

The Impact of Traveler Information on Commuter's Travel Behavior and Toll Road Choice

Findings from a Commuter Survey in Austin, TX

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ABSTRACT

There is ample evidence that traveler information can affect commuter's travel behavior, especially route choice. However, no effort was found to address how propensity to divert would change if the alternate route was a toll road. In order to better understand the impact of traveler information on commuter's travel behavior and toll roads, a survey was conducted in Austin, TX and initial findings are presented in this paper. Commuters' travel patterns, requirements on traveler information, route switching propensity when provided with traveler information, anticipated time savings from route switching, and likelihood of choosing toll roads are examined. It was found that the impact of traveler information on commuter's route switching and toll road choice is positive. The survey results verify the feasibility of using traveler information to enhance the operations of both tolled and non-tolled roads.

Key Words: Advanced traveler information systems; ATIS; Travel behavior; Toll roads; Route choice; Travel time; Value of time.

INTRODUCTION

There is a significant amount of research verifying that traveler information could affect commuter's travel behavior and bring benefits to drivers. Khattak et al (1) found that the largest stated propensity to divert is obtained when the users get real-time information about traffic conditions on alternate routes. Yim et al (2) reported that 75% of commuters surveyed in San Francisco Bay Area listen to traffic information on the radio, and 50% of them change their travel behavior accordingly. Khattak et al (3) reported that with travel information, 17% of respondents in the Bay Area change routes while another 20% change at least two decisions among departure time, route, and mode. Mehndiratta et al (4) reported that among the en-route travel information users in the Seattle region, 34% change part of their routes while 22% change their routes completely.

The evidence is ample that traveler information can affect commuters' travel behavior, especially the route choice. However, no effort was found to address how propensity to divert would change if the alternate route was a toll road. In Texas, the primary strategy for adding capacity to the Texas transportation network is by supporting the development of toll roads. Instead of waiting for gas tax revenues to accumulate, the Texas Department of Transportation (TxDOT) can use toll financing to build projects more quickly, and thus relieve congestion sooner. For example, SH 130 Toll Road, a relief route for IH-35 in Central Texas, will be completed in 2007 compared to around 2020 under traditional financing. However, to repay bond debt for new toll roads, investors will depend on toll revenue, an uncertain source. Traffic on toll roads is initially low, and grows slowly over time as motorists become aware of the time savings and other benefits of a toll road. Persad et al (5) have shown that toll roads generally do not earn enough revenue in the first 5-15 years to cover all expenses.

Given this situation, TxDOT initiated a study to investigate the potential of using Advanced Traveler Information Systems (ATIS) to enhance the operations of both tolled and non-tolled roads. There is anecdotal evidence that toll road prospects can be enhanced if motorists receive timely information about congestion in the region. For example, traffic growth on the tolled Melbourne City Link in Australia has been partially attributed to aggressive provision of information on delays on competing routes. Enhanced diversion of traffic to toll roads would have two benefits: increase toll collections, and reduce congestion on non-tolled roads. Better utilization of the added capacity provided by toll roads would allow the public to realize the true purposes of supporting toll roads: namely, greater mobility, improved safety, and reduced pollution across the entire system.

To examine how the use of traveler information would alter commuter travel behavior, a survey of commuters was conducted to determine the effect of information on travelers' route choice, including toll roads. The survey area is limited to the greater Austin metropolitan area, and the target population is commuters who travel in and out of this area. The survey was launched on May 13, 2005. By July 23, 2005, 473 responses were received. The findings and preliminary analysis presented in this paper are based on those survey responses.

SURVEY APPROACH AND ADMINISTRATION

The survey is distributed as an online questionnaire accessible through an online survey provider at <http://www.zoomerang.com/survey.zgi?p=WEB224BSKBS56C>. The advantages of using a web-based survey approach include:

- Low cost. Compared to mailing out survey forms and door-to-door interview or other means of interview, the web-based survey is inexpensive to researchers.
- Convenient for respondents to answer. Once the questionnaire is well structured, it is straightforward and easy to follow. People can access the survey wherever and whenever they have internet access.
- Targeted. Internet users are also likely to be travel information seekers. Abdel-Aty et al (6) found that the odds of response by internet were much higher for young users, professionals, and regular toll road users.
- Convenient for data processing. The online survey results are in digital format and are updated instantaneously. For researchers, it is convenient to obtain and process the most up-to-date results.

The web-based survey consists of four parts. The first section contains eight introduction questions on commuter's commuting patterns such as number of weekly commuting days, trip purpose, transportation mode, trip time, trip distance, and so on. The second section targets commuters' usage and requirement of traveler information. The third section focuses on commuters' response to traveler information and their anticipated time savings from route switching. The last section captures commuters' demographic data. The Austin Chamber of Commerce (ACC) assisted in distributing the survey by including an article in its electronic newsletter, which is widely distributed among employers in the Austin area. Subsequently, a number of other agencies in the Austin area provided a link to the survey on their webpages, including that of the Center for Transportation Research at the University of Texas at Austin.

SURVEY RESULTS AND ANALYSIS

Austin Travelers' Commuting Patterns

About 80% of survey respondents commute 5 days a week at an average trip distance of 18 miles with an approximate arrival time of 8 a.m. Although the average outbound and home-bound trip distances are almost the same, the average outbound and home-bound travel time are significantly different. As shown in Table 1, the average home-bound travel time for the respondents is approximately 10 percent higher than out-bound trips. One explanation is that people are using the evening homebound trip rather than the morning inbound trip to catch up on errands or other non-work related activities.

Work is cited as the primary trip purpose by 94% of respondents, with 30% of respondents identifying shopping as their secondary trip purpose, followed by recreation/social at 20% and child care/child's school at 16%. The most common form of transportation is the automobile at 91.8%. Public transit comes in at an expected low of 5.5%. Few commuters, less than 3%, commute by walking or riding motorcycles and bicycles.

TABLE 1 Travelers' Commuting Patterns in Austin, TX

Weekly Commute Days	# of Responses	Percentage	Outbound Trip		Home-Bound Trip	
			Average Travel Time (min.)	Average Travel Dist. (mi.)	Average Travel Time (min.)	Average Travel Distance (mi.)
0	5	1.1%	--	--	--	--
1	3	0.6%	--	--	--	--
2	4	0.8%	--	--	--	--
3	6	1.3%	--	--	--	--
4	35	7.4%	31.2	18.5	41.6	18.6
5	377	79.7%	34.6	17.7	38.6	17.8
6	23	4.9%	39.9	19.2	42.4	19.3
7	20	4.2%	38	16.7	41.7	17.1

92% of respondents indicate that they are familiar enough with local Austin's roadways to find an alternate route if necessary. Austin's population concentrations and resulting road usage is reflected in the study data with 72% of respondents commuting on at least one of Interstate Highway 35, Loop 1, and US183 shown in Figure 1. Specifically, 43%, 32%, and 12.5% of respondents commute on IH-35, Loop1, and US183 respectively.

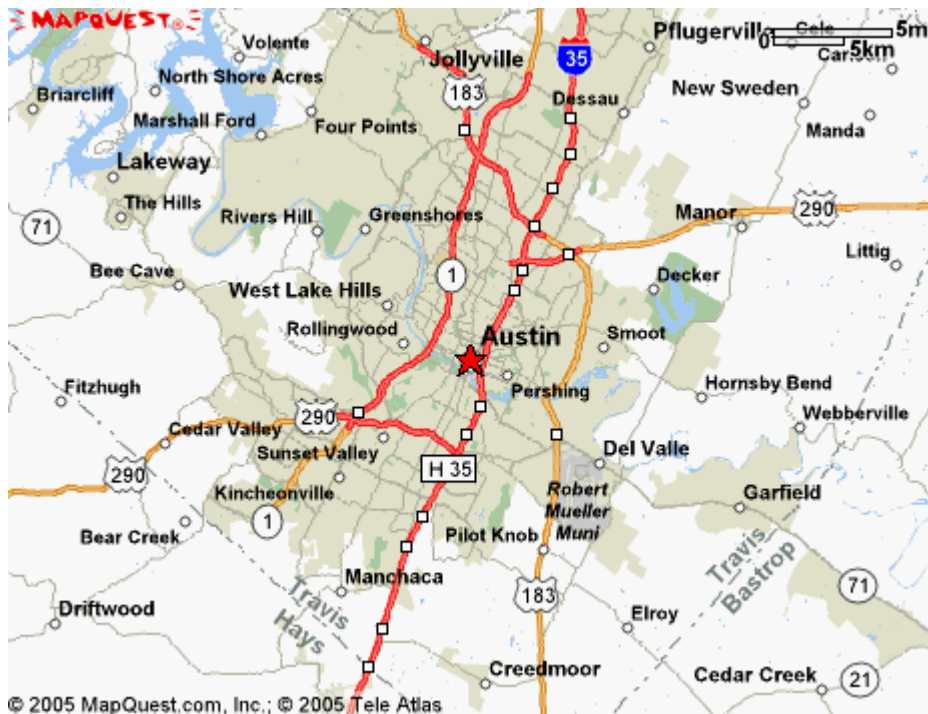


FIGURE 1 Major Routes in the Austin Area.

Traveler Information Usage

Most respondents indicate that they do seek traveler information during their commute trips. The findings in Table 2 show slightly more commuters seeking traveler information during morning versus evening rush hours. When seeking information during morning rush hours, 47% of respondents reported that they often seek traveler information, compared to 44% who often seek information during evening rush hours. This can be explained by the fact that commuters usually have more pressure on travel time during the morning rush hours.

TABLE 2 Commuters' Frequency to Seek Traveler Information in Austin, TX

Time	Frequency to Seek Traveler Information			
	Never	Sometimes	Fairly Often	Very Often
Morning Rush Hours	19%	34%	21%	26%
Evening Rush Hours	21%	35%	22%	22%

In terms of traveler information types, 52% of respondents indicate that they seek pre-trip information and 78% indicate they seek en-route information, which is very close to findings presented by Hobeika et al. (7) on commuters' needs in the I-95 Northeast corridor.

When seeking traveler information to determine traffic conditions, commuters show particular interests in accident locations, congested roads, weather conditions, and lane closures. Table 3 present a summary of Austin commuters' interests in seeking traveler information. The findings on commuters' likelihood of seeking information are consistent with a study conducted in Sydney, Australia by Kim and Vandebona (8). In addition to commuters' likelihood of seeking a certain content of information, time when information is sought was also investigated. As shown in Table 3, the percentages of commuters seeking each kind of information during morning rush hours are significantly higher than those during evening rush hours. This is consistent with the findings shown in Table 2.

TABLE 3 Traveler Information Sought by Commuters in Austin, TX

Content of Traveler Information	Likelihood of Seeking Information	Time of Day Information is Important		
	Likely/Very Likely	AM Rush Hours	PM Rush Hours	Both AM and PM
Accident Location	81%	12%	5%	77%
Congested Roads	69%	14%	6%	67%
Weather Conditions	61%	12%	3%	68%
Road Work	59%	17%	6%	63%
Lane Closure	55%	15%	6%	68%
Road Hazard Warning	44%	14%	5%	63%
Estimated Trip Time	31%	19%	7%	44%
Alternate Route	NA	12%	4%	39%

Previous studies indicate a preference for en-route information (9) and a need for regular updates on the existence of traffic problems and expected delays (10). The findings in Austin support this argument—more commuters are seeking en-route information. 90% of the survey respondents cite the radio, assuming in-vehicle radio, as their current most frequently used

means for retrieving traveler information. Table 4 shows commuters' current usage and preference in the manners of retrieving traveler information. Following Radio, TV is the second largest traveler information source for commuters. When asked about their preference, commuters show greater interests in receiving traveler information by radio and roadside variable message sign (VMS) than other means. It can be seen that the VMS and Internet, especially the VMS, are "under-marketed". There is a great potential to deliver traveler information to commuters via VMS. When looking at the "other" category for receiving traffic updates, the cell phone is often cited. This may imply that there is increasing demand for en-route delivery mechanisms other than the radio. In addition, use of cell phones may also indicate a level of comfort with new technology as a medium for traveler information delivery and retrieval.

TABLE 4 Austin Commuters' Preference in Receiving Traveler Information

Question	Radio	TV	Local Newspaper	VMS	Internet
How do you <i>currently</i> receive traveler information on the local roadway system?	90%	37%	4%	12%	15%
Which of the following would you <i>prefer</i> to use to receive traveler information on the local roadway system?	79%	20%	2%	38%	18%

Traveler Information and Commuters' Route Switching

The important factors that affect traveler's en-route diversion behavior are travel time on current and alternative routes, awareness of congestion levels, and trip purpose (11). Among these attributes, travel time is considered most important. In some studies, researchers proposed a notion of "anticipated travel time" because of the subjectivity of the travel time on which driver's choice is based (12). Those studies suggest that traveler information will influence drivers' judgment on anticipated travel time and finally influence drivers' route choice. In this survey, several questions were designed to investigate the potential impact of traveler information on commuter route switching.

When queried about the impact traveler information has on travel behavior, 67% of the respondents stated that they would select an alternate route, followed by 19% who said they would leave earlier than planned and 3% reporting no impact on travel decisions. Table 5 presents Austin commuters' likelihood of switching route given particular traveler information. For example, it can be seen that about 87% of respondents are likely or very likely to seek an alternate route if they are informed of an accident on their regular routes. 55% of respondents are likely or very likely to change route if they know that the travel time on an alternate route is shorter than their current route. 65% of respondents indicate that they are likely or very likely to change route if an alternate route is recommended.

TABLE 5 Potential Impact of Traveler Information on Austin Commuters' Route Change

Traveler Information Content	Likelihood of Switching Route				
	Very Unlikely	Unlikely	Neutral	Likely	Very Likely
Road Work	4%	6%	12%	46%	32%
Lane Closure	4%	6%	15%	37%	38%
Road Hazard Warnings	5%	9%	23%	41%	22%
Accident Locations	3%	3%	7%	35%	52%
Estimated Travel Time	5%	8%	31%	34%	21%
Recommended Alternate Route	5%	5%	24%	39%	26%
Weather Conditions	7%	8%	25%	35%	25%

Saving time is clearly an impetus for route switching. However, few efforts have been found in the existing literature to address how much time would eventually change commuters' decisions on choosing a new route. In order to better understand the impact of "anticipated travel time" on commuters' route choices, Table 6 presents respondents' minimum anticipated time savings from route switching. It can be seen that the majority of respondents hope to save 5 to 15 minutes from changing their routes. The anticipated time saving accounts for 36.6% of commuters' regular one-way commute time on average.

TABLE 6 Austin Commuters' Minimum Anticipated Time Savings from Route Switching

Minimum Time Saving to Switch	# of Respondents	Percentage
5 Minutes	105	22%
10 Minutes	192	41%
15 Minutes	123	26%
20 Minutes	29	6%
25 Minutes	3	1%
30 Minutes	17	4%

Commuter's Attitude toward Toll Roads

Inherently people are reluctant to change their travel patterns, including departure time, mode, and route. When a commuter is faced with a choice between a tolled route and a non-tolled route, the toll road is normally less attractive because of the obvious extra cost. However, in many situations, traveler information may help travelers overcome the resistance to change travel decisions. Previous studies and this survey have found that unexpected delays will increase the propensity to change route and drivers who are under time pressure would try to avoid congestion by switching to alternative routes. When a driver is informed that the traffic condition of his regular route is worse than usual, he will be more likely to switch to an alternate route. The significant factors that could affect travelers' route-switching decision have been identified by Polydoropoulou et al. (13):

- Travel time on both the usual and the alternate route

- Congestion levels on alternate routes
- Knowledge of the travel time on the alternate route
- The existence of radio-broadcasted travel information.

The impact of these factors is confirmed by this commuter survey (see Table 5). The findings verify the potential of using ATIS to inform travelers of delay and congestion so as to encourage them to switch to alternate routes, including toll roads.

In the literature search, no studies have been found on traveler's willingness to choose a toll road when provided with information. In order to address this problem, an additional question was asked in the survey to see how much a commuter would be willing to pay to save the time mentioned above in Table 6. The findings show 50% of respondents are not willing to pay and 11% of respondents are unsure. About 39% of respondents indicate they are willing to pay a fee, ranging from \$0.05 up to \$275.5 with most respondents preferring to pay less than \$1, for the time savings mentioned above. For those respondents who are willing to pay, the average amount is \$2.19, with an average anticipated time saving of 12.5 minutes. It is equivalent to about \$10.50 for 1 hour, consistent with another commuter survey in Austin (14).

When asked if a commuter would like to choose a toll road when traveler information indicated that he could save time on the toll road, 45% of respondents said they would choose it while 55% said toll road was not an option. When looking at the reasons for "not choosing" toll roads, "tax already paid" is often cited. Table 7 depicts that as income level increases, the percentage of respondents willing to choose toll roads increases as well. Table 8 shows that male commuters are more likely to choose toll roads than female commuters when provided with traveler information.

TABLE 7 Austin Commuters' Willingness to Choose Toll Roads by Income Levels

Household Income Level	Willingness to Choose Toll Roads if Information is Provided		Total
	No	Yes	
\$25,000 to \$34,000	61.0% (25 respondents)	39.0% (16 respondents)	100.0%
\$35,000 to \$49,000	56.9% (29 respondents)	43.1% (22 respondents)	100.0%
\$50,000 to \$74,000	61.0% (61 respondents)	39.0% (39 respondents)	100.0%
\$75,000 to \$99,000	52.9% (55 respondents)	47.1% (49 respondents)	100.0%
\$100,000 to \$149,000	55.2% (48 respondents)	44.8% (39 respondents)	100.0%
\$150,000 to \$199,999	38.1% (8 respondents)	61.9% (13 respondents)	100.0%

TABLE 8 Austin Commuters' Willingness to Choose Toll Roads by Gender

Income Level	Willingness to Choose Toll Roads if Information is Provided		Total
	No	Yes	
Male	53.1%	46.9%	100.0%
Female	59.4%	40.6%	100.0%

CONCLUSIONS AND POLICY IMPLICATIONS

The objective of the study is to examine how the use of traveler information would affect commuter travel behavior. In particular, the study looks at:

- What type of information influences commuter's decisions
- Commuter's requirements on traveler information
- Market for traveler information
- Value of information
- Potential toll market
- Traveler information and toll road choice

Key findings and policy implications of this survey are summarized as follows:

- 1) Most respondents, around 92%, indicate they are familiar enough with the Austin road network to find an alternate route if necessary. On the other hand, 45% of respondents said they would choose a toll road when traveler information indicates that maybe they could save time on the toll road. Thus there is a tremendous opportunity to use ATIS to improve the operations of both tolled and non-tolled roads.
- 2) 72% of respondents commute on at least one of IH-35, Loop 1, and US183. This finding would be very useful for regional traffic management, toll road marketing, and ATIS deployments.
- 3) Commuters have more pressure on travel time during the morning rush hour. As a result, commuters seek traveler information more often during the morning rush hour than evening rush hour. Nevertheless, the majority of commuters seek traveler information during both morning rush hour and evening rush hour.
- 4) The traveler information sought by the majority of commuters includes accident locations, congested roads, road work, weather conditions, and lane closures. This finding, along with finding 3, is particularly useful for ATIS marketing.
- 5) Although radio and TV are currently most often used by Austin commuters to receive traveler information, VMS is the most "under-marketed" means of information delivery. The survey results show that VMS, internet, and in-vehicle technologies have great potential in delivering traveler information to commuters.
- 6) The majority of survey participants, 67%, cite "choose an alternate route" as the response to traveler information. This percentage is far higher than those of citing "choose an alternate transportation mode", "change departure time", "cancel trip", and "no impact". The impact of traveler information on commuter's route switching is quite impressive.
- 7) Most respondents, 89%, indicate that they expect to save 5 to 15 minutes by changing their routes. The anticipated time saving accounts for 36.6% of commuters' regular one-way commute time. This is one of the unique findings in this study.
- 8) About 39% of respondents indicate they would pay for saving travel time. For those respondents who are willing to pay, the average amount is \$2.19, with an average anticipated time saving of 12.5 minutes. It is equivalent to about \$10.50 for 1 hour. This figure represents the value commuters in the Austin area place on personal travel time.

- 9) 45% of respondent said they would choose a toll road if traveler information indicated that they could save time. It was confirmed that income level and gender have effects on commuter's willingness to choose toll roads.

ACKNOWLEDGEMENT

This research is funded by TxDOT under research project number 0-5079. The authors would like to acknowledge TxDOT for their support of this research effort. Additionally, the authors are grateful to Robert Daigh, the program coordinator, and Frank Bushong, the project director. Also, the authors want to thank the Austin Chamber of Commerce for their generous help with the survey.

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