Innovative Commuter Surveying Techniques Utilized In An ATMS Evaluation

Prepared by

Marc Jacobson
Assistant Research Scientist
Texas Transportation Institute

and

Russell H. Henk, P.E.
Associate Research Engineer
Texas Transportation Institute

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TEXAS TRANSPORTATION INSTITUTE
THE TEXAS A&M UNIVERSITY SYSTEM
3500 NW LOOP 410, SUITE 315
SAN ANTONIO, TEXAS 78229
(210) 731-9938 ● (210) 731-8904 FAX

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INTRODUCTION

This paper presents procedures and results associated with a unique approach for conducting commuter surveys in San Antonio, Texas. This approach was specifically developed in association with a before-and-after evaluation of Phase II of San Antonio's Advanced Transportation Management System (ATMS) known as TransGuide. Following this brief introductory section is a discussion of the broader before-and-after study scope, other surveying options which were considered (and more typically utilized), the specific survey approach which was ultimately selected, and the results which have been experienced to data. The paper concludes with a discussion of this approach's relative efficiency compared to alternative surveying techniques.

BACKGROUND

Study Scope

The Texas Transportation Institute (TTI) is currently conducting a before-and-after evaluation of TransGuide--Phase II. The second phase of TransGuide will approximately double the size of the system to include a total of approximately 55 center-line miles of freeway in the San Antonio urban area (see Figure 1).

In addition to the expansion of the ATMS, Metropolitan Model Deployment Initiative (MMDI) activities are also taking place in San Antonio. The study being conducted by TTI is focused on non-MMDI activities, or in other words, only ATMS components/applications (e.g., dynamic message signs, lane control signals, etc.) which are not directly associated with the MMDI and were already planned in association with basic expansion of the ATMS in San Antonio prior to designation as an MMDI site.

The component of this before-and-after study which is the subject of this paper involves the development and administration of commuter surveys. This task represents only one of several analyses being undertaken as a part of the entire study. The primary purpose of the surveys is to identify and/or otherwise quantify user understanding and utilization of ATMS components (i.e., data which cannot be attained through alternative means of data collection). This paper describes the Geographic Information System and electronic mail application that was utilized to conduct some of the commuter surveys.

Surveying Options Considered

Several alternative methods were considered for administering surveys. These options included: 1) mail-out survey methods (such as license-plate based mailings); 2) on-site and/or field surveys (either manually or using the Street Smart automated system); 3) telephone surveys; and 4) focus groups. The nature of the study necessitated the development and maintenance of a survey panel to quantify or otherwise gauge changes in system user utilization and perception of TransGuide both before and after Phase II implementation. Consequently, several of these aforementioned options would require significant financial undertakings per survey (e.g., postage expenses for mail-

out surveys with postage-paid return envelopes) if a significant survey panel were to be developed and maintained.

Experience with a recent survey (1995) associated with a before-and-after evaluation of TransGuide (Phase I) was drawn upon significantly when deciding which approach to use for the Phase II study. The basic approach utilized in this earlier effort (i.e., Phase I study) consisted of engaging large employers in the central business district (CBD) and distributing surveys (typically) through respective human resource departments. A general survey was distributed originally to all major employers in the CBD which agreed to participate. This general survey queried prospective survey panelists as to their willingness to participate as a panel member and posed several questions regarding their normal commute route and perception of, and satisfaction with, existing incident management services and activities. The panel which was established numbered approximately 650 individuals. As with the initial general survey, these individuals subsequently received surveys (associated with major incidents both before and after TransGuide Phase I implementation) which included pre-addressed, postage paid envelopes within which to return their responses.

Several challenges were encountered with this previous surveying effort. As opposed to distributing surveys to all 650 panel members for every major incident, the normal commute route information which participants provided in the initial general survey was utilized to categorize panelists into groups based on their routes. This approach was utilized in order to: 1) minimize postal expenses and general paperwork management; and 2) avoid needlessly surveying individuals who would logically not be impacted by certain incidents (based on the known location of the incident). The geometric configuration and frequent traffic interchanging characteristics of the freeways associated with Phase I of TransGuide (see Figure 1), however, made this a much more difficult task than expected — typically resulting in a new group (or sample) definition with every survey distribution. Handling everything manually also made it difficult to insure a short time period between the occurrence of the major incident and respective panel members having the survey in their hand (to provide the best opportunity possible for panelists to recall the incident and actions they had taken). While ultimately successful, this approach used in the Phase I study was time-intensive and moderately expensive (with postage costs alone exceeding $1,000).

SURVEY DESIGN

Similar to the surveys conducted in the Phase I analysis, the purpose of the commuter surveys in the evaluation of the second phase of the TransGuide ATMS was to gauge people's changing opinion about the quantity and quality of traffic information available as well as specific actions taken relative to "incident conditions." By comparing responses before the activation of the expanded section of TransGuide to those received after the activations, any noticeable changes in driver behavior would be captured. This feedback provides one method of quantifying the benefits provided by the ATMS.

Two types of surveys are to be distributed throughout the course of this study. The first type is a "General Traffic Survey" which is shown in Figure 2. This survey identifies how often and from what sources the participant receives his/her traffic information. The participant is also asked to rate the quality of information that is received. This type of survey will be distributed twice throughout the study and will be sent to every panel member. The first distribution has been completed to

measure responses before the activation of the second phase of TransGuide. The second distribution will occur at the conclusion of this evaluation once the system has been activated.

The second survey type is an "Incident-Related Survey." This survey, which is shown in Figure 3, determines whether the panelist was impacted by a known incident. If the particular panelist was impacted, any additional information that the panelist received (regarding the incident) is requested. This type of survey will be distributed throughout the length of this study both before and after the activation of the extended TransGuide components. Two of these studies have been completed and a third is in the process at the time of this writing. Unlike the "General Traffic Surveys," the surveys relating to incidents will only be sent to those panelists whose daily route would take them past the incident scene at the time of the incident. The sections that follow provide details on how the panel was selected, how the routes and appropriate survey participants were identified, and how the surveys were distributed.

Study Panel

To best facilitate distribution of the surveys, a study panel was formed of employees of United Services Automobile Association (USAA). This organization employs over 10,000 people making it one of the largest businesses in San Antonio. The headquarters building is located on Interstate 10 in Northwest San Antonio (see Figure 1). This location requires nearly every employee to travel on one of the freeways covered by Phase II of the TransGuide project to commute to and from work.

With the aid of the Corporate Research Department at USAA, 1,000 potential panel members were identified. The potential members were randomly selected so that their commuting origins would encompass the entire city. Each of the potential panel members received a letter requesting their assistance as a member of the study panel and an initial survey were then distributed to each potential panel member.

Each person that agreed to participate in the panel was asked to provide information about their normal morning and evening route to/from work. They were also asked to provide their typical work schedule, carpooling information, and their home zip code. Finally, each person was given the option of receiving future surveys electronically instead of on paper. Since USAA had not yet completed efforts to provide all employees with e-mail, the electronic method was not available to all panelists.

From this initial questionnaire, a total of 651 people agreed to participate in the study panel. This return represents an agreement (response) rate of 65%. Of those agreeing to participate in the panel, 290 (45%) wished to participate electronically and provided a useable e-mail address. While the survey methods differed between the two groups, their demographics were similar since they were drawn from the same population of USAA employees.

Geographic Information System Application

Often times when an incident occurs, only a small percentage of the survey panel would be impacted by the incident. By sending surveys only to those people whose normal route passed the incident site, the amount of non-applicable surveys that would be generated and sent would be

drastically reduced. One result of this type of survey administration would be a reduction in cost. A second, and perhaps equally important, result is that the survey panel would not lose respect for the surveys by repeatedly receiving surveys that were not applicable.

Entering Route Information

A Geographic Information System (GIS) is a tool that allows data to be linked by a geographic attribute. In other words, GIS has the ability to query the database of survey panelists and select only those panelists whose normal commute would pass an incident scene. For this application the ArcView GIS Software from Environmental Systems Research Institute (ESRI) was utilized.

Using the route information that was provided on the initial questionnaire, an electronic route was generated for each respondent's morning and evening commute. The digital route consisted of a set of lines that mapped out the particular route that was on one or more of the freeways covered by the TransGuide system. By using the ability of GIS to locate specific addresses or intersections, the process of creating the digital routes was highly automated.

The result of the routing process was two files containing the route information for each of the survey panelists. One file contained all of the morning route information and the other consisted of the evening route information. Since ArcView generated the routes automatically, all of the routes were perfectly aligned with the GIS base map of the highway network. This further helps to reduce errors when identifying which panelists should receive a survey.

Determining Survey Recipients

Each day police reports, personal observations, and reports from the TransGuide home page on the Internet were used to identify if there was a significant incident that would have impacted a number of survey panelists. If such an incident was identified, the GIS application was used to identify which of the survey participants might have been affected by the incident based on the route information that they had provided. The identification process was a crucial element in reducing error in survey distribution, but needed to be completed in a timely manner so that the surveys could be distributed while the incident was still fresh in the minds of the panelists.

The two inputs were required to the GIS application to properly identify affected motorists. The first input was whether the morning or evening routes should be used. By using two separate route files, those people that consistently take a different route in the evening could be identified. The selection of the appropriate database was as simple as one mouse click in the GIS application.

The second input that was required to identify survey recipients was the location of the incident. This could be entered in one of two ways. First, if a specific address or intersection was known, this information could be entered into the system and the incident would be identified. Otherwise, the user could simply click on the map at the incident location. Using either method, once the location has been identified, those routes that pass through the incident location were selected.

The selection of each route corresponds to selecting a member of the survey panel. The GIS application outputs a list of those panel members that were selected based on the survey

identification (ID) number that was assigned to the panel member. The entire selection process can be performed in less than one minute allowing incident surveys to be distributed to the appropriate panel subset even before the incident has been cleared from the roadway. Thus, respect for the accuracy of the survey is maintained and the panelists can answer the survey questions while all of the details of their commute are fresh in their minds.

Survey Distribution

Once the appropriate sub-panel was identified, the next step was to distribute the surveys. Two methods of distribution were utilized. For those panelists that had requested to receive their surveys electronically, a combination of e-mail and a page on the Internet were utilized. The remaining panelists received an identical version of the survey distributed on paper; both of these methods are described below.

Electronic Survey Distribution

The use of modern technology, such as the Internet, greatly assists in the timely distribution of surveys as well as the reduction of the survey results. Surveys can be distributed automatically to large quantities of people in less time than it takes to address and stamp a single envelope. In addition, the survey results are already contained in an electronic format that can be read and analyzed using database software. This significantly reduces the time and money that is required to have all of the survey data manually entered into the computer.

For the survey that was conducted for this research, each member of the panel that agreed to participate in electronic surveys provided an e-mail address where they could be contacted. In most cases a work e-mail address was provided, although some panelists preferred to receive their notifications at their home e-mail address. These e-mail addresses were entered into the database along with the panelists assigned ID number and their route information.

The general process that was followed to distribute and take an electronic survey was accomplished in three steps. First, a "form" e-mail was sent to each applicable participant in which they were informed that their input was requested on a survey. The e-mail reminded the panelist of the study and the purpose of the survey. Finally, the e-mail included an address to a page on the World Wide Web where the participate should go to complete the survey. Each participant received a unique page address so that the responses could be organized by survey ID number.

Once the panelist received the e-mail, the next step was to go the web address that was provided. The survey page included several questions that allowed the participant to either click on the appropriate answer or to type in their answer. Each survey also provided a section where the panelists could provide comments on the survey. An example of a portion of an on-line incident survey is shown in Figure 4.

The final step in completing the survey was to submit the information to be saved. Once the information was submitted, the panelist was thanked for their information and provided contact information if they had any questions. The responses were then stored on the computer and periodically downloaded to the main database of survey information for further analysis.

The entire process from distribution to collection of the results was automated to be very efficient. For incident surveys, the output from the GIS application was used directly to automatically generate an appropriate mailing list. The database also generated the "form" e-mail and sent each e-mail to the users. It was found that using this method, it took less than two minutes to distribute customized e-mails to over 280 people. Thus, for those panelists receiving electronic surveys, the survey could be ready and the e-mail distributed to the appropriate subgroup of panelists within five minutes of identifying an incident.

Paper Survey Distribution

For those panelists that were unable or did not wish to receive surveys electronically, a paper version of the survey was also distributed. The survey ID for each person that should receive a survey was sent to the Corporate Research Department at USAA along with a copy of the survey. This list was based on the list generated by the GIS application with the e-mail recipients removed. Once the surveys were distributed, those that were returned were manually entered into the database for further evaluation. The surveys distributed by paper were identical to those distributed via the Internet except they included an option for the panelist to choose to receive future surveys electronically.

SURVEY RESPONSES

At the time of this printing, the first "General Traffic Survey" has been completed. In addition, three "Incident Related Surveys" have been distributed and returned. All of the surveys were conducted using the procedures outlined in the above section. The response rates for the various surveys are presented in the following sections. Due to the small sample sizes and limited application (to date), the results presented should be considered anecdotal in nature and do not represent a thorough statistical analysis.

General Traffic Survey

The "General Traffic Survey" was distributed before any of the incident surveys to gauge the current information sources that the panel was using. Table 1 summarizes the response rates from this survey which was distributed to the entire study panel. As Table 1 indicates, just under half of the paper surveys were returned, while nearly two-thirds of the electronic surveys were received. The 184 non-responses to the paper survey represents wasted costs for paper, manpower, and in some circumstances, postage. The non-responses to the electronic survey, however, do not translate into a wasted cost since these surveys are distributed and processed automatically. Overall, the response rate results indicate that, for this group, people are less likely to neglect the survey that is conducted electronically.

Incident Related Surveys

Following an accident on the afternoon of May 28, 1998, an "Incident Related Survey" was distributed to those members of the survey panel that were identified as passing the incident scene. As Table 1 indicates, of the 59 surveys distributed, 81.4% were returned. The response rates for the paper and electronic surveys were nearly identical. These high rates of return show that a well targeted and applicable survey can yield high response rates.

While the response rates were very similar for the two distribution methods, there are some significant differences in cost. For example, the cost of labor for the distribution and data reduction needs of the paper survey as well as the supply costs are much greater than that of the electronic survey (assuming that access to an Internet web server is available). Thus, for this survey, the Internet-based survey offered a means to obtain the same response rate at a much lower cost.

The second "Incident Related Survey" was distributed on June 11, 1998, after an incident which occurred during the morning rush hour. Overall, the response rate for this survey was only 62 % as shown in Table 1. The electronic survey response rate was less than 50 % while the paper survey response rate was nearly 75 %. One possible reason for the decline in overall response rate is that a number of people were likely on vacation at the time this survey was distributed as the school year had ended.

A third "Incident Related Survey" was distributed following an accident that occurred on the morning of July 24, 1998. The overall response rate for this survey dropped to 58.1% as shown in Table 1. The response rate for electronic surveys was 49.4% while the paper survey response rate was 63.2%. The main reason for the lower response rate across both survey media was that this survey was for an accident on a Friday when many of the survey panelists might have bee absent from work (i.e. many USAA employees participate in a four 10-hour day work week plan). This demonstrates that while the GIS application will reduce the number of non-applicable surveys that are distributed, some might still be distributed due to unforseen circumstances.

CONCLUSIONS

The approach outlined previously appears to have several advantages over historical methods for conducting and/or administering surveys based on preliminary results. This GIS/Internet-based methodology seems to be particularly useful (relative to other available options) in instances where very large samples and/or multiple survey distributions are required. A summary of this approach's relative efficiency (in comparison to alternative survey methods) under these conditions is provided in Table 2. The summary is based on the researchers' past survey experiences. Statistical differences among the various surveying techniques could only be determined after a more thorough statistical analysis.

The base assumptions associated with the relative efficiency ratings shown in Table 2 also include the fact that basic background development, such as specific survey content, has already been formulated for each alternative method and is, therefore, a constant across alternative methods. The efficiency ratings range from very poor (receiving a rating of 5) to excellent (receiving a rating of 1).

Obtaining data via surveys is an extremely useful means of conducting evaluations and a wide variety of other studies. The methodology outlined in this paper is certainly not the best approach for every survey one would wish to conduct. Any survey conducted via the Internet may introduce sample bias due to certain demographics which may limit Internet access. This potential bias, which was accounted for in this study, needs to be carefully considered before utilizing this method. This method has, however, proven to be extremely efficient and effective for obtaining and managing a large survey panel and associated data. For someone experiencing similar needs, it is an approach worth strongly considering.

Table 1. Summary of Survey Response Rates

Measure	General Survey	Incident Related Surveys		
		May 28	June 11	July 24
Number of Surveys Distributed by Paper	364	33	32	136
Number of Surveys Distributed by E-Mail	286	26	18	79
Total Number of Surveys sent to USAA	**650**	**59**	**50**	**215**
Number of Paper surveys Returned	180	27	23	86
Response Rate for Paper Surveys	49.5 %	82.0 %	72.0 %	63.2 %
Number of Electronic Surveys Returned	179	21	8	39
Response Rate for Electronic Surveys	62.6 %	81.0 %	44.0 %	49.4 %
Total Response Rate for Surveys to USAA	55.2 %	81.4 %	62.0 %	58.1 %

Table 2. General Effectiveness of Surveying Techniques for Large Data Collection Efforts

Surveying Technique	Measure of Effectiveness and Relative Efficiency[1]						
	Total Cost	Cost per Distribution[2]	Portability of Data/Data Mgmt.	Response Rate	Large Sample Size[3]	Human Resources Required	Turn Around Time[4]
General Mailout	5	5	5	4	4	4	4
Manual On-Site Distribution[5]	3	3	5	2	4	4	4
Automated On-Site Survey[6]	2	3	1	1	3	2	3
Telephone Surveys	4	3	5	4	3	4	5
Focus Groups	3	4	5	1	4	4	4
GIS/Internet-Based	2	1	1	2	1	1	1

[1]Relative efficiency is provided on a scale of 1 to 5; with 1 = excellent, 2 = very good, 3 = average, 4 = poor, 5 = very poor.
[2]Assuming multiple distributions are required.
[3]Assuming a large single sample or multiple samples are desired.
[4]The time required to distribute and/or conduct surveys once the need to do so has been identified and the survey content has been established.
[5]Refers to paper surveys being distributed via inter-office mail within a major employer's office(s) with no postage (or only return postage) paid.
[6]Automated on-site survey techniques such as Street Smarts O-D data collection software.

- General Traffic Survey -

1. How often do you listen to radio broadcasts for traffic condition announcements?
   ☐ Everyday ☐ 2 to 3 times per month
   ☐ 1 to 3 times per week ☐ Never

2. On a scale of 1 to 10 (with 10 being the best), how would you rate:

   The accuracy of radio traffic information (i.e., correct location/description of incident)?

1	2	3	4	5	6	7	8	9	10
very poor		poor		average		good		excellent	

   The timeliness of radio traffic information (i.e., advanced notice/reports reflect current conditions)?

1	2	3	4	5	6	7	8	9	10
very poor		poor		average		good		excellent	

3. How often do you watch television for traffic condition announcements?
   ☐ Everyday ☐ 2 to 3 times per month
   ☐ 1 to 3 times per week ☐ Never

4. On a scale of 1 to 10 (with 10 being the best), how would you rate:

   The accuracy of television traffic information?

1	2	3	4	5	6	7	8	9	10
very poor		poor		average		good		excellent	

   The timeliness of television traffic information?

1	2	3	4	5	6	7	8	9	10
very poor		poor		average		good		excellent	

5. If you encounter significant traffic congestion due to an incident on the freeway, what do you normally do?(choose one only please)
   ☐ Stay on the freeway and wait it out
   ☐ Get off the freeway onto the frontage road and continue (on the front. rd.) until I have bypassed the incident
   ☐ Get off the freeway and take an alternate route (other than the frontage road)

6. If you find out about a major incident on your normal route prior to departing on your trip, what do you normally do? (choose one only please)
   ☐ Delay my departure time
   ☐ Take an alternate route
   ☐ Take my normal route

7. What would be the most convenient way for you to receive traffic condition information?
   _____

8. Any additional comments you would like to add?
   _____

Would you like to begin receiving surveys via e-mail? If so, please provide your e-mail address below:
_____

THANK YOU!!

Figure 2. An Example General Traffic Survey that was Distributed.

- Incident-Related Survey -

1. Did you encounter traffic congestion resulting from the accident on eastbound Loop 410 at Blanco on Tuesday afternoon, March 23?
   ☐ Yes, I passed the incident scene at approximately _____ p.m. ☐ No

If "Yes", please continue with Question #2; if "No", please continue with Question #3.

2. Compared to delay you normally experience at the same time of day you encountered this incident, what is the estimated additional delay you experienced (in minutes)?
   _____ minutes

3. Did you take an alternate route or delay your departure time to avoid the traffic congestion/accident site?
   ☐ Yes. I used the following route instead (please describe route):_____
   _____
   ☐ Yes. I delayed my departure time by _____ minutes
   ☐ No. I did not take an alternate route because (choose one only please):
   - ☐ I did not have a good alternate route as an option.
   - ☐ I did not think it would save me any time.
   - ☐ This incident really did not apply to me (please continue with question #7)
   - ☐ Other (please explain) _____

4. If you answered yes to taking an alternate route in question #3, do you feel like you saved time by doing so?
   ☐ Yes. I feel I definitely saved time.
   ☐ It probably took about the same amount of time.
   ☐ No. The alternate route took more time.

5. Did you receive any kind of advanced notice regarding this incident?
   ☐ Yes, from: ☐ No
   - ☐ Radio
   - ☐ Television
   - ☐ Other (please specify) _____

6. Did any kind of advanced information/notification assist you in avoiding this incident?
   ☐ Yes, from: ☐ No
   - ☐ Radio
   - ☐ Television
   - ☐ Other (please specify) _____

7. On a scale of 1 to 10 (with 10 being the best), how would you rate the current methods for notifying motorists of traffic congestion, accidents, etc.?

1	2	3	4	5	6	7	8	9	10
very poor		poor		average		good			excellent

8. Any additional comments you would like to add?_____
   _____

Would you like to begin receiving surveys via e-mail? If so, please provide your e-mail address below:
_____

THANK YOU!!

Figure 3. An Example Incident Related Survey that Was Distributed.