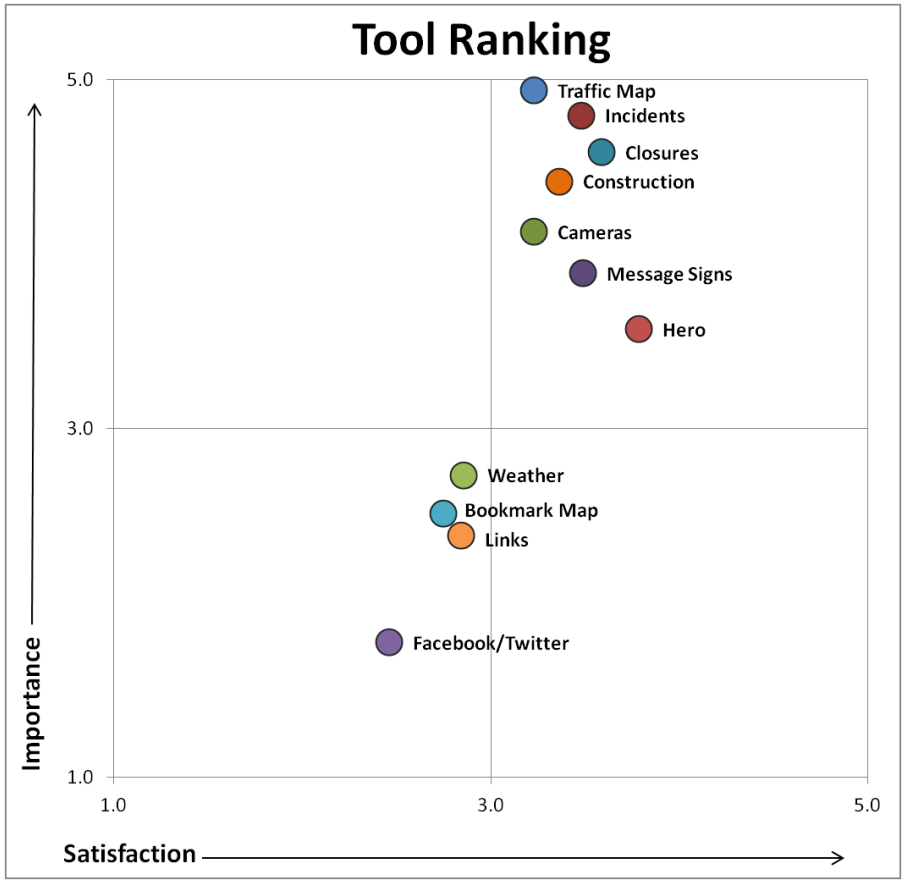


Figure 17: Combined satisfaction and importance ranking across all tools

New Features

To survey what types of information the current users of NaviGAtor might feel is missing from the system as it is, 11 different tools, common to other ATIS websites, but not available on NaviGAtor, were described and participants were asked to rank them in order of importance. Their answers were weighted, 11 points for an answer of 1 and so on, and averaged for each tool. Figure 18 shows the new tool ranking scores with a margin of error of 17.06%. Most of the tools rank too closely to separate them out from each other with any confidence. However, the travel time calculator is clearly considered more important by the survey respondents.

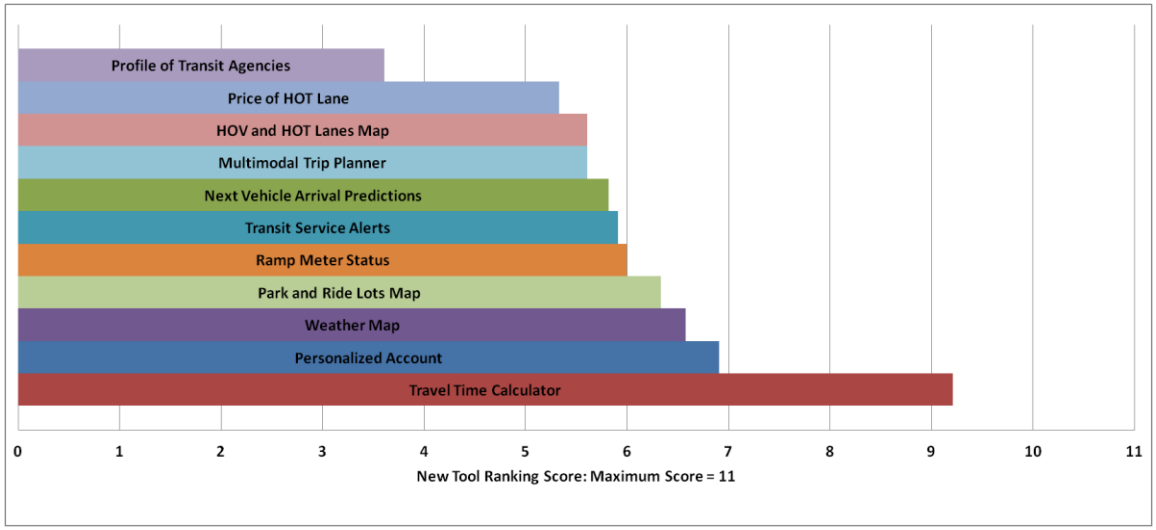


Figure 18: New tool ranking scores

Website Satisfaction

Finally, the last piece of targeted information in the survey was the participants' opinion of the site itself. For these questions, a series of statements were provided, for which the respondents would answer how strongly they agreed or disagreed with them. Table 5 shows the statements used to determine user satisfaction with each metric of the website. A distinction is made between needed information and desired information,

because it is important to know if the users' basic needs are being met, in comparison to the information they would ideally like to have. For example, incidents represent information they need, but travel time between two points is information they desire.

Table 5: Statements used to determine user satisfaction with each metric of the website

Metric	Statement
Currency	All of the information I get from the NaviGAtor website is kept up-to-date.
Navigation	The first time I used the NaviGAtor website it was not hard to find what I was looking for.
Usability	I find the NaviGAtor website easy to read and understand.
Format	The format of the NaviGAtor website is easy to use.
Organization	The organization of the NaviGAtor website is easy to understand.
Desired Information	The information I would like to have is available on the NaviGAtor website.
Needed Information	The information I need is available on the NaviGAtor website.

The responses to the statements about website metric are shown in Figure 19. The responses are shown by percentage from strongly agree, which is always positive in this case, to disagree, which is always negative. This chart can be read in multiple ways. A low percentage of agreement, as well as a high percentage of disagreement indicates a negative response. For example, the most negative responses, as determined by the percentage of disagreement, were to the usability and organization of the website. In contrast, the least positive responses, as determined by the percentage of agreement, were for usability and format. Because usability is in both of these categories, it can be assumed that this is the least agreeable statement. However, while most of the statements are more variable, it is clear that needed information is the most positive statement, suggesting that the respondents continue to use NaviGAtor because their basic information needs are being met.

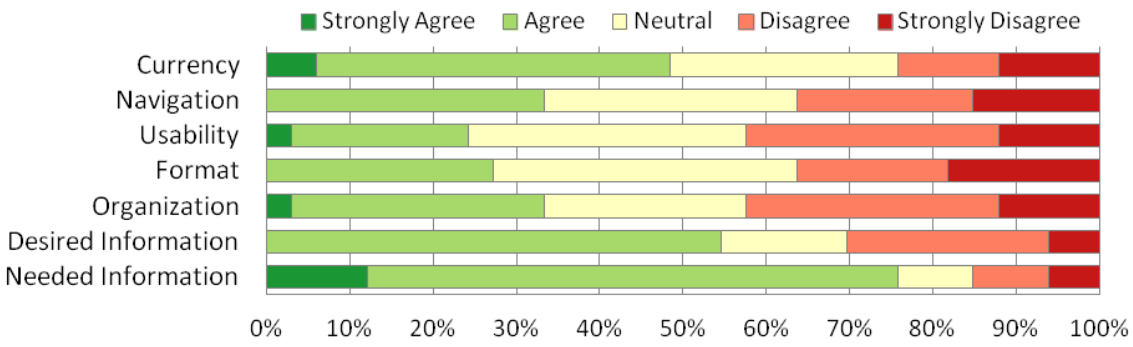


Figure 19: Responses to statements about website metrics

The overall satisfaction of the website was also surveyed. The results of which are shown in Figure 20. Despite the overall negative responses to the website metric statements, the respondents' overall satisfaction with the website was mostly positive. This could mean that the respondents of the survey are not looking for much more than the basic needed information.

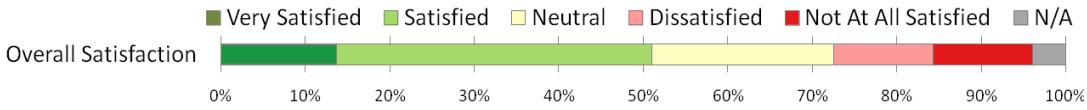


Figure 20: Overall satisfaction results

Open Answer Responses

The survey also contained two opportunities for respondents to leave open answer comments including suggestions on new tools and suggestions to make the site easier and more useful. Thirteen suggestions of new tools were made, six of which were about a mobile app or an improvement to the current mobile website. The remaining seven included providing alternate routes, providing trip times, providing live camera feeds, improving the traffic map so it would hold its position when zooming in, improving the display of the upcoming construction, including the live map and incident report on the home page, and getting access to more cameras.

The second open response question yielded ten suggestions. These included three suggestions about improving the legibility of current and upcoming construction, including putting upcoming construction on the traffic map. Also, two suggestions were made about improving the mobile version of the website, two suggestions were made about removing the ads on the homepage The rest of the suggestions included improving the zooming functions on the traffic map, improving the reliability of cameras and road signs, and providing more relevant information on the homepage.

CHAPTER 6

FUTURES WORKSHOP

Origins

A future's workshop is a method of participation that encourages creative solutions from the public. The workshop's designer, Robert Jungk, was a socialist who believed in participative and collective decision-making. His desire to affect social change and bring greater power to the public manifested when he was arrested for anti-Nazi activities as student in Nazi Germany. Later, his work led him to an anarchist socialist group, whose non-hierarchical, decentralized, and collective decision-making style motivated Jungk to design the future's workshop in the 1950s. [31] The basic structure of a future's workshop is: critique phase, fantasy phase, and implementation phase. The critique phase is meant to expose and bring to light the actual problem situation. The fantasy phase, designed after Alex Osborne's brainstorming techniques, is meant to develop new ideas. While the future's workshop was created to empower oppressed groups and create social change, this technique has been used extensively in environmental issues, and has been increasingly applied in varied settings with many objectives. [32]

The main purpose of a future's workshop is to gain implementable ideas to fix a problem. In the critique phase, the goal is to list all of the negative aspects of the forum topic. Then the fantasy phase changes those negative statements to positives and expands to encompass anything and everything needed in a utopian version of the forum topic. Working backwards from there, an implementation phase is used to define the ways in

which some pieces of the fantasy phase could be provided and prioritized. The main outcome of this workshop is to devise creative and implementable solutions.

Methodology

A future's workshop was chosen as a method for collecting data on GDOT's 511 traveler information system, because a main piece of creating an effective and efficient traveler information system is to create the system that the public wants to use. A future's workshop can allow more freedom than a survey and inspire a more creative environment. However, the workshop's structure was changed slightly because the participants were not capable of implementation and had no way of knowing by what means their ideas would or could be implemented. Therefore, the implementation phase was omitted and more focus was placed upon the fantasy phase.

To receive the most creative responses to the workshop, a supportive environment is necessary so that average commuters would not feel intimidated by industry professionals such as Intelligent Transportation Systems specialists. Therefore, the decision was made to hold separate workshops for each stakeholder group. Stakeholder groups that had a formal organizations and regularly scheduled meetings were initially targeted, as it would be easier to coordinate logistics for the workshops. Unfortunately, although several organizations were willing to participate in the forums, schedule conflicts prevented any of their participation.

The general public workshop was also difficult to coordinate, because the general users of 511 do not have any kind of formal coalition. To gather them together, the database created from the "Contact us" page of the NaviGAtor website was used. The "Contact us" page of NaviGAtor contains a form, in which users can send a message to

the website's managers. The form itself asks for general information including name, e-mail, telephone number, "nature of request", and message. The "nature of request" question has four options including website or system problem, ramp meter, camera, or sign malfunction, schedule a tour of the TMC, and other. After the user completes the form, its contents are placed into a database. The database used in this research contained almost 1,500 emails from January 28th 2011 to June 26th 2012. The messages containing comments about the 511 system were found and the commenter was asked to participate in a Future's Workshop via email. Initially only those comments that were not aggressive were chosen, however, due to the lack of response, all of the most recent comments about the 511 system were chosen. In total, almost 100 people were asked to participate via email, of which, five people confirmed their interest in attending, ultimately resulting in three actual attendees.

During the workshop, large pieces of paper were used by the recorder to record the ideas made by the participants as the facilitator conducted the workshop. These comments were later permanently recorded and coded by topic using three different categories including functionality/features, organization/aesthetics, and data/information. These were then analyzed on content and given implementation strategies.

Results

The workshop lasted an hour and yielded a total of 32 main discussion points, 13 during the critique phase and 19 during the fantasy phase. These were coded into the three previously named categories: functionality/features, organization/aesthetics, and data/information. The results are provided in Table 6.

Table 6: Results of Workshop

Functionality/Features	Organization/Aesthetics	Data/Information
Critiques		
Moving map location difficult: zooming/scale		
Mobile app and website take too long to load		
App hard to navigate while driving: dangerous		
Radio updates take too long while driving: ads, announcers		
Too many menus when calling 511		
The web interface is too complex: difficult to navigate (fake map on the home page)		
Takes too long to get important information on website, not all in one place: incidents		
Map is too small		
Too many tabs on website		
Too many ads on website		
Inaccurate information: sometimes listed correctly, but misplaced on map, or missing, etc		
Too much jargon: connector, spaghetti junction		
There is not enough information about incidents: exit number, mile post, clearance time		

Functionality/Features	Organization/Aesthetics	Data/Information
Fantasy		
Allow app to use GPS to give relevant updates		
Put quick button on app screen to call in incidents		
Shorten load times on website and app		
Allow hovering on map to see features: cameras, incidents, construction, etc		
Create app that can use voice control		
Allow use of origin and destination instead of only dropdown menu on map		
Include local businesses in app using GPS - Could sort/filter by popularity/ratings - Could pay for the advertisement = revenue		
Have a place for public input instead of 'contact us'		
White background for website		
Simple map (green, yellow, red is good)		
Unite under one name: NaviGAtor *and* 511 confusing, 511 is enough		
Make map bigger		
Work with WSB to build on what they have - Allow others to use data to make websites/apps		
Include estimated time of clean up for incidents		
Show closed roads as different than red on map		
Remove jargon from radio and 511 or also include mile markers and exit numbers		
Give alternate route for avoiding traffic via website, app, or radio		
Put estimated time on changeable message signs		
Add pavement markers and directional signs to confusing parts of the system for wayfinding		

While the results of the forum may be useful for gauging what the public wants, the actual contents of this list are merely suggestions. The more important result comes from teasing out the participants actual interests from the list. For example, four of the 13 critiques are related to the participant's dissatisfaction with receiving information while driving including "Mobile app takes too long to load", "App hard to navigate while driving: dangerous", "Radio updates take too long while driving", and "Too many menus when calling 511". Also, 7 (37%) of the 19 suggestions made in the fantasy phase are relevant to receiving information while driving including "Allow app to use GPS to give relevant updates", "Put quick button on app screen to call in incidents", "Shorten load time on app", "Create app that can use voice control", "Include local businesses in app using GPS", "Give alternative route info for avoiding traffic", and "Put estimated time on changeable message signs". Given the consistency, one of the public's main interests may be the availability of travel information during one's trip. Looking more closely at all 11 of the comments made on this subject we see that safety, speed, convenience/relevance, and accuracy appear to be priorities.

With a better understanding of actual interests regarding information while traveling, the solution can have a better gauge of effectiveness. For instance, many of these interests can be included in the development of a new app. If a new app is designed, which is hands-free, can update quickly and frequently with regard to the user's current location, and in which the information is accurate, then all of the interests regarding a mobile app will have been met. One such application of this nature currently exists. It is called "Trip Talk" and was created by Information Logistics for the Pennsylvania Turnpike. While reviews for this app are mixed, with a score of 3.8 out of

5 from 29 reviewers, its features contain all of the elements found to be of interest to the public in this forum. The application is opened at the beginning of the trip and remains on throughout the duration. The app automatically "broadcasts" traffic updates and advisories, using public agency's data, within a specified range of the mobile device's GPS. When there are no updates, the app remains silent, outside of advertisements for businesses also within range of the GPS. It is likely that there are many apps currently being developed that are similar to this one and are worth looking into.

Most of the other suggestions are fairly straightforward. For example, there appears to be an interest for speed and convenience with regard to the website, in which load times and the poor organization make finding information quickly difficult. Most of the solutions to these issues are technical. For instance showing camera pictures, incident reports, and construction reports when hovering over the icons shown on the map, changing the programming to allow faster loading speeds, and adding a trip planning function by allowing users to input an origin and destination can all take time to implement. However, in lieu of these technical changes, organizational changes can be made to meet some of the vested interests and make the website more efficient. For instance, the real time traffic map can be relocated to the home page. Additionally, the incidents and construction pages can include the actual report listed below the location to minimize the number of clicks. In fact, given the space required to report incidents and construction, including both on one page could also be feasible.

Some suggestions may not be feasible. For example, working with WSB on creating a traveler information website might not work, as it is important to have a 511 website as a resource for out of town travelers. However, the interest behind it suggests

that the organization and functionality of WSB's website is superior to GDOT's, for all of the reasons listed in the critique phase, and can be used as a model to be improved upon.

The WSB comment in the fantasy phase also suggests that GDOT allow its data to be used by private website and application developers. While GDOT currently does allow developers to use their data, advertising its availability more explicitly to developers could generate more interest and, thus lead to the creation of more applications and websites.

CHAPTER 7

FEEDBACK WEBSITE

Methodology

One of the tools used to seek out user input in GDOT's ATIS was an online feedback tool. Online feedback tools are a new way to survey a customer base. There are many online feedback tools for purchase and they have many different formats and features. Common features include a short satisfaction pop-up survey, a forum where users can seed ideas, questions, problems, and praise, a tab on the side of the website, and an analytic component to view some of the website's statistics. Different feedback tools also have different functionalities, for instance, the ability to customize the tool, and the level of moderation available for the comments can vary between different websites. This was a large factor in choosing a feedback tool for this study, because, as a public institution, GDOT had to be very careful about what kinds of comments were shown on the site. Five of the most popular tools available today are CrowdSound, IdeaScale, GetSatisfaction, UserEcho, and UserVoice. UserVoice was chosen for this study because it was available to public institutions for free through a civil engagement discount, free use for government agencies, and had all of the functionality we were interested in. The functionalities that we were most interested in through this study were a high level of customizability, the ability for users to see other users' ideas, and the ability for users to vote for each other's ideas, all of which were offered by UserVoice.

Once UserVoice was selected as the online tool, the site was set up and customized to restrict the form to only ideas, which were to be approved through email

before being published. The reason the form was restricted to ideas was because of the backlash from the public after the NaviGAtor website was redesigned. GDOT found the comments sent in after the redesign to be aggressive in nature. In order to keep the users of NaviGAtor thinking toward the future in positive ways, it was decided that moderated new ideas would be appropriate at the start, with the addition of comments and problems later.

The feedback tab was put on the NaviGAtor website on August 20th. Screen shots of the tab are provided in Figure 21 and Figure 22 below. The tab was seeded with eight ideas for features that were found from surveying other ATIS websites and used in the survey including 'Let people calculate the approximate time of their trip', 'Show when the next bus/train is coming', and 'Show the status of ramp meters'. This was in an effort to show users how the system worked and to note their reactions to these ideas.

Figure 21: Screenshot of Feedback tab on NaviGAtor home page

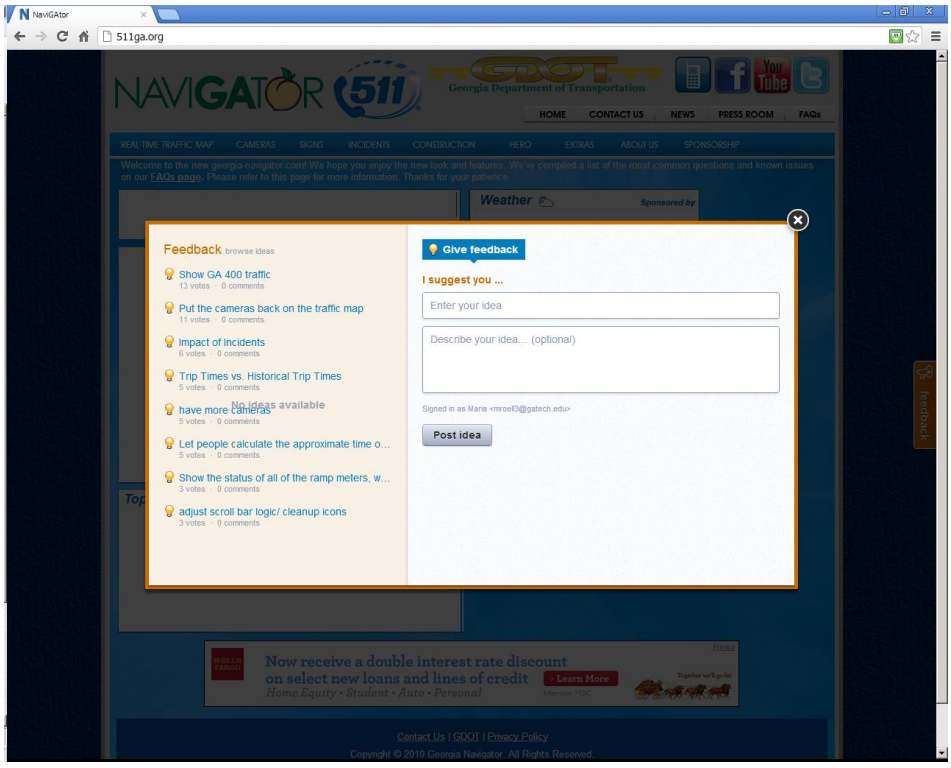


Figure 22: Screenshot of Feedback window after tab is clicked

Results

In the two months that the UserVoice feedback website has been active, 40 ideas have been added. Between September 24th and October 24th, there have also been 144 visits and 25 active users. Table 7 below contains all of the ideas ordered by number of votes and color coded by type of request as of October 23rd 2012.

Twenty-six of the ideas have one vote, seven have two votes, one has three votes, and seven have more than 3 votes with 16 as the highest number of votes for any one idea. This level of activity is low considering the amount of people visiting the site each day; however, it is not unexpected. There are many possible reasons for the low percentage of participation. For example, the feedback tab, as an internet convention, is a fairly new concept that many of the NaviGAtor users may not be familiar with.

Therefore, they may be less likely to see the tab. Also, many users of the NaviGAtor system, according to our survey, use the NaviGAtor site shortly before leaving on their trip, which could indicate that they do not have time to browse the ideas. This is further illustrated by the same ideas being suggested with only one vote each. It is possible that there will be an increase in feedback site usage the longer it is left active.

Table 7 also breaks down the ideas into type of request using the same categories as the forum comments. The breakdown is 21 ideas for features/functionality, 13 ideas for data/information, and 4 ideas for organization/aesthetics. Similar to the workshop comments, the feedback ideas tend to find more solutions in the creation of features or improved functionality, rather than through changes to the organization of the site. However, there are many more ideas related to functionality and the site working properly in the feedback ideas than in the workshop comments. This is most likely because when something does go wrong, the feedback tab is readily accessible. Adding the questions, problems, and praise options into the feedback tab would help sort these ideas out into temporary glitches and more persistent issues.

Table 7: Ideas from UserVoice by number of votes and color coded by type of request as of 10/23/2012

Functionality/Features	**Organization/Aesthetics**	**Data/Information**
Number of Votes	Idea	Comment
16 votes	Show GA 400 traffic	GA 400 traffic should be displayed on your maps.
15 votes	Put the cameras back on the traffic map	
11 votes	Trip Times vs. Historical Trip Times	Bring back the option to calculate current trip times between exits/interchanges and pair them with the old historical trip times. So, if the current trip time is longer than the historical trip time (say for the past year), let us know. If it's speedier, that will help people choose the right route.

Table 7: Continued

10 votes	Impact of Incidents	I miss the detail on the incidents. Showing moderate for example, then an approximate time the road will be cleared.
8 votes	Let people calculate the approximate time of their trip	This could be in the form of a travel time calculator.
6 votes	Show the status of all of the ramp meters, whether they are on, off, or not functioning	
6 votes	Have more cameras	Would be nice to have more cameras for a more complete traffic view and instead of snap shots how about live cameras.
3 votes	Adjust scroll bar logic/ clean up icons	Scroll bar scrolls both page and zoom simultaneously; it's annoying, only do zoom! Certain boards will only show if you zoom in.
2 votes	Show when the next train or bus is coming	Use GPS to map or give estimated times of arrival of transit vehicles
2 votes	Add a weather map to the traffic map	Overlay weather on the traffic map to review both conditions at the same time
2 votes	Include transit alerts	Map and list all of the transit service interruptions or diversions
2 votes	Show current price of HOT lane	
2 votes	Update incident reports as soon as they are cleared	
2 votes	Update FAQs	Your FAQ section has info that is obviously pre 2011 as many answers state "expected 2011" and such. If you don't keep FAQs current, they are pointless. Save resources by just deleting that section of the site if it's not current and misleading.
2 votes	Put traffic signs (cms) back on map	
1 vote	Site doesn’t work with internet explorer 9	Says its some kind of javascript error
1 vote	show alternative routes to avoid traffic	Have an icon to click on which shows alternate routes to avoid or go around major traffic incidents.

Table 7: Continued

1 vote	Make live traffic video available	Picture is worth 1000 words. Video is worth 1000 pictures + you could make $ from advertisements on the site, more than enough to pay for the necessary upgrades. Maybe feed it through youtube?
1 vote	Need a chart to show best times of the day to travel interstates	I want to calculate the best time-of-day to travel alternate routes to work. The traffic rush-hour seems to be getting wider, but is it starting earlier, later, or what? I want to drive from Cartersville to Norcross, and I am looking for "Best Drive Times" that are very specific.
1 vote	Give option to save preferences	After turning some features off, such as cameras, need to be able to save this view in a profile
1 vote	Show scale at bottom of traffic maps. Google has it, you don't.	
1 vote	Show cameras, incidents, cms, etc. when button is turned on	I have cameras, incidents, cms, closure and construction turned on, and it says they are on...but they are not on.
1 vote	Make the map bigger. Make the page fill the screen.	The current map page leaves about 1-1/2" of blue margin on the left and right sides. Why not just make the page fill the screen? Give the user a 'full screen' option to view the map. I constantly have to zoom in and then zoom out to see various parts and to read the street names.
1 vote	update the traffic on the map more frequently	
1 vote	Keep up the good work	
1 vote	Simplify look	Takes too long to load on computer or portable phone. More space between color lines showing traffic flow along a highway so we can see which direction is having traffic flow issues.
1 vote:	Get a mobile app!	Develop a mobile application for the georgia-navigator.com website!!!

Table 7: Continued

1 vote	Make the site work without javascript	
1 vote	Show routes for SR 316	It would help if you would let drivers know about roads leading out of town, like Highway 316 towards Athens. This would help drivers know in advance if alternates should be used before we get to the area and get locked into a traffic jam.
1 vote	Have mobile apps for Android and iPhone	
1 vote	Make camera timestamps visible on first click	Visitors have to click image a second time to get a full size view to be able to read the timestamp
1 vote	Show ramp closures	
1 vote	Speed up page loading for mobile	
1 vote	Find a way to enlarge sensor map page without changing the map itself	
1 vote	Fix the Get The App button	The app center opens, but it doesn't take you to the app for Navigator. What's the name of the app? Can't find it...
1 vote	Continue the good work!	
1 vote	Use Hwy 41 as a description for Cobb Parkway instead of Hwy 3	
1 vote	Add a link to multi-modal trip planner	Add a link to a trip planner that includes transit or bike directions, such as OpenTripPlanner (http://opentripplanner.com/).
1 vote	include personal account abilities	Allow users to sign into their own account on NaviGator to save typical trip routes and get updates on those specific routes.
1 vote	511 Line and your cameras don’t seem to be working	I have noticed lately that the camera network and 511Live for my mobile devices are not working. Any idea when these will come back online?

CHAPTER 8

COMBINED ANALYSIS

While larger samples and more representative participants would have improved this study, all four of the methods used in this research are informative to an internet-based ATIS design process. The website evaluation provides a baseline for comparison of features with other traveler information websites, as well as provides a checklist of criteria that traveler information websites should try to accommodate. Survey methods provide the demographic characteristics of users and can gather the general preferences of those users. Future's workshops provide face-to-face interaction, improving the relationship between the agency and the users of the ATIS, as well as providing a helpful dialogue to tease out users' actual interests. Feedback websites also improve the relationship between the agency and the users, as well as providing the user's priorities and creative problem solving abilities to the agency.

The results obtained from the website evaluation were varied for most of the categories, but lacked a large range in the overall results, because each website excelled in different categories. It is possible that one category might be more effective in increasing user satisfaction than the other. This could be studied by surveying all of the users across the different websites to see which are the most satisfied in comparison to the how well each website performed in each of the categories. While surveying users from every website for satisfaction was outside of the scope of this study, the results of the public participation methods can be used to make some assumptions about which categories are currently the most important to Georgia's NaviGAtor users. In this case,

the users represented in this study seem most interested in the availability of features, the ease of navigation, and convenience.

The users' preference for features in the website was most apparent in their discussions of the traffic map. Many of the comments they made were about putting information that GOT already has access to on the map, which would add to the level of features offered in the map's data layers. Participants also had recommendations for improving the functionality of the map, such as the ability to roll-over icons for information, or improving the zoom mechanism. In the survey, respondents also showed a preference for a travel time calculator to be added to the list of available features on the website.

The ease of navigation and convenience was also very important to the participants of these methods. The organization of the website was mentioned frequently as a problem during the future's workshop, as well as in the feedback site's ideas. The survey respondents also scored usability as the lowest metric in the website satisfaction questions. Thus, our recommendations for the website include reorganization and an update to the navigation pane.

Based upon this study's website evaluation, Georgia's NaviGAtor website was ranked fourth for features and ninth for usability. These results suggest that the users of the website have identified the deficiencies the site has in these areas. It could also imply that user satisfaction for the NaviGAtor website would increase with the improvement of the navigation and organization of the website. However, this does not give much insight into whether or not these categories are the most important for website quality. More data would be needed to compare the level of satisfaction between websites with different

deficiencies to see which categorical deficiencies have the greatest impact on overall website satisfaction.

The results of the survey, future's workshop, and feedback site were in agreement with each other and reinforced one another. Each of these methods suggested that most of the basic information considered as necessary is available, but it may not be presented in the most convenient ways. They also all found a preference for increasing the mobile capabilities of Georgia's ATIS.

The survey was especially effective for examining the usage characteristics of its respondents. For instance, there was a significant preference shown for mobile use, but a majority of the respondents responded that their current method of use was their computer. It was also clear that most of the respondents check the site most often shortly before leaving. This type of frequency suggests that the users are likely to change their travel decisions based on the traveler information, because this is the time when many travel decisions are being made. It also means that it is important to keep the website convenient and easy to use, because users may be under time constraints. This usage pattern could explain a disparity that can be seen between the website evaluation and the public participation comments. In the website evaluation of webpage load time, NaviGAtor was among the top performing websites as compared to the other site evaluated. However, many of the comments in the future's workshop and the feedback site were about the website taking too long to load. The users' perception of time in this case is may be affected by the time pressure they are usually under when they are accessing the site.

The survey had very few respondents compared to the volume of visitors the website regularly receives. Several factors could have contributed to the low response rate on the survey. First, the survey was only advertised in the alerts box on the homepage and on the alerts page itself. Therefore, as more alerts were added, the survey link moved down the list and eventually out of sight. Second, the time in which users might regularly access the site, according to the survey results, would mean that most users may be using the site quickly and may not want to stop to take the survey. The high dropout rate could also indicate this, as users may have left the survey because they no longer felt they had the time to finish it. Therefore, a different recruitment plan is needed with a more prevalent placement of the survey link. The user of the website could also be prompted to take the survey upon entering the site via a pop-up message.

Overall, the survey was effective at providing general characteristics of the respondent population, but was less useful in describing the areas with the biggest need for improvement, or the ways in which most users would like to see the issues resolved. These characteristics are supported by Rowe and Frewer's study [23], which found that surveys are able to clarify agreement and disagreement in a population, but do not give a clear direction for policy makers. The future's workshop and the feedback website also had small samples, but provided a better picture of these aspects of the ATIS development process.

The future's workshop was held with a very limited number of participants. There are many possibilities for this low level of enthusiasm. Firstly, the workshop was held at 5:30pm on a workday, so people might be less inclined to take the time to participate. Secondly, the only users whose contact information was available were those

who were dissatisfied enough with the website that they sent a comment to GDOT via the Contact Us page. These users may have been too discouraged by then to feel that a workshop was worth their time. Third and finally, it is generally difficult to get participants involved in workshops, because workshops are thought of as inconvenient.

Even with the low level of participation, the results of the workshop seemed to reflect the interests of many of the general users of Georgia's 511 system in the Atlanta area. Also, the results were instructive in determining the participants' actual interests imbedded in their suggestions. In reaching these interests, simple solutions that resolve multiple suggestions can be found more easily. This is the greatest advantage of this participation method as Rowe and Frewer found "'focus groups' advantage lie in… identifying values that underlie opinions." [23] The participants also expressed gratitude in our holding the workshop. They mentioned that they had felt that their feedback was unimportant to GDOT's web development and that they had had a lack of trust for the agency. Therefore, the workshop helped to make the participants feel that their opinions were being heard. However, this is too small a sample size to make any conclusions about how the general public would feel in a future's workshop.

The feedback website also had fewer participants than the number of daily users of the site would warrant. The reasons for the low response rate were most likely time constraints, similar to the survey, and also unfamiliarity with the feedback tab. Also, there were six ideas submitted to the feedback website that were not approved by the moderator due to their negative or unhelpful language. While none of them were outright offensive, they did display anger, which does not help produce a creative discussion forum. These comments were either edited by the site moderator to be more direct and

less emotional, and then resubmitted to the forum or deleted, in the case of those that did not have any focused directives. The number of angry ideas submitted was not significant compared to the acceptable ideas posted (6/40), suggesting that the users who were completely dissatisfied were not the only ones using the feedback site.

The results do coincide with survey and future's workshop comments. This could mean that even though there was a low participation rate for each method, they each gave a fair representation of the general user's perspective of the NaviGAtor website. However, because the survey and feedback site's participants were both self-selected and the workshop's participants were selected from a list of users who had previously made comments on the site, it is more likely that there is a significant bias toward a specific group of users. Further research should be done on the actual composite of the NaviGAtor users using a wider participant base.

Overall, all of the participation methods showed different strengths and weaknesses. The survey provided the most analytical data for the widest span of users, but lacked any real depth of user input. The future's workshop provided the most in-depth user input, but is also the most difficult to implement and involves the least amount of users. Finally, the feedback website provides a medium level of user input at a wide span, but lacks the analytical data of the survey and the ability to tease out users' actual interests versus their suggestions. The small sample size and clear bias toward higher incomes, in the case of the survey, require this test to be repeated for larger samples to make any strong conclusions.

CHAPTER 9

DISCUSSION

Georgia Department of Transportation

This study found many potential issues in GDOT's current ATIS. Its technological shortcomings caused the most user dissatisfaction, but the website's navigation and features were also frequently mentioned throughout all of the public participation methods and the website evaluation. Several recommendations for each of these issues are outlined below, as well as a recommendation for all Departments of Transportation on the use of public participation to avoid user dissatisfaction and increase the effectiveness of ATISs to reduce congestion.

Technological Recommendations

The most frequently mentioned recommendation in all of the three participation methods used was the lack of options for mobile access of traveler information. The typical mobile-optimized website and mobile application can cause some major safety issues when they are applied to traveler information, because of the distraction they can create while driving. This was recognized by participants in the future's workshop. There are several options in creating mobile traveler information without endangering drivers. One of these options, the Trip Talk application, was already mentioned in this report. It is recommended that this application be further researched by GDOT, along with similar technologies, in order to create a safe, user-friendly mobile traveler information option for travelers in Georgia.

It is also recommended that GDOT ensure the quality of its data. This will allow it the freedom to open its data up to mobile application creators, in order to give the users more options as to how we could receive their traveler information. In order to have an ATIS that is effective in reducing congestion, the greatest number of people possible must use the information often to make their travel decisions. Providing many different options will work to meet the greatest number of people's preferences. This is only possible if many developers are given the opportunity to create applications, resulting in competition, which will increase the sophistication and functionality of the applications.

Website Recommendations

One of the factors that led to an increase in demand for traveler information in the literature was for those who were exposed to the greatest amount of congestion and volatility in traffic conditions. Atlanta's congestion fits this description well. Therefore, there is a high probability that demand for traveler information is high for the commuters in the Atlanta area. Coupled with the fact that internet technologies are the most effective form of ATIS, it is important that Georgia's NaviGtor website be high quality. The results of the website evaluation find that NaviGAtor's lowest scoring category is usability. Most of the site's potential issues in this category were for poor navigation. It is recommended that the website's organization be changed, specifically for construction and incidents. Currently, these alerts are found by clicking through individual roads. Providing an interactive table with both construction and incidents, where sorting and filtering by construction or incidents, time, road, and direction would be more convenient.

Based upon the color, fonts, use of graphics, and page balance the aesthetics of the NaviGAtor website were also ranked very low. The agency icons at the top of the page were very large and eye-catching, making the actual traveler information harder to find. Also, the current advertisements are displayed in the same area and using the same designs as the actual information. It is recommended that the icons be reduced in size and that the ads be more obviously separated so that the information that a user requires stands out more clearly. The picture of the traffic map on the home page was also found to be confusing to some users, so it is recommended that either a small version of the actual, interactive map replace the current picture, or that the picture be removed all together.

The survey found that most users find the real time traffic map to be of the greatest importance, but they were not fully satisfied with it in its current state. It is recommended that the traffic map be reformatted according to some of their requests to make it easier to use. For instance, implementing roll-over information instead of clicking each icon for more information would make using the map faster. Also, providing the planned construction in its own data layer would increase the amount of information that can be displayed. Finally, the zooming mechanism was cited several times for its inconvenience. Consultation with web developers may provide more options for this function.

The survey also found that a travel time calculator is one of the most desired tools for the current website. Travel times were also mentioned in the future's workshop and the feedback website. The addition of this information, whether in the form of a

calculator or tabulated for each road segment, is an addition the users of NaviGAtor would most likely welcome.

Use of Public Participation in ATIS Development

It is recommended that all Departments of Transportation running an active ATIS investigate the usefulness of a feedback website, such as UserVoice. Not only is the service free to public institutions, the moderation of the ideas is simple and quick, very similar to the processing of the comments made on a Contact Us page. The minimal to nonexistent cost of the service is worth the added transparency between agency and user, as well as providing the agency with a wealth of knowledge from the user on how to make a more effective ATIS. It is also recommended that the options for questions, problems, and praise be opened up for users, as these would mostly serve to assist the moderator in sorting the responses.

It is also recommended that a user survey be provided periodically to stay informed on any changes to the users' general demographics, usage characteristics, and overall satisfaction with the site. This could provide insights before dramatic upgrades or changes to the system take place, which could be taken into consideration when planning a system redesign.

Implementing future's workshops is only recommended for ATIS development when the results of both the feedback website and surveys are predominantly negative. Also, different recruiting methods are recommended to have more users engaged in the process. Future's workshops can be used to find the actual interests of the systems users to discover the precise reason of their dissatisfaction more than either of the other methods. It can also give the agency more credibility and create more loyal users.

However, the workshops are also the most difficult to implement, and the feedback website can provide similar results if very in-depth information is not needed.

CHAPTER 10

CONCLUSION

Overall the use of public participation was found to be instructive in the development of ATISs. Information on the users of the systems is invaluable in determining how to best disseminate traveler information to most impact travel decisions. For example, the survey respondents were found to have a different preferred method of access, mobile, than their current method of access, computer. A majority of survey respondents also reported that they visit the NaviGAtor website most often shortly before leaving. Both of these user attributes lead to different ATIS designs than user preferences for call-in access when first planning a trip.

The future's workshop and feedback website were less instructive on the usage characteristics of the NaviGAtor website, but were found to be better at eliciting creative responses from those who participated. The responses from the future's workshop were primarily focused on the safety of a new mobile application, whereas the responses on the feedback website offered pointed solutions to typical user issues, such as providing GA 400 data on the traffic map.

This research was conducted at GDOT primarily because they were undergoing a major redesign of their ATIS, especially their website, during the research process. It is clear that many of the recommendations that came out of this research were followed by the new website's designers after reviewing a beta version of the site. For instance, new features have been added, including a travel time calculator. Also, many of the usability characteristics suggested, such as using drop-down menus, minimizing the icons, and

separating out the ads from the informational space are included in the new website design. More specific suggestions from the participants, such as a larger traffic map and a report of the expected clear time incidents are also provided. Many new functions, such as the traffic data from Georgia 400 are going to be added before the site goes live.

Future research will include a the new NaviGAtor website in the same method of website evaluation as presented in Chapter 4 of this thesis. However, as a beta website, the lack total functionality reduces the applicability of the website evaluation rubric. Once the website is live, its score for the rubric can be compared to the current website's score, as well as a measurement of the reaction of the users using the three participation methods researched here, with new recruiting techniques. The comparison of findings before and after the website upgrade will be instructive of the appropriateness of the website evaluation rubric, as well as the further study of the appropriateness of using public participation for ATIS design.

More research should also be done on general traveler information user preferences, but it is more important for each agency to research their own constituents, as every area has different needs and preferences. Only three types of participation methods were examined here, but there any many that could be used to assist agencies in creating their ATIS. If users begin to have input into design, ATISs could be a low cost, effective method of reducing congestion.

APPENDIX A

SCORES FROM THE WEBSITE EVALUATION

Website Evaluation Rubric / Criteria	NJ	NY	AZ	CO	FL	SF	L. A.	HO	PH	CH	GA
Functionality											
Explorer	5	5	n/a	n/a	n/a	5	5	5	n/a	n/a	n/a
- Plan trip	5	5	5	3	5	n/a	5	5	n/a	5	5
- camera	5	5	5	3	5	5	3	3	5	5	5
- map	**5.0**	**5.0**	**5.0**	**3.0**	**5.0**	**5.0**	**4.3**	**4.3**	**5.0**	**5.0**	**5.0**
Firefox	5	5	n/a	n/a	n/a	5	5	5	n/a	n/a	n/a
- Plan trip	5	5	5	5	5	n/a	5	5	n/a	5	5
- camera	5	5	5	5	5	5	5	5	5	5	5
- map	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**
Chrome	5	5	n/a	n/a	n/a	5	5	5	n/a	n/a	n/a
- Plan trip	5	5	5	5	5	n/a	5	5	n/a	5	5
- camera	5	5	5	5	5	5	5	5	5	5	5
- map	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**
Time Stamps	0	4	2	5	5	5	5	2	0	5	5
Home time	3	3	4	5	5	3	3	5	4	3	4
Traffic time	3	3	1	1	5	4	3	5	4	3	5
Cat. Score	4.000	4.267	4.067	4.067	5.000	4.467	4.200	4.667	4.333	4.333	4.800
Accessibility											
Home page:											
Priority 1	5	5	5	5	5	5	5	5	5	5	4
Priority 2	1	0	3	0	4	1	1	1	1	2	1
Priority 3	4	3	5	5	5	1	4	4	4	5	5
Traffic Map:											
Priority 1	5	5	4	5	5	5	5	5	5	5	5
Priority 2	1	0	0	0	5	1	1	1	1	2	1
Priority 3	4	3	4	5	5	2	4	5	4	5	5
Brightness	5	5	5	5	5	5	5	5	5	5	3
Contrast	5	5	5	5	5	5	5	5	5	5	2
Cat. Score	3.714	3.286	3.714	3.571	4.857	3.357	3.714	3.786	3.714	4.143	3.286

Usability											
Pane consistency	5	5	4	5	5	4	4	3	5	4	5
Pane content	5	4	3	3	3	5	5	1	2	4.5	4
Hyperlinks	5	4	4	3	4	4	4	4	4	4	4
3 Click Rule											
- map	5	4	4	4	4	4	4	4	5	5	4
- incidents	4	4	5	4	4	3	4	4	n/a	3	3
- construction	4	4	4	3	4	3	3	4	3	3	3
	4.3	**4.0**	**4.3**	**3.7**	**4.0**	**3.3**	**3.7**	**4.0**	**4.0**	**3.7**	**3.3**
Direct link	5	5	5	5	5	4	5	4	2	2	2
Aesthetics	4	4.5	2	3	3	5	4.5	2	2	3.5	1
Cat. Score	4.643	4.393	3.571	3.714	3.857	4.286	4.393	2.786	3.000	3.643	3.071
Features											
Integration	2	4	1	1	1	3.5	3.5	2	1	1	1
Trip Planning	2	4	0	0	0	4	3	2	0	0	0
Traffic Map	4	4	4	5	2	5	4	2	2	5	4
	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	5	4	3	3	4	2	4	4
	4	4	4	4	4	4	4	4	0	4	4
	4	4	4	4	4	4	4	4	0	5	4
	4	3	3	3	5	5	4	4	3	3	3
	0	4	4	0	2	0	4	4	0	4	4
	0	0	0	0	0	0	0	0	0	3	0
	4	4	4	0	4	0	0	5	0	0	2
Map layers	**2.9**	**3.3**	**3.3**	**2.3**	**3.3**	**2.3**	**2.7**	**3.6**	**0.7**	**3.3**	**3.0**
Personalized account	4	4	0	0	4	4	0	0	3	3	0
streaming video	4	0	0	3	2	0	4	3	0	0	0
Feedback	2	3	1	1	0.5	2	1	1	0	4	5
Cat. Score	2.476	3.048	1.381	1.381	1.631	2.881	1.786	1.429	0.952	2.548	2.000
Overall Score	3.731	3.907	3.129	3.129	3.760	3.875	3.593	3.176	2.937	3.653	3.279

APPENDIX B

SURVEY

This is a research study of the Georgia Department of Transportation's NaviGAtor website. The NaviGAtor website brings you real-time travel information to get you to your destination faster and safer. This website is currently being redesigned and GDOT and Georgia Tech are looking for your input to get the user's perspective on its best attributes, as well as its shortcomings. The following survey is meant to help us better understand how you use the NaviGAtor website. It will also allow you to voice your opinion on what should change and what should stay the same.

This study is anonymous and your participation in this study is voluntary. You do not have to fill out the survey if you do not want to. There will be no penalty and you do not waive any of your legal rights if you choose not to complete the survey. No one under 18 years old may participate in this survey. Your completion of the survey provides your consent to participation and is greatly appreciated.

By taking 15 minutes to share your answers to these questions you will help make this website better suited to your needs. We look forward to incorporating your opinions into the new version of NaviGAtor!

1. What is your age?
    a. Under 18
    b. 18-24
    c. 25-34
    d. 35-44

e. 45-54
f. 55+

2. How do you typically access 511 / NaviGAtor traveler information? (check all that apply)
    a. Call
    b. Computer
    c. Smart (internet-enabled) phone
    d. No Answer

3. In a given month, how frequently do you access 511/NaviGAtor at each point during your trip?
    a. When first planning a trip
        i. Every time I travel
        ii. About once a week
        iii. About once a month
        iv. Rarely
        v. Never
    b. Shortly before leaving
        i. Every time I travel
        ii. About once a week
        iii. About once a month
        iv. Rarely
        v. Never
    c. During my trip
        i. Every time I travel
        ii. About once a week
        iii. About once a month
        iv. Rarely
        v. Never

4. What other sources of traveler information do you regularly use? (check all that apply)
    a. Google, Bing or other online trip planners
    b. Mobile device maps and trip planners
    c. In-vehicle GPS
    d. Radio or television traffic reports
    e. Other _____
    f. No Answer
5. How satisfied are you with the following tools currently featured on the NaviGAtor site?
   (Very Satisfied, Satisfied, Neutral, Dissatisfied, Not At All Satisfied, No Answer)
    a. Congestion/ Speed
    b. Incidents
    c. Cameras
    d. Message Signs
    e. Closures
    f. Construction Reports
    g. Real-Time Traffic Map
    h. 511 Hero service
    i. Weather
    j. Twitter Feed and Facebook
    k. Bookmark Map Feature
    l. Links to other websites (tolls, transit, etc.)

6. How important do you find the following tools currently featured on the NaviGAtor site?
   (Very Important, Important, Neutral, Unimportant, Not at all Important, No Answer)
    a. Congestion/ Speed
    b. Incidents
    c. Cameras

d. Message Signs
e. Closures
f. Construction Reports
g. Real-Time Traffic Map
h. 511 Hero Service
i. Weather
j. Twitter feed and Facebook
k. Bookmark Map Feature
l. Links to other websites (tolls, transit, etc.)

7. Overall, how satisfied are you with the NaviGAtor website?
   (Very Satisfied, Satisfied, Neutral, Dissatisfied, Not At All Satisfied, No Answer)
8. How would you like to primarily access the NaviGAtor site?
   a. Call
   b. Computer
   c. Mobile-optimized website
   d. Smart phone specific application
   e. Text Message
   a. Other _____

The following tools have the possibility of being added to the NaviGAtor website. Please read the description for each one before answering question 11.

a. Personalized Account: This feature would enable you to sign into your own account on the NaviGAtor website where you can save your typical trip routes and get updates based on those routes.
b. Travel Time Calculator: This feature would enable you view the estimated travel time of your desired route.
c. Next Vehicle Arrival Predictions: This feature would enable you to see the estimated arrival time of all transit vehicles that are equipped with GPS technologies.

d. Weather Map: This feature would give you the ability to see the weather map on top of the real time traffic map.
e. Transit Service Alerts: This feature would contain a map of any transit service interruptions or diversions, as well as list them in text form.
f. Ramp Meter Status: This feature will enable you to look up any ramp meter to see whether it is on or off.
g. Price of the HOT Lane: This feature will provide a live feed of the price of the HOT lane.
h. HOV and HOT lanes Map: This feature would enable you to mark all of the HOV and HOT lanes on the real time traffic map in order to plan your desired route.
i. Park and Ride Lots Map: This feature would enable you to map all of the park and ride lots to help plan which mode of transportation you could take.
j. Profile of Transit Agencies: This feature would be a breakdown of all of the necessary information needed to efficiently navigate Atlanta's transit systems including service area, route maps, fare structure, and major destinations served.
k. Multimodal Trip Planner: This feature would enable you to search for the best route for you based on a variety of characteristics such as tolls, travel time, number of transfers, etc.

9. Rank the following tools by which you would most like to see available on the NaviGAtor site?
(1= Most Important, 11= Least Important)

a. Personalized Account
b. Travel Time Calculator
c. Next Vehicle Arrival Predictions
d. Weather Map
e. Transit Service Alerts
f. Ramp Meter Status

g. Price of the HOT Lane
h. HOV And HOT Lanes Map
i. Park And Ride Lots Map
j. Profile Of Transit Agencies
k. Multimodal Trip Planner

10. Are there any additional tools that you would like to see on the NaviGAtor website?

_____

11. Please state how much you agree or disagree with the following statements. (Strongly agree, agree, neither agree or disagree, disagree, strongly disagree)
    a. The information I need is available on the NaviGAtor website.
    b. The information I would like to have is available on the NaviGAtor website.
    c. The organization of the NaviGAtor website is easy to understand.
    d. The format of the NaviGAtor website is easy to use.
    e. I find the NaviGAtor website easy to read and understand.
    f. The first time I used the NaviGAtor website, it was not hard to find what I was looking for.
    g. All of the information I get from the NaviGAtor website is kept up-to-date.

12. Do you have any other suggestions to make the NaviGAtor website more useful, or easier to use for you?

_____

13. What is your primary mode of travel?
    a. Drive alone
    b. Carpool
    c. Bus or train
    d. Bike or walk
    e. Other

14. What is your household income?

a. $0-$25,000
b. $25,000-$50,000
c. $50,000-$75,000
d. $75,000-$100,000
e. $100,000+

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