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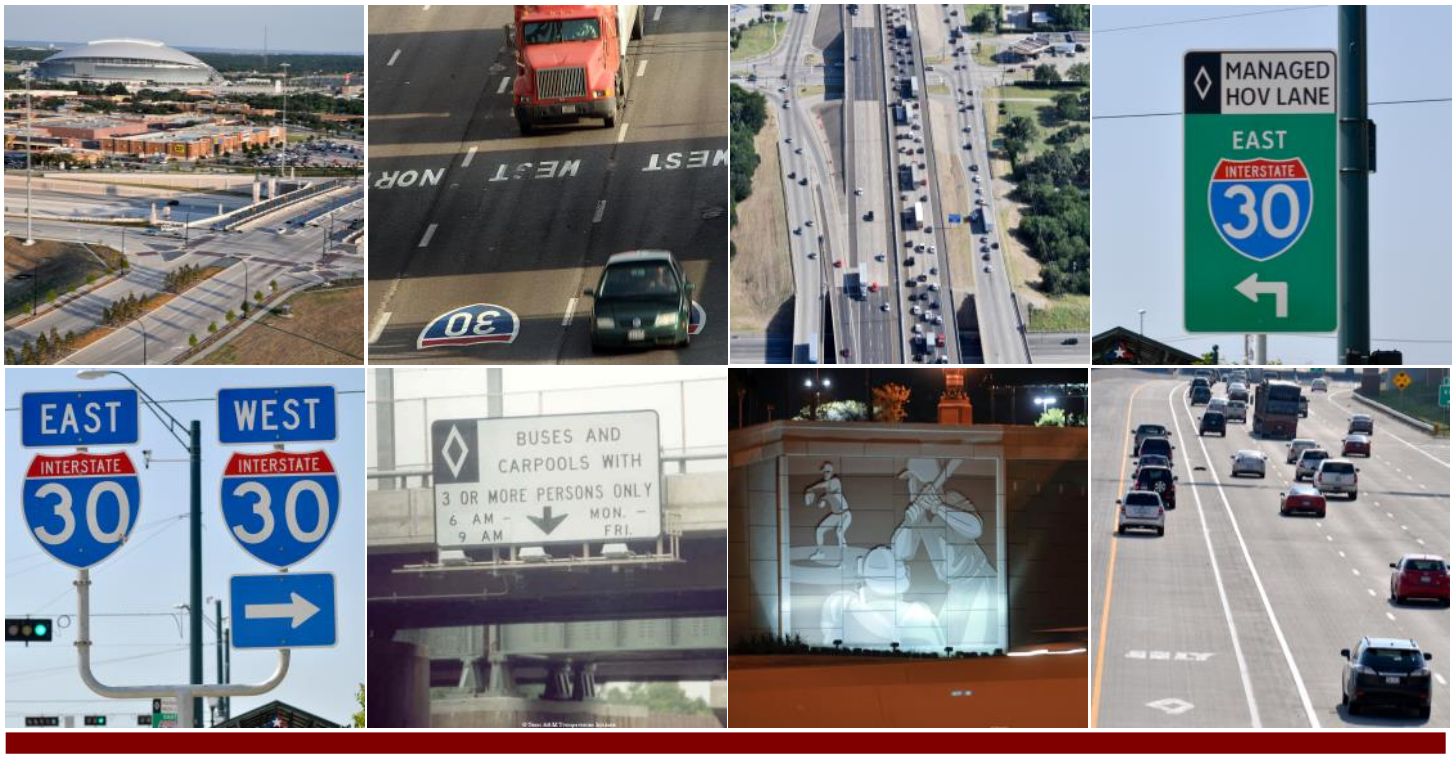

I-30 Express Lanes Survey Report

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DISCLAIMER

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EXECUTIVE SUMMARY

Express lanes (ELs), are facilities within freeways that impose tolls or other vehicle restrictions that ensure faster speeds, improve trip reliability, and generate revenue. These facilities are capable of improving performance on all lanes of a corridor, even when managing traffic flow for select lanes. The most frequently cited reason travelers will use ELs is to avoid congestion on the adjacent general purpose lanes (GPLs). Express Lanes can also have secondary benefits, which may include trip reliability, feeling safer, and potentially earning transit credits for each trip taken.

Judging how the public will react to ELs and estimating their potential use is difficult. To better predict usage, a survey was developed to measure how travelers would respond to various incentives. This report examines responses from a survey administrated in the Dallas-Fort Worth area where an Express lane is under construction and is expected to open in the fall of 2015. Appendix A contains the survey instrument and Appendix B provides more specifics on the survey incentives and methodology.

Dallas-Fort Worth survey respondents reported that they generally travel alone with over 70 percent indicating they did so for their most recent trip on I-30. The most commonly reported trip purpose was work-related commutes at 40 percent followed by recreational/social/shopping at 32 percent.

Stated preference (SP) questions were used to help understand how travelers would respond to various incentives for using the Express Lane. Examples of incentives include loyalty rewards such as a free trip on the Express lane for every 10 paid trips or transit discounts during peak hours. The responses showed that there were definite differences in the how the various incentives were favored by the respondents. Stated preference question 1 had no incentives and almost 80 percent of respondents chose to drive alone on the general purpose lane. After incentives were introduced in stated preference question 2, this percentage dropped to 70 percent. The transit incentives did not encourage much additional use of the EL, while incentives offered for carpooling or driving alone during off-peak periods on the EL were more accepted. Although the transit incentives did not seem to be favored by the respondents, currently there is little transit service in the area so respondents may not be accustomed to using that mode.

Respondents were then given the chance to sign up for a Pilot Program where the various incentives would be offered to the participants and subsequently rated by those respondents in a follow-up survey. This would help further understand which incentives were most effective.

INTRODUCTION

As congestion on freeways grows, Express Lanes (ELs) have become a more commonly used method to control and optimize freeway traffic. They are also known as managed lanes and are defined by the Federal Highway Administration (FHWA) as "highway facilities or a set of lanes where operational strategies are proactively implemented and managed in response to changing conditions" (*1*). They are managed to ensure free flow conditions on the lane or lanes. The main reason travelers choose to use ELs is that they are typically less congested and offer travel time savings. However, more recent studies have shown that travel time reliability is also an important aspect of express lane choice (*2*). This is done by restricting access, through tolls or limiting the types of users. One type of managed lane is the high occupancy toll (HOT) facility, which is toll-free for vehicles with the required number of occupants but tolls any single occupancy vehicles (SOVs) or other vehicles without the required occupancy wishing to use the lane. These tolls and/or occupancy requirements will typically change throughout the day based on the time of day and level of congestion. Although ELs are a relatively new concept, their popularity has grown and implementation is being considered by many agencies. Therefore, it is important to understand them and how they are used.

Judging how the public will react to ELs and estimating their potential use is difficult. The initial operating characteristics can greatly impact how ELs are accepted and how it will be used by the public. The first few months of operating an Express Lanes are often referred to as the ramp-up period, when traffic volumes have yet to reach full potential. The ramp-up period can last up to the first few years as users become aware of how the Express Lanes function, alter their travel behavior, and realize the travel-time saving benefits of using the facility. For that reason, pricing and operating rules are commonly altered after opening to adjust for changes in user perceptions (*3*).

Several incentive programs have been instituted to encourage carpooling and transit use on the lanes. A recent program, Cash for Commuters, in the Atlanta area offered up to $100 to commuters who shifted from driving alone to alternate modes (*4*). The program goals were to reduce congestion, improve air quality, and encourage drivers to choose alternative modes of travel. The Washington, D.C., metropolitan area implemented a similar incentive program run by Commuter Connections, with a goal to reduce congestion and encourage drivers of single occupant vehicles (SOV)s to either carpool or to use transit (*5*).

A more recent and very similar program was implemented on the I-10 and I-110 freeways near downtown Los Angeles. The program converted the old high occupancy vehicle (HOV) lanes into HOT lanes and also improved transit availability by adding 59 new buses and expanding transit stations. Tolling began in November 2012 for I-110 and February 2013 for I-10 and is managed using a FasTrak account transponder. The pricing for those driving alone and wishing to use the Express Lanes varies between $0.25 and $1.40 per mile and is usually based on ensuring the EL does not exceed a certain level of congestion. Additionally, the I-10 express lane requires 3+ occupants during peak hours (5 a.m.–9 a.m. and 4 p.m.–7 p.m.) for a free trip (*6*).

For the I-10 and I-110 Express Lanes, two loyalty programs were implemented for carpoolers and transit users to encourage travelers to carpool or use transit. For carpoolers, every trip taken while carpooling was recorded via FasTrak account and entered into a monthly lottery pool for a

chance to win gift cards. Each carpool trip taken gave the account an additional chance to win. A separate pool was also created for 3+ carpools with more valuable rewards. Overall, there were a total of four lottery pools, two for I-10 and two for I-110. Transit users could earn a $5 toll credit by taking 32 one-way peak hour trips on either I-10 or I-110.

Although there have been several programs around the country that have offered incentives to change travel modes, almost all have incentivized either alternative modes of transportation such as carpooling or transit or reductions in travel such as telecommuting. This survey for the I-30 Express Lanes tested incentives such as transit credit for multiple uses of transit or fare discounts during peak hours, but also included incentives for driving alone while on the ELs during off-peak periods such as rewards for loyal use. The incentives for driving alone on the ELs were the same ones given to carpoolers: a free trip for every 10 paid trips, various gifts such as gift cards or gas cards for using the Express Lane, and discounts to local businesses. These incentives were tested in the survey by offering the respondents four different choices for travel with some including incentives (see Figure 1).

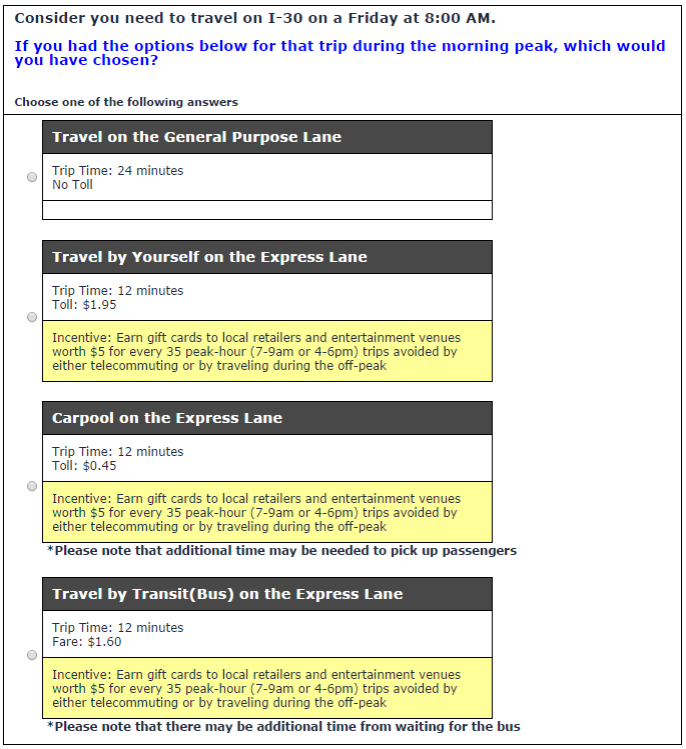

Figure 1: Example of SP Question with EL Incentive

I-30 (TOM LANDRY FREEWAY)

This study focused on travelers on the I-30 freeway between Arlington and Dallas, also known as the Tom Landry Freeway (see Figure 2). This section also goes through the cities of Grand Prairie and Arlington.

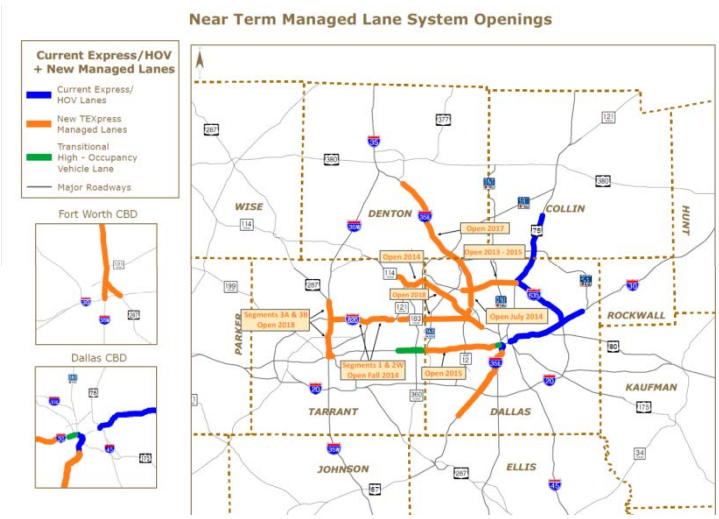

Figure 2: Map of TEXpress Lanes in the Dallas-Fort Worth Area

The road is currently a six-lane divided freeway. ELs are being added in between GPLs (see Figure 3). ELs are currently being constructed with plans to open in October 2015. Other than being a major route inside the metropolitan area, it is notable for having both the Dallas Cowboys and Texas Rangers stadiums near it.

(source: http://www.vta.org/projects-and-programs/highway/vta-express-lanes-sr-237-express-lanes-project [*8*])

Figure 3: Example of an Express Lane set-up

PROGRAMS IN THE DALLAS-FORT WORTH AREA

Try Parking It (http://www.tryparkingit.com/) is the Dallas-Fort Worth region's Commuter Tracking and Ride-matching website that encourages commuters to use alternatives to driving alone to work such as ridesharing, biking, walking, telecommuting, and taking transit. Commuters are then encouraged to record information about those work-related trips. Try Parking It has been operated by the North Central Texas Council of Governments (NCTCOG) since 2006. In 2008, the ride-matching component of the website was launched, which allows commuters to locate both traditional carpool and vanpool matches. In March 2013, the program reached a milestone of 5 million miles saved and 10,600 vehicle trips saved. The program currently does not offer incentives; however incentives such as gift cards, airline tickets, and iPads were offered in the past during Commuter Challenge campaigns. These prize incentives were made available by participating sponsors.

DFWConnectARide (https://dfwconnectaride.com/) is the region's first casual carpooling website. Completed in 2014, the website allows commuters to locate and connect with other commuters for real-time carpool matches. DFWConnectARide was developed as a component of the Value Pricing Pilot Project along the I-30/Tom Landry corridor.

I-30 SURVEY METHODOLOGY

TRAVELER TRIP CHARACTERISTICS

The first question within the survey was a basic inquiry about the respondent's recent travel on the freeway. Questions on the survey include how often the respondent makes trips on the I-30 freeway, the associated trip purpose, and the time of the trip. Answers to these questions were then used later in the survey to set the stated preference scenarios.

INCENTIVES

After the initial basic questions, the next section of the survey provided a short definition about ELs and listed a series of potential incentives. Six incentives were shown and the respondent was asked to rate each on a scale of 1–5 (see Figure 4). A response of 1 indicated that the respondent would not change their trips while a response of 5 indicated the respondent would likely change a lot of their trips due to that incentive.

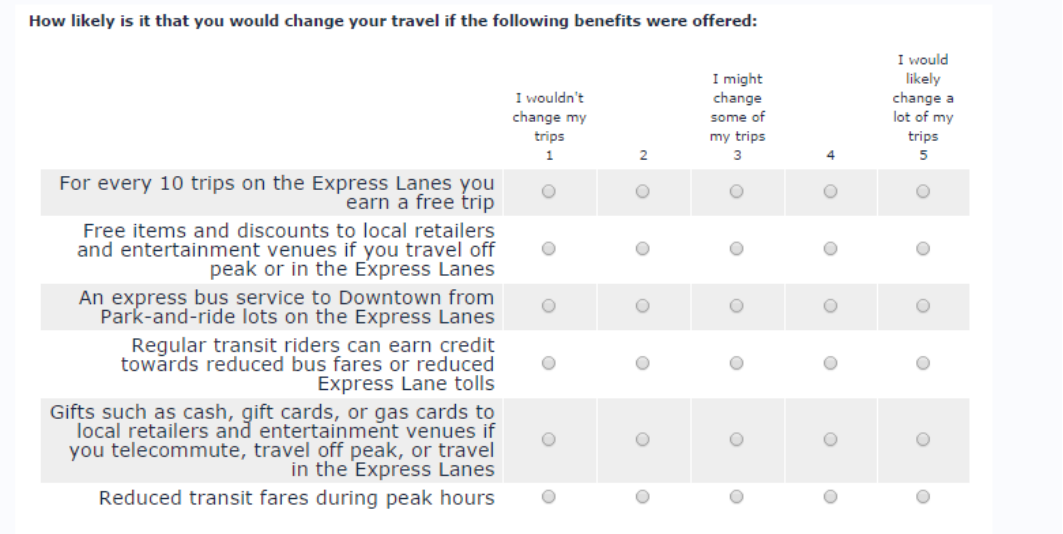

Figure 4: Incentives List as Presented in the Survey

The six incentives were presented in a random order so that the order they were shown would not influence their average rating.

STATED PREFERENCE QUESTIONS

In the stated preference questions section of the survey, three questions were asked to measure how people would respond if multiple travel options were available on I-30. In each question, four choices were given:

- Travel on the General Purpose Lane.
- Travel by Yourself on the Express Lane.

- Carpool on the Express Lane.
- Travel by Transit (Bus) on the Express Lane.

Travel on the GPL would be free, but have a longer travel time. The travel time on the other three would all be the same as they were all on the ELs. However, footnotes were added to indicate that extra time may be needed for carpooling and transit. This would be to either pick up and drop off passengers or wait at the bus stop (see Figure 5).

Trip characteristics were either based on the answers given in the first section or were randomly generated if the respondent had not answered some of those trip detail questions from the first section. For example, if the day of the week and time of day were not provided, then a random weekday was chosen and the trip was set to either the AM or PM peak (50 percent chance of either) (Figure 5). However, if the day and time had been provided by the respondent, the first sentence of the question would read "You described your most recent trip on I-30 as occurring on a 'day of the week' at 'time' in a 'vehicle'. 'Day of week,' 'time' and 'vehicle were replaced with the respondents' actual answers from the questions earlier in the survey. These characteristics set the basis of the stated preference questions. The next sections will explain how the travel time, toll rates, and incentives were generated.

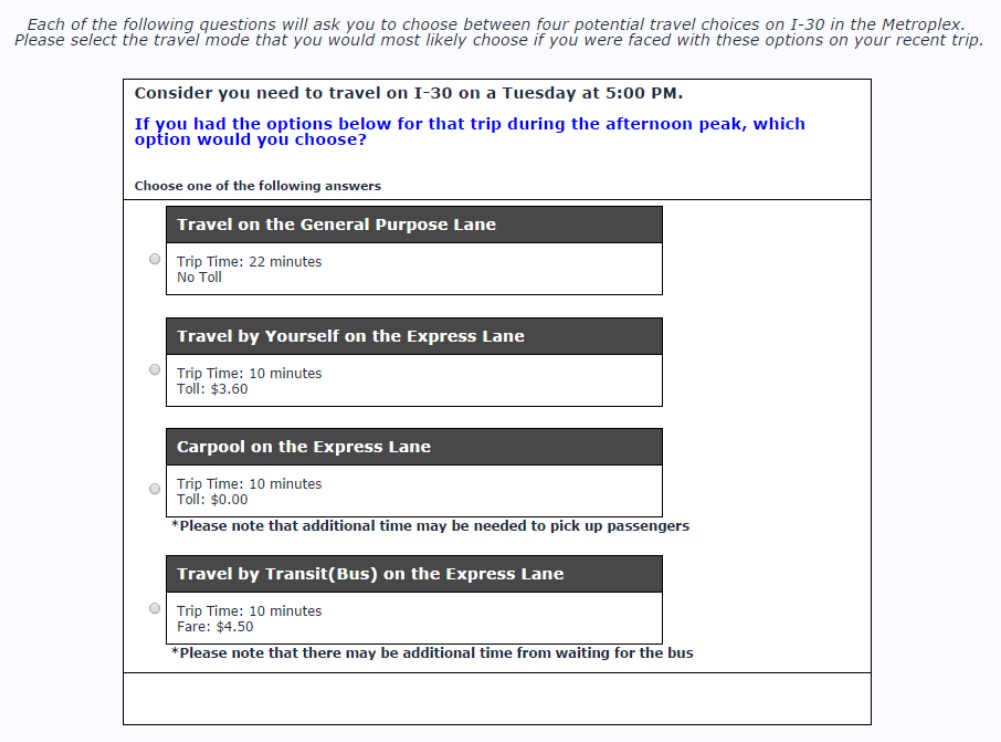

Figure 5: Stated Preference Questions

Stated Preference Question Design: Travel Time

Travel time is one of the most important factors a person considers when choosing their mode of transportation. Travel time depends on several factors including speed, distance, and time of day. To calculate the base travel time, the following equation was used:

$$TT = \frac{D * 60}{V/TDF} \quad (1)$$

Where: TT = total trip time (minutes)
D = distance (miles)
60 to convert to miles/hour to miles/minute
V = speed (mph)
TDF = time of day factor, (see 'Trip Time of Day' section below)

Typical speeds referenced in the survey were based on data obtained from freeway detectors on GPLs (see Table 1) and is summarized in Table 2.

Table 1: I-30 General Purpose Lane Average Speeds (DALTRANS Detector Data Archive)

I-30 WEST (TOM LANDRY) AVERAGE SPEEDS (mph)

Date: 11/5/2013
source: DALTRANS - Detector Data Archive

Time Period	Belt Line Eastbound (3 lanes)	Belt Line Westbound (3 lanes)	Sylvan Eastbound (3 lanes)	Sylvan Westbound (3 lanes)
0:00-1:00	64	69	66	59
1:00-2:00	62	68	65	55
2:00-3:00	61	65	58	55
3:00-4:00	59	68	60	54
4:00-5:00	66	67	64	58
5:00-6:00	66	69	65	61
6:00-7:00	63	68	60	59
7:00-8:00	61	70	40	61
8:00-9:00	67	71	30	61
9:00-10:00	65	69	62	60
10:00-11:00	65	68	65	60
11:00-12:00	66	69	65	60
12:00-13:00	66	69	66	60
13:00-14:00	65	68	64	58
14:00-15:00	64	66	57	54
15:00-16:00	64	65	59	55
16:00-17:00	67	64	54	57
17:00-18:00	67	63	46	59
18:00-19:00	61	47	56	56
19:00-20:00	67	69	64	59
20:00-21:00	67	70	66	60
21:00-22:00	67	71	67	61
22:00-23:00	70	72	67	62
23:00-0:00	65	70	66	59

Table 2: Speed Range Used for the Survey

	Express lane (mph)	General purpose lane (mph)
Minimum speed	55	45
Maximum speed	75	60

Stated Preference Question Design: Trip Time of Day

The time of day that a trip is taken will have a significant effect on the total travel time due to the added congestion during peak periods. To account for this, a time of day factor was used. The factor is dependent on whether the GPLs or ELs are chosen and the time period the trip is taken (see Table 3). If the respondent provided the time the trip started, that input was used. However if the time was not provided, the survey defaulted to the peak period (randomly choosing between the AM and PM peak). This factor was then used in the Travel Time equation (see equation 1) to calculate the total travel time for the scenario.

Table 3: Time of Day Factors Based on Trip Start Time

Trip Start Time	Time of Day	Time of Day Factors	
		General Purpose Lane	Express Lane
6 AM to 7 AM	Morning Shoulder Period	1.4	1.1
7 AM to 9 AM	Morning Peak Period	1.8	1.2
9 AM to 10 AM	Morning Shoulder Period	1.4	1.1
10 AM to 4 PM	Mid-Day	1.0	1.0
4 PM to 5 PM	Evening Shoulder Period	1.4	1.1
5 PM to 7 PM	Evening Peak Period	1.8	1.2
7 PM to 8 PM	Evening Shoulder Period	1.4	1.1
8 PM to 6 AM	Night	1.0	1.0

Because ELs are managed, the travel time is less and is more consistent throughout the day. Therefore, it is less impacted by congestion and the time of day factor. The Time of Day column in Table 1 indicates what was shown to the respondent to help describe the hypothetical trip.

Stated Preference Question Design: Toll Rate

The toll rate was based on values taken from the existing LBJ TEXpress Lanes on I-635 and the bus fares on the Dallas Area Rapid Transit (DART). The LBJ TEXpress is based on real-time demand but generally ranges from 10 cents to 25 cents per mile during off-peak hours and 45 cents to 75 cents per mile during peak hours (*9*). The difference between the toll rates on the LBJ TEXpress and those for the I-30 Express Lanes are based on the operating goals for each facility. The LBJ TEXpress was developed as a public-private partnership with a strong revenue generation goal, whereas the I-30 Express Lanes seek to maximize throughput. Tolls for facilities with a strong revenue goal tend to have higher tolls, because more money can be taken from a smaller user base that has a high inelasticity due to a strong aversion for travel delay. Therefore, the starting toll level shown in the SP questions may be a bit higher than what the rate on I-30 ELs may be, but it is in the range of expected rates based on the other facility in the area.

The DART currently charges $2.50 for a 2-hour pass that can be used locally, and $5.00 for a 2-hour pass that can be used regionally. DART also offers an off-peak pass (9:30 a.m. to

2:30 p.m.) that costs $1.75 for local trips and $3.50 for regional trips (*10*). Using these numbers, ranges for both the toll and price of transit were developed that could be used for the survey. Two different methods were used to determine the exact values that would be used, described in more detail in the following sections.

TRAVEL TIME AND TOLL RATE SELECTION DESIGN

The travel times and the toll rates for the SP questions were determined through a randomly selected process for each respondent. Specifically, the two random generation methods deployed were the Bayesian Efficient design and a Random Adjusting design. Each method had a 50 percent chance of being selected for the participant. These designs for each method are discussed in the following sections.

Bayesian Efficient Design

One way the survey's attributes (travel time, toll, transit fare, and incentives) were generated was by using the Bayesian Efficient design. In this design, the attributes travel time (based on speed), toll rate, and transit fare were estimated to minimize the standard errors for the parameters while maximizing the *t* statistic. The asymptotic standard errors are minimized for the discrete choice models. In this survey, the D-error efficiency criterion was used, so the Bayesian Efficient design was determined by minimizing the D-error of the asymptotic variance-covariance (AVC) matrix in the discrete choice model. The AVC matrix is the inverse of the Fisher information matrix in a discrete choice model (*11*).

The parameters (coefficients or β values) for the survey attributes, such as toll and travel time, are not known before conducting the survey. Therefore, prior values of attributes from previous studies and literature must be used to estimate the parameters. In this survey, the priors were assumed to have normal distributions with non-zero means. The mean values were obtained from a previous Transit to SOV study (*12*).

The Bayesian error was calculated using equation 2:

$$\boldsymbol{D_{b-error}} = \int_{\boldsymbol{\beta}} \boldsymbol{detAVC}\left(\tilde{\boldsymbol{\beta}}\middle|\boldsymbol{X}\right)^{\frac{\mathbf{1}}{\boldsymbol{K}}} \emptyset\left(\tilde{\boldsymbol{\beta}}\middle|\boldsymbol{\theta}\right) \boldsymbol{d\tilde{\beta}} \quad (2)$$

Where: $\emptyset\left(\tilde{\beta}\middle|\theta\right)$ = joint distribution of the assumed parameter priors
θ= the corresponding parameters of the distribution
K = the number of parameters in the model

The integral is computationally difficult so it can approximated by several different methods, including the use of Halton draws to simulate the distributions (*11*). This was the method used for this study. Once the Halton draws are completed, *R* independent draws are taken from each of the prior distributions of the K-parameters and the D_b-error is then calculated using equation 3:

$$\widehat{D}_b - error = \sum_{r=1}^{R} detAVC\left(\tilde{\beta}^r\middle|X\right)^{\frac{1}{K}}/R \quad (3)$$

Where: $\tilde{\beta}^r = [\tilde{\beta}_1^1, \ldots, \tilde{\beta}_k^r]$
R = the draw (1, 2,…, R)

The values for the attribute levels (see Table 5) were obtained from toll rates as described above in the section 'Toll Rate' and the speeds were obtained as described in the section 'Travel Time.' The cost for carpooling was set to be either free or a fraction of the full toll rate. Transit was assumed to only travel on the ELs.

For this survey, the N-Gene software program was used to generate the D_b-efficient designs. By inputting the attribute levels, means, and standard deviations, the program generates values of attributes such as toll rate and travel speed to be used in the survey. The stopping point is based on how small of an error is desired. A random parameter panel logit (rppanel) was specified for the discrete choice model and the priors were then simulated using 400 Halton draws from the prior distribution. The resulting Bayesian design is shown in Table 6 and has 24 rows divided into 8 blocks of 3 rows each. A respondent would be given SP questions with the attributes from all three rows out of a randomly chosen block. The D_b-error for the design was found to be 0.74, which indicates an efficient design.

Table 4: Attribute Levels

Attribute	Lane	Levels
Travel Time (minutes)	Express Lane	8; 8.57; 9.23; 10; 10.91
	General Purpose Lane	10; 10.91; 12; 13.33; 15
Toll Rate (cents/mile)	Express Lane	30, 35, 40, 45, 50
	General Purpose Lane	0, 0, 15, 25
Transit Fare (dollars)	Express Lane	3.5, 4.0, 4.5, 5
	General Purpose Lane	N/A

Table 5: Prior Coefficients for the D-Efficient Design

Attribute	Attribute Levels		Mean Value of Priors	Standard Deviation of Priors
Travel Time (minutes)	Express Lane	8; 8.57; 9.23; 10; 10.91	−0.33	0.32
	General Purpose	10; 10.91; 12; 13.33; 15		
Toll Rate (cents)	EL Drive Alone	30, 35, 40, 45, 50	−1.22	
	EL Carpool	0, 0, 15, 25		
	General Purpose	0		
Transit Fare (dollars)	Transit	3.5; 4; 4.5; 5		

Table 6: D-Efficient Design Results

Mode	General Purpose Lane	Express Lane			
Block	Speed (mph)	Speed (mph)	Toll Rate (single occupant) (cents/mile)	Toll Rate (carpool) (cents/mile)	Transit Fare (dollars)
	45	75	50	15	3.5
1	50	70	35	15	4.5
	40	75	30	25	3.5
	50	70	45	25	4.00
2	50	60	50	0	5.00
	55	55	35	0	3.5
	60	65	40	0	1.00
3	55	65	40	0	5.00
	55	55	30	0	4.5
	40	70	40	15	5.00
4	45	65	30	0	5.00
	60	60	50	15	4.5
	55	55	35	25	3.5
5	45	65	40	0	4.5
	45	70	40	0	4.0
	60	60	35	0	3.5
6	60	60	50	25	5.00
	55	60	45	15	4.0
	50	70	30	0	4.0
7	40	75	45	0	5.00
	40	75	30	25	4.5
	45	60	45	15	3.5
8	50	65	45	25	4.00
	55	75	35	0	4.5

Random Adjusting Design

The other method used to select the attribute levels was by an adaptive random adjusting design. In this method, for the first SP question the attributes (initial speed and toll rate) are generated randomly from a range. This range was based on the speeds and toll costs obtained from the LBJ TEXpress and the DART transit rates as described above in the section Stated Preference Question Design: Toll Rate. The speed and toll rate in the following SP questions are then adjusted based on what the respondent chooses as the mode of transportation in the previous SP question. For example, if GPL is chosen in question 1, then the toll rate would be multiplied by a randomly generated factor of 0.35 to 0.7. If EL was chosen, then the toll rate would be multiplied by a random amount between 1.3 and 1.9.

For the second and third questions, the speed would again be randomly generated using the same method as in the first question. Constraints were added to ensure the toll would not be either too high or too low (see Table 7). The initial speed and toll rates were again set based on data obtained from detectors on the I-30 freeway and current rates used for the LBJ TEXpress and the DART (see Table 8).

Table 7: Allowable Range of Random Adjusting Design Attributes

Mode	Minimum	Maximum
Toll Rate (single occupancy) (cents/mile)	10	100
Toll Rate (carpool) (cents/mile)	0	50
Transit Fare (dollars)	1.00	10.00

Table 8: Random Adjusting Design Attributes

Attribute	Lane	Range
Speed (mph)	Express Lane	55 + (0 to 20)
	General Purpose Lane	40 + (0 to 20)
Toll Rate (cents/mile)	Express Lane	30 + (0 to 20)
	General Purpose Lane	0
Transit Fare (dollars)	Express Lane	3.5 + (0 to 1.5)
	General Purpose Lane	N/A

INCENTIVE SELECTION DESIGN

The main focus of this survey was to determine how travelers would react and adjust their behavior if incentives for travel on EL were provided. For example, if a free trip on EL was offered after every 10 paid trips, would drivers be more willing to use ELs? To do this, incentives were added to the second and third SP questions. The incentive was chosen randomly among the six to ensure that every incentive would get equal consideration. All but one incentive had a numerical aspect. The value of the numerical aspect was randomly selected from a range. The six incentives and their incentive values were as follows:

- Earn a free trip for every 8, 9, 10, 11, or 12 paid trips taken on the Express Lanes.
- Earn gift cards worth $5 for every 20, 25, 30, or 35 peak-hour trips saved by either telecommuting or by not traveling during the peak hours (7–9 a.m. or 4–6 p.m.).
- 5 percent, 10 percent, 15 percent, 20 percent, or 25 percent discount offered through select businesses.
- For every 20, 25, 30, or 35 trips taken by transit, $5 in credits that can be used on ELs.
- A transit fare discount of 10 percent, 20 percent, or 30 percent.
- Express bus service from park-and-ride lots to downtown.

The first three incentives applied to driving a personal vehicle on ELs (see Figure 6), while the last three only applied to the Transit (Bus) option (see Figure 7).

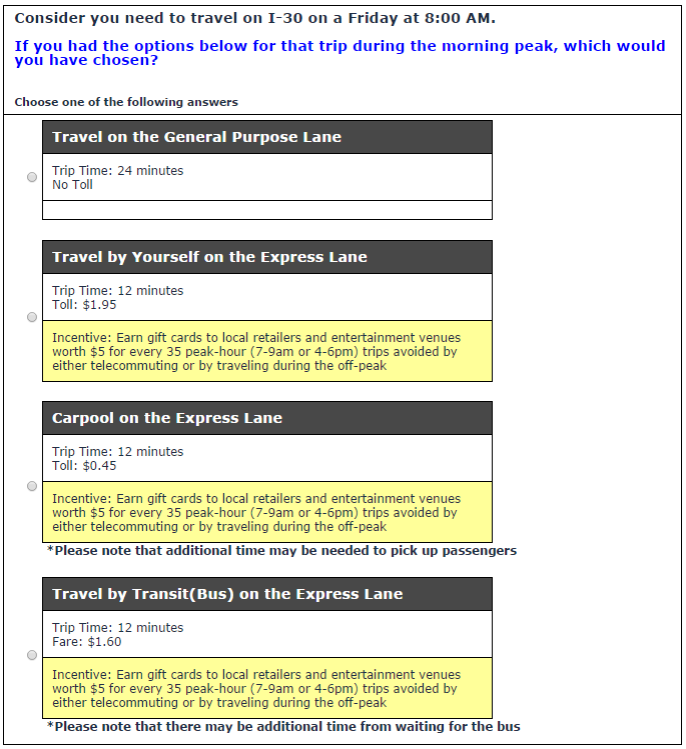

Figure 6: Example of SP Question with EL Incentive

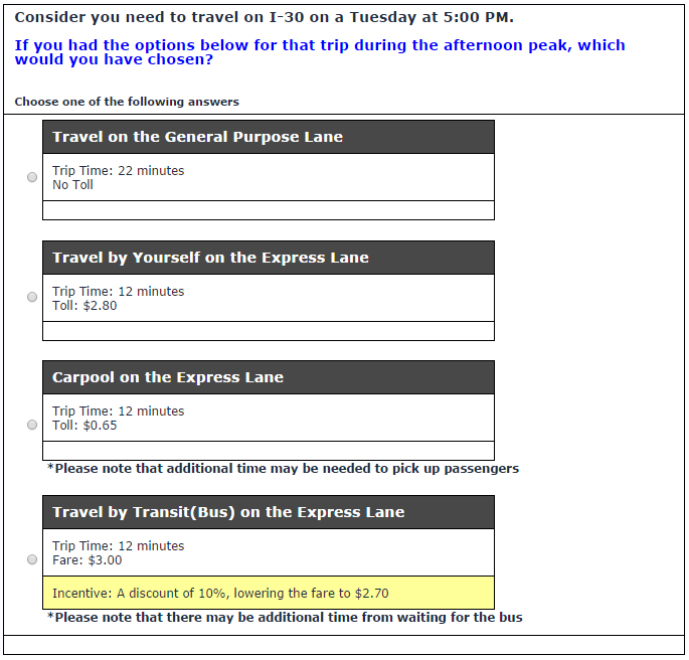

Figure 7: Example of SP Question with Bus Incentive

DEMOGRAPHICS

The last set of questions asked about the socioeconomic and demographic characteristics of the respondent (gender, age, race, education level, and household income). There was also a text box at the end for any comments or suggestions related to transportation on I-30.

PILOT PROGRAM

The final part of the survey introduces the pilot program to the survey respondent. Once the I-30 ELs are constructed, the pilot program would offer various incentives to the participants. The incentives offered would be the same as, or similar to, the ones presented in the survey and discussed in the previous section of this report. Exactly which incentives are offered would be based on the survey responses and the ability to implement the various discounts and benefits. The respondents who sign up and participate in the program would be given a follow-up survey at a later date to collect data on how effective the incentives actually were and how it compared to SP responses. This will help determine what the most useful incentives are for maximizing the use and efficiency of the ELs.

SURVEY ADMINISTRATION

The survey was developed and distributed using LimeSurvey software, available through a free website. LimeSurvey was used to both create the survey and collect the responses. The URL www.i-30survey.org was used to direct people to the online survey. The survey was available from August 1, 2014, until November 30, 2014. The initial effort to garner responses was from August 1 to September 15 and included an incentive to encourage responses. Three randomly chosen respondents received a $250 MasterCard gift card at the end of that initial effort. Along with the random prize drawing, advertisements (as shown in Figure 8), and press releases were sent out to various transportation agencies, websites, and media outlets throughout the Dallas-Fort Worth area. Print advertisements were purchased in the Dallas Morning News Neighbors section and the main section of the paper for publication on September 5 and 12, both Fridays. Articles were placed in NCTCOG and North Texas Tollway Authority (NTTA) newsletters that were distributed in print and via email. Social media was also used to advertise. Twitter® was used to target media and community groups, and Facebook® was used by TTI, NCTCOG, and NTTA to post links to the survey. Additionally, advertisements were posted on Craigslist.

The initial effort garnered fewer responses than desired and thus the survey remained online past the original anticipated end date of September 15. Researchers and NCTCOG staff felt that another push to let people know of the survey might be able to garner additional responses. This effort was successful and the survey attracted several hundred more responses prior to its closing on November 30, 2014.

Researchers used the LimeSurvey software to examine where survey referrals originated. The locations with the most number of referrals were government websites such as arlington-tx.gov (city of Arlington), gptx.org (city of Grand Prairie), and drivingnorthtexas.com, which is operated by the NTTA (see Table 9). The social media websites Facebook and Twitter were also successful in generating referrals. Traditional newspaper and television station websites such as cbslocal.com, fwbusinesspress.com, and opinionarlington.com garnered a small number of referrals.

Table 9: Number of Referrals from Various Sites

Referral Address	Referral Count
arlington-tx.gov	215
cbslocal.com	3
dallascitynewsroom.com	3
drivingnorthtexas.com	148
facebook.com	70
fwbusinesspress.com	5
gptx.org	38
nctcog.org	38
opinionarlington.com	5
reagan.com	2
texas.dotnewz.com	1
tryparkingit.com	2
twitter.com	13
uta.edu	3

Figure 8: Example Advertisement

A second outreach effort occurred in November and lasted until the end of the survey on November 30, 2014. Although this push did not include an incentive for responses, it still garnered a significant amount of responses (see Figure 9).

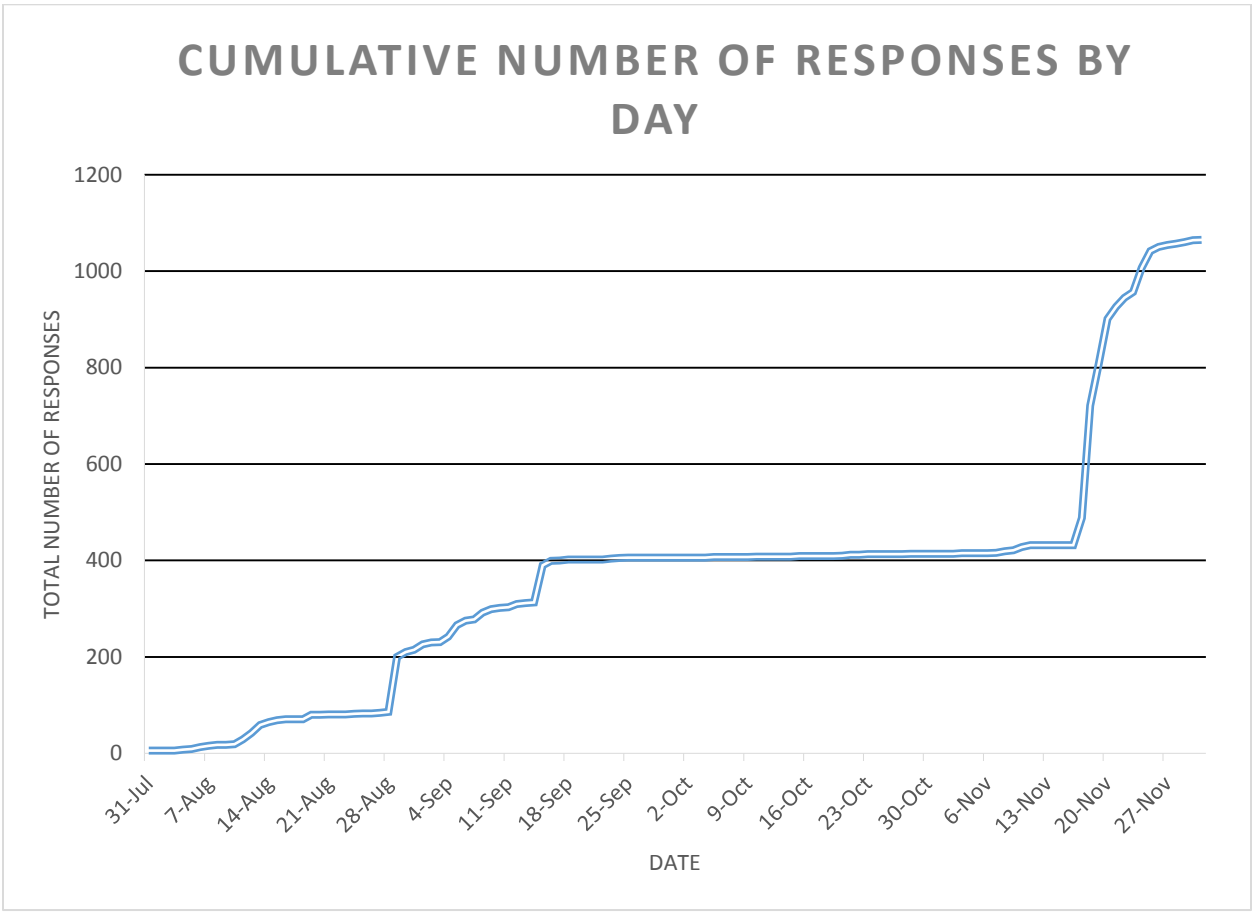

Figure 9: Cumulative Number of Responses by Day

After the survey was closed to the respondents, data from the survey were checked to ensure that responses were legitimate and could be used in the analysis. Since a monetary prize was used as an incentive, there was a possibility that respondents could complete the survey multiple times to better their chances of winning. Therefore, it was important to filter out any responses that were

very likely to be duplicates. It was also important to check the partially completed responses to determine which of those were usable.

The following methods were used to filter unusable responses:

- Time started/ended and IP address were used to see if anyone took the survey multiple times in a row.
  - Most repeated IP addresses had differing answers and were assumed to be different family members or employees at the same company. These were all kept.
  - Several instances were found where someone started the survey, quit before finishing, then later started a new response and completed the survey. Any previously completed questions were answered in the same way. Therefore the partial responses (initial survey entry) were removed.
- Time started/ended was used to see how quickly people completed the survey. Any that took less than 3 minutes were further scrutinized. However, if nothing else was suspicious it was left in the dataset. A total of 173 responses were under three minutes. six were removed, mostly because although they completed the survey, they skipped almost all the questions.
- Any responses with suspect zip codes were removed: one response had a 3 digit zip code and was removed.

Next, surveys that were not completed were examined to determine if enough of the survey had been completed that it was still useful. If all but the demographics section was complete, including all three SP questions, the response was kept. If the whole survey including the demographics section was completed, but the respondent did not answer all the SP questions, it was removed.

After filtering using the above methods, out of the 894 completed surveys, 10 were removed for reasons stated above. Out of the 161 incomplete responses, 14 were kept and the rest were removed. Overall, after filtering, 898 responses were kept out of 1055 total responses.

SURVEY RESULTS

Once the data were filtered, the next step was to begin analysis of the data. Table 10 summarizes traveler characteristics, incentive ratings, stated preference answers, and demographics from the survey.

Table 10: Survey Response Averages

Survey Design Type:	Efficient[A]	Random[B]	All
Characteristic	Percentage of Travelers		
How Frequently do you travel on the I-30 (Tom Landry) Freeway?			
Multiple times per day	28.1	34.3	31.4
About once a day	7.4	6.3	6.8
A few times per week	23.5	21.7	22.5
Once a week	10.0	5.0	7.3
A few times per month	29.7	29.7	30.0
I have not used I-30 in the past 6 months	1.6	3.0	2.3
What was the purpose of your most recent trip on I-30?			
Commuting to or from work	40.1	40.4	40.3
Recreational/Social/Shopping	32.9	30.7	31.8
Major Sports game	2.3	2.7	2.5
Work Related (non-commuting)	15.7	15.0	15.4
Class or School	4.5	3.6	4.0
Other	4.5	7.6	6.1
On what day of the week was your most recent trip?			
Sunday	7.0	7.2	7.0
Monday	15.7	14.0	14.8
Tuesday	19.4	17.6	18.5
Wednesday	13.1	10.8	12.0
Thursday	16.4	16.0	16.2
Friday	14.3	18.7	16.6
Saturday	14.3	15.6	14.9
Average respondent trip time (minutes)	30.1	33.4	31.8
% Passenger vehicle, SUV or Pick-up truck	99.1	99.3	99.2
How many people were in the vehicle?			
1	74.3	69.0	71.6
2	19.4	21.4	20.4
3	4.6	6.0	5.3
4	1.7	2.3	2.0
5+	0	1.4	0.7

Survey Design Type:	Efficient[A]	Random[B]	All
Characteristic	Percentage of Travelers		
Was the respondent the driver or passenger?			
Driver	73.3	72.9	73.1
Passenger	26.7	27.1	26.9
Average time to pick up passenger (minutes)	3.00	4.7	3.95
Passenger's relation to respondent			
Neighbor	2.5	3.3	2.9
Child	14.9	20.1	17.5
Co-worker	12.4	6.0	8.7
Adult family member	56.2	56.4	55.3
Commuter in a casual carpool	0	4.0	2.2
Other	14.0	10.1	13.5
Incentives (Weighted Average)[C]			
For every 10 trips on the Express Lanes you earn a free trip	2.33	2.35	2.34
Gifts such as cash, gift cards, or gas cards to local retailers and entertainment venues if you telecommute, travel off peak, or travel in the Express Lanes	2.39	2.38	2.38
Free items and discounts to local retailers and entertainment venues if you travel off peak or in the Express Lanes	2.19	2.18	2.19
Regular transit riders can earn credit toward reduced bus fares or reduced Express Lane tolls	1.95	1.87	1.91
Reduced transit fares during peak hours	2.26	2.23	2.24
An express bus service to Downtown from Park-and-ride lots on the Express Lanes	1.80	1.85	1.83
Time of Day of Trip			
Peak	40.0	43.7	41.9
Shoulder	25.7	23.4	24.5
Off-Peak	34.3	32.9	33.6
Efficient Design block assignment			
1	14.7	-	
2	13.3	-	
3	11.5	-	
4	12.6	-	
5	12.0	-	
6	11.0	-	
7	12.6	-	
8	12.2	-	
Stated Preference (SP) Question 1			
Average GPL travel time for SP1	16.2	17.4	16.9
Average Express Lane travel time for SP1	11.1	10.4	10.7
Average drive alone toll for SP1	4.03	4.01	4.02

Survey Design Type:	Efficient[A]	Random[B]	All
Characteristic	Percentage of Travelers		
Average carpool toll for SP1	1.23	0.51	0.86
Average transit fare for SP1	3.88	4.25	4.07
Mode Choice in SP1			
General Purpose Lane	78.8	79.0	78.8
Managed Lane Drive Alone	11.8	9.5	10.7
Managed Lane Car Pool	6.0	8.9	7.5
Transit	3.5	2.6	3.0
Stated Preference Question 2			
Average GPL travel time for SP2	17.7	17.6	17.6
Average Express Lane travel time for SP2	10.1	10.4	10.2
Average drive alone toll for SP2	4.16	2.71	3.42
Average carpool toll for SP2	0.80	0.33	0.56
Average transit fare for SP2	4.74	2.73	3.71
Incentives			
For every X trips, earn one free trip			
Number of times offered	75	73	148
% of the time chosen when offered	18.7	19.2	18.9
Average X	10.1	10.0	10.1
Average X when chosen	10.0	10.0	10.0
Average X when not chosen	10.1	10.0	10.1
Gifts such as cash or gift cards for every X trips			
Number of times offered	74	79	153
% of the time chosen when offered	24.3	25.3	24.8
Average X	27.3	27.1	27.2
Average X when chosen	26.4	28.5	27.5
Average X when not chosen	27.6	26.6	27.1
X% discount to local businesses			
Number of times offered	78	84	162
% of the time chosen when offered	21.8	39.3	30.9
Average X	15.4	15.4	15.4
Average X when chosen	18.2	14.8	16.0
Average X when not chosen	14.6	15.8	15.1
$5 credit for every X trips taken by transit			
Number of times offered	55	65	121
% of the time chosen when offered	3.6	3.1	3.3
Average X	28.1	27.8	27.9
Average X when chosen	32.5	22.5	27.5
Average X when not chosen	28.0	28.0	27.9

Survey Design Type:	Efficient[A]	Random[B]	All
Characteristic	Percentage of Travelers		
Transit discount of X%			
Number of times offered	79	80	159
% of the time chosen when offered	7.6	2.5	5.0
Average X	19.4	19.6	19.5
Average X when chosen	18.3	20.0	18.8
Average X when not chosen	19.5	19.6	19.5
Express Bus Lanes			
Number of times offered	74	81	155
% of the time chosen when offered	5.4	3.7	4.5
Mode Choice in SP2			
General Purpose Lane	71.7	66.8	69.2
Managed Lane Drive Alone	11.6	16.9	14.3
Managed Lane Car Pool	12.5	13.0	12.8
Transit	4.2	3.3	3.7
Stated Preference Question 3			
Average GPL travel time for SP3	17.5	17.6	17.5
Average Express Lane travel time for SP3	10.3	10.4	10.4
Average drive alone toll for SP3	3.67	2.23	2.92
Average carpool toll for SP3	1.04	0.25	0.64
Average transit fare for SP3	4.10	2.02	3.03
Incentives			
For every X trips, earn one free trip			
Number of times offered	74	75	149
% of the time chosen when offered	16.2	35.0	25.5
Average X	10.1	9.9	10.0
Average X when chosen	9.8	9.8	9.8
Average X when not chosen	10.2	10.0	10.1
Gifts such as cash or gift cards for every X trips			
Number of times offered	78	70	148
% of the time chosen when offered	30.8	35.7	33.1
Average X	27.6	27.4	27.5
Average X when chosen	27.1	28.4	27.8
Average X when not chosen	27.9	26.9	27.4
X% discount to local businesses			
Number of times offered	65	97	162
% of the time chosen when offered	29.2	40.2	35.8
Average X	14.2	12.8	13.3
Average X when chosen	14.7	12.2	13.0
Average X when not chosen	13.9	13.2	13.5

Survey Design Type:	Efficient[A]	Random[B]	All
Characteristic	Percentage of Travelers		
$5 credit for every X trips taken by transit			
Number of times offered	65	76	142
% of the time chosen when offered	3.1	3.9	3.5
Average X	28.2	26.9	27.5
Average X when chosen	27.5	30.0	29.0
Average X when not chosen	28.2	26.8	27.4
Transit discount of X%			
Number of times offered	73	81	154
% of the time chosen when offered	4.1	6.2	5.2
Average X	20.1	20.4	20.3
Average X when chosen	20.0	26.0	23.8
Average X when not chosen	20.1	20.0	20.1
Express Bus Lanes			
Number of times offered	80	63	143
% of the time chosen when offered	3.8	7.9	5.6
Mode Choice in SP3			
General Purpose Lane	71.6	62.0	66.7
Managed Lane Drive Alone	13.5	21.3	17.5
Managed Lane Car Pool	10.2	13.0	11.8
Transit	4.7	3.7	4.2
Demographics			
Gender			
Male	52.4	50.7	51.4
Female	47.6	49.3	48.6
Age			
18–24	10.1	6.6	8.3
25–34	19.5	21.7	20.6
35–44	17.6	18.6	18.2
45–54	21.1	23.9	22.5
55–64	21.8	19.5	20.6
65+	10.0	9.7	10.0
Ethnicity			
White/Caucasian	80.8	78.4	79.4
Hispanic/Latino	8.6	8.5	8.5
African American	4.0	5.4	4.8
Asian American	1.9	2.3	2.1
Native American	1.4	0.9	1.2
Other	3.3	4.5	3.9

Survey Design Type:	Efficient[A]	Random[B]	All
Characteristic	Percentage of Travelers		
Education			
Less than high school	0.0	0.2	0.1
High school graduate	3.1	4.5	3.8
Some college or vocational school	21.6	21.3	21.6
College graduate	40.4	44.3	42.3
Post-graduate college	35.0	30.0	32.2
Household Income			
Less than $10,000	1.2	1.1	1.2
$10,000–$14,999	1.2	0.5	0.8
$15,000–$24,999	3.3	2.9	3.1
$25,000–$34,999	6.7	5.4	6.0
$35,000–$49,999	9.1	7.2	8.2
$50,000–$74,999	19.3	19.2	19.2
$75,000–$99,999	13.8	16.3	15.1
$100,000–$199,999	25.3	25.3	25.3
$200,000 or more	4.8	6.5	5.7
Prefer not to answer	15.3	15.6	15.4

[A] This is the Bayesian Efficient Design (Db- efficient design) method discussed above
[B] This is the random adjusting design method discussed above. Approximately half of the respondents received each of these design methods, which varies the attributes given in the stated preference questions in different ways.
[C] Ranked from 1 (I wouldn't change my trips) to 5 (I would likely change a lot of my trips)
All tolls and fares are in dollars. All travel times are in minutes.

Survey respondents ranged from frequent users of the Tom Landry Freeway to travelers who rarely use the freeway, with plenty of respondents in all categories. Virtually all of the travelers (99.2 percent) traveled using a passenger vehicle, SUV, or pick-up truck. Over half of the trips were work-related (55 percent when commuting and non-commuting trips are taken into account).

From the weighted averages of the incentives, it can be seen that some incentives were more likely to encourage travelers to use the EL than others. The incentives that were rated highest (most likely to encourage managed lane use) were "for every 10 trips on the Express Lanes you earn a free trip" and "gifts such as cash, gift cards, or gas cards to local retailers and entertainment venues if you telecommute, travel off-peak, or travel in the Express Lanes" with weighted averages of 2.34 and 2.38, respectively. Transit incentives were rated lower, with "transit riders can earn credit toward reduced bus fares…" and "express bus service to Downtown from Park and Ride lots…" having a weighted average of 1.91 and 1.83, respectively. The transit incentive most likely to encourage EL use was "reduced transit fares during peak hours" with a weighted average of 2.24.

From the SP questions, it is clear that driving alone is the preferred method of travel on the Tom Landry Freeway. Without incentives in the first SP question, almost 90 percent of respondents chose to drive alone on either the general purpose lane or on the managed lane. However, with

the introduction of incentives in SP2 and SP3, these numbers decreased. The number of respondents that chose the option of driving on the GPL decreased from 79 percent in SP1 to 69 percent in SP2 to 66 percent in SP3. It is likely that the decrease was due to both the incentives offered and the lower toll prices. This is because more respondents who received the random adjusting survey design shifted from GPL to EL. Respondents who received the survey with random adjusting SP question attributes had lower toll costs than the D-eff survey design. This is because the toll was adjusted downward if the respondent chose a non-toll option in the previous SP question.

The value of the incentive made minimal impact on the respondent's decision. This is shown by the average value of the incentives when offered, when chosen, and when not chosen. There is not much difference in the value of the incentive among the three. For example, the averages for the SP2 incentive "for every X trips, earn on free trip" are all 10.0 or 10.1, indicating that the value of the incentive may have not had a large enough range.

CONCLUSION

This report overviews the creation and administration of a survey for I-30 Tom Landry freeway travelers. The purpose of the study was to develop an understanding of how travelers would respond to various incentives for using ELs so that the future I-30 ELs could be better managed.

Most travelers were found to be commuting or on work-related trips, although a large amount of trips were found to be recreational, social, or shopping. Because most trips were solo drivers, it is important to see how they react to the various incentives for both solo driving and alternate modes. The incentive questions and SP questions showed that some incentives such as gift cards and gas cards were most highly accepted while transit incentives were not as impactful.

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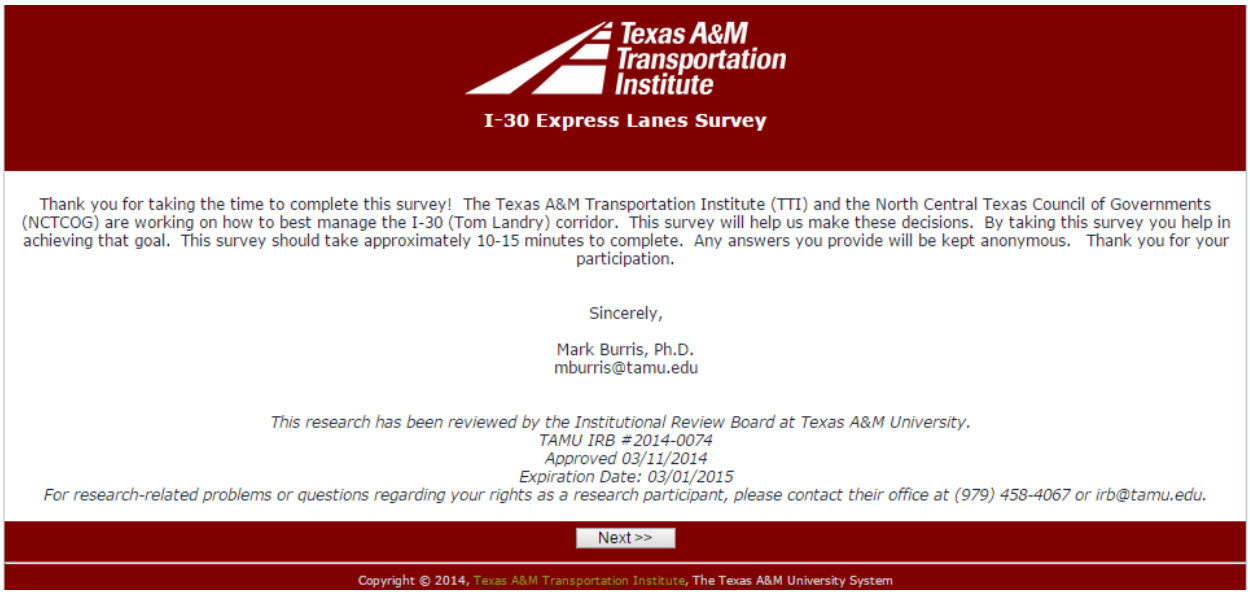
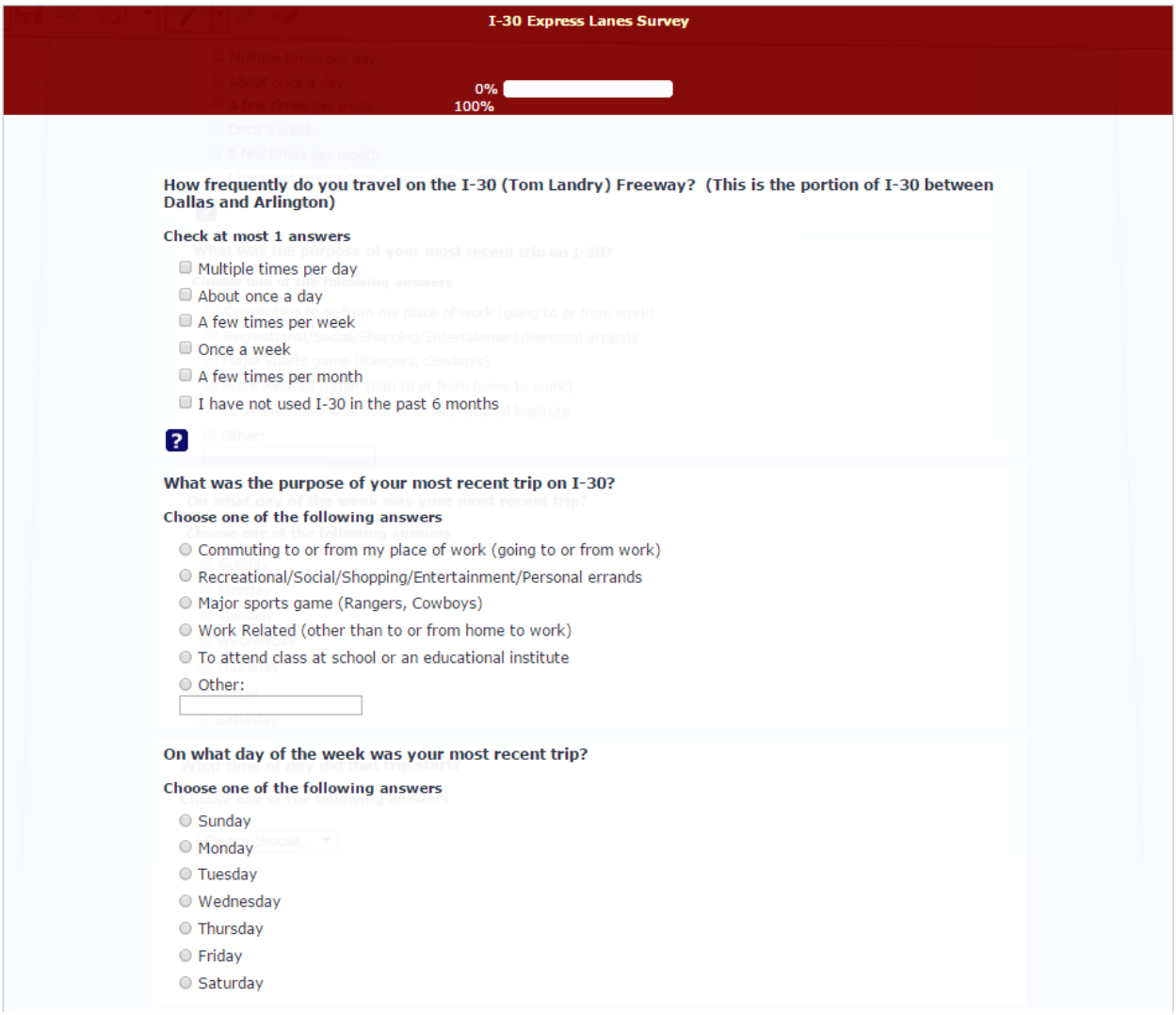
APPENDIX A: I-30 TRAVELER SURVEY INSTRUMENT




I-30 Express Lanes Survey
0%
100%
How frequently do you travel on the I-30 (Tom Landry) Freeway? (This is the portion of I-30 between Dallas and Arlington)
Check at most 1 answers
Multiple times per day
About once a day
A few times per week
Once a week
A few times per month
I have not used I-30 in the past 6 months
What was the purpose of your most recent trip on I-30?
Choose one of the following answers
Commuting to or from my place of work (going to or from work)
Recreational/Social/Shopping/Entertainment/Personal errands
Major sports game (Rangers, Cowboys)
Work Related (other than to or from home to work)
To attend class at school or an educational institute
Other:
On what day of the week was your most recent trip?
Choose one of the following answers
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday

What time of day did that trip start?

Choose one of the following answers

Please choose... ▼

Where did you start and finish this trip?

In what zipcode did you start this trip?

In what zipcode did you finish this trip?

How long was your most recent trip on I-30?

(The amount of time from when you entered the freeway to when you exited the freeway)

minutes

Only numbers may be entered in this field

What kind of vehicle did you use for your most recent trip?

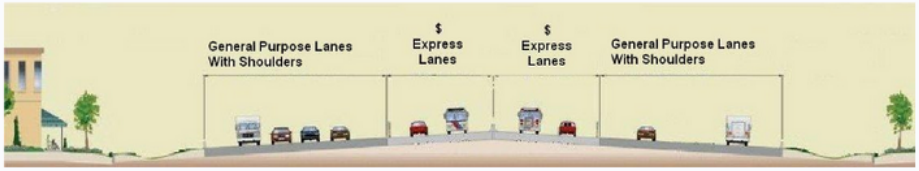
Choose one of the following answers

- Passenger Car, SUV, or Pick-up Truck
- Motorcycle
- Bus
- Other:

<< Previous Next >>

I-30 Express Lanes Survey

0%
100%



What are Express lanes? They are a special type of highway lane(s) that provides uncongested travel . Express lanes control the flow of traffic by only allowing certain vehicles for free (like only 3-person carpools) and/or altering the toll rate for other vehicles.

The North Central Texas Council of Government (NCTCOG) is helping the Texas Department of Transportation (TxDOT) plan the operation of the new I-30 Express Lanes in Dallas. As part of the planning efforts, NCTCOG is exploring how different incentives could change the habits of drivers, carpoolers, and transit riders. They want to know which incentives would be the most effective for users.

How likely is it that you would change your travel if the following benefits were offered:

	I wouldn't change my trips 1	2	I might change some of my trips 3	4	I would likely change a lot of my trips 5
Gifts such as cash, gift cards, or gas cards to local retailers and entertainment venues if you telecommute, travel off peak, or travel in the Express Lanes	○	○	○	○	○
Reduced transit fares during peak hours	○	○	○	○	○
Free items and discounts to local retailers and entertainment venues if you travel off peak or in the Express Lanes	○	○	○	○	○
An express bus service to Downtown from Park-and-ride lots on the Express Lanes	○	○	○	○	○
For every 10 trips on the Express Lanes you earn a free trip	○	○	○	○	○
Regular transit riders can earn credit towards reduced bus fares or reduced Express Lane tolls	○	○	○	○	○

Warning: you will not be able to come back to these questions once you click 'Next'

<< Previous | Next >>

I-30 Express Lanes Survey

0%
100%

Each of the following questions will ask you to choose between four potential travel choices on I-30 in the Metroplex. Please select the travel mode that you would most likely choose if you were faced with these options on your recent trip.

Consider you need to travel on I-30 on a Thursday at 8:00 AM in a passenger car, SUV, or pick-up truck.

If you had the options below for that trip during the morning peak, which option would you choose?

Choose one of the following answers

Travel on the General Purpose Lane

Trip Time: 22 minutes
No Toll

Travel by Yourself on the Express Lane

Trip Time: 13 minutes
Toll: $4.00

Carpool on the Express Lane

Trip Time: 13 minutes
Toll: $0.00

***Please note that additional time may be needed to pick up passengers**

Travel by Transit(Bus) on the Express Lane

Trip Time: 13 minutes
Fare: $3.90

***Please note that there may be additional time from waiting for the bus**

<< Previous Next >>

I-30 Express Lanes Survey

0%
100%

Please select the travel mode that you would most likely choose if you were faced with these options on your recent trip.

Consider you need to travel on I-30 on a Thursday at 8:00 AM in a passenger car, SUV, or pick-up truck.

If you had the options below for that trip during the morning peak, which would you have chosen?

Choose one of the following answers

Travel on the General Purpose Lane

Trip Time: 22 minutes
No Toll

Travel by Yourself on the Express Lane

Trip Time: 11 minutes
Toll: $1.85

Carpool on the Express Lane

Trip Time: 11 minutes
Toll: $0.00

***Please note that additional time may be needed to pick up passengers**

Travel by Transit(Bus) on the Express Lane

Trip Time: 11 minutes
Fare: $1.80

Incentive: Express bus service from park-and-ride lots to Downtown

***Please note that there may be additional time from waiting for the bus**

Consider you need to travel on I-30 on a Thursday at 8:00 AM in a passenger car, SUV, or pick-up truck.

If you had the options below for that trip during the morning peak, which would you have chosen?

Choose one of the following answers

Travel on the General Purpose Lane

Trip Time: 25 minutes
No Toll

Travel by Yourself on the Express Lane

Trip Time: 13 minutes
Toll: $1.15

Incentive: Earn gift cards to local retailers and entertainment venues worth $5 for every 25 peak-hour (7-9am or 4-6pm) trips avoided by either telecommuting or by traveling during the off-peak

Carpool on the Express Lane

Trip Time: 13 minutes
Toll: $0.00

Incentive: Earn gift cards to local retailers and entertainment venues worth $5 for every 25 peak-hour (7-9am or 4-6pm) trips avoided by either telecommuting or by traveling during the off-peak

***Please note that additional time may be needed to pick up passengers**

Travel by Transit(Bus) on the Express Lane

Trip Time: 13 minutes
Fare: $1.10

Incentive: Earn gift cards to local retailers and entertainment venues worth $5 for every 25 peak-hour (7-9am or 4-6pm) trips avoided by either telecommuting or by traveling during the off-peak

***Please note that there may be additional time from waiting for the bus**

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I-30 Express Lanes Survey

0%
100%

Please state your gender.

Choose one of the following answers

- Male
- Female

Which of the following age categories best represents your age?

Choose one of the following answers

- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65 and over

What is your race/ethnicity?

Choose one of the following answers

- White/Caucasian
- Hispanic/Latino
- African American
- Asian American
- Native American
- Other:

What is your highest level of education?

Choose one of the following answers

- Less than high school
- High school graduate
- Some college or vocational school
- College graduate
- Postgraduate college

What is your annual HOUSEHOLD income?

Choose one of the following answers

- ○ Less than $10,000
- ○ $10,000 - $14,999
- ○ $15,000 - $24,999
- ○ $25,000 - $34,999
- ○ $35,000 - $49,999
- ○ $50,000 - $74,999
- ○ $75,000 - $99,999
- ○ $100,000 - $199,999
- ○ $200,000 or more
- ○ Prefer not to answer
- ○ It is easier to note wages per hour ($/hr)

Thank you for taking the time to fill out this survey. Your responses will be helpful as we work to improve travel in your area. If you have any comments or suggestions related to transportation on I-30, please type them below.

Please finish this survey by hitting "Submit" below. You will then be given instructions on how to enter the prize drawing for 1 of 3 MasterCard giftcards, enroll in the Pilot Program, or both.

<< Previous Submit

APPENDIX B: EXAMINATION OF THE CHANGE IN MODE SHARE DUE TO MANAGED LANE INCENTIVES

INTRODUCTION

After the survey data were gathered and basic analysis was completed, the next step was to create a model that could estimate how the incentives affected mode choice. This was done using the software Limdep. After testing many variables, a suitable model was found that could be used for planning. This section examines the creation of the model and then how the impacts of the incentives on mode choice were calculated.

MODEL DEVELOPMENT

The first step was to determine which variables were able to help predict mode choice and were significant in the model. This was done through testing of many different models using the variables collected in the survey, including:

- Trip characteristics such as: occupancy, trip frequency, driver or passenger, trip purpose, toll, travel time, incentive offered
- Demographic characteristics such as: age, gender, ethnicity, income

The base model included travel time, toll, and all of the 6 incentives (see Table 1). Although only incentive 3 and 5 were significant, all 6 incentives were included since their impact on mode choice was needed in the Traffic Thermostat.

Table 1: Incentive Descriptions

Incentive Number	Incentive Description
Incentive 1	Earn a free trip for every 8, 9, 10, 11, or 12 paid trips taken on the Express Lanes
Incentive 2	Earn gift cards worth $5 for every 20, 25, 30, or 35 peak-hour trips saved by either telecommuting or by not traveling during the peak hours (7-9am or 4-6pm)
Incentive 3	5%, 10%, 15%, 20%, or 25% discount offered through select businesses
Incentive 4	For every 20, 25, 30, 35 trips taken by transit, $5 in credits that can be used on ELs
Incentive 5	A transit fare discount of 10%, 20%, or 30%
Incentive 6	Express bus service from park-and-ride lots to downtown

The incentives were included in the model in two different ways. The first included the value of the incentive (for example, incentive 3 would have a value of 5, 10, 15, 20, or 25). The second model only included a variable to indicate if the incentive was offered or not. The value was set it to ‘1’ if the incentive was offered, and ‘0’ if it was not.

The variables were examined for their level of significance in the model. The variables that were statistically significant were kept, while those with a poor level of significance were removed.

Variables with levels of significance between 95% and 80% were further tested to see which were most useful for the model without overcomplicating it. Incentives, toll and travel time were always included in the model regardless of their level of significance. The best model chosen was based on rho-squared values, percent predicted correctly, and the simplicity of the model. This led to the final models shown in Table 2 and Table 3.

Table 2: Model 1 - Incentives with Their Values

Utility Function for Mode:	Variable Name	Description	Coefficient	P-Value
All Modes	TTIME	Travel time	-0.11	0.00
	TOLL	Toll (for driving) or fare (for transit)	-0.09	0.01
MLDA (Managed Lane Drive Alone)	ONE	The alternative specific coefficient	-2.34	0.00
	SPORTS	The dummy variable used to describe if the respondent's trip purpose was to attend a major sporting event (Rangers or Cowboys)	0.86	0.00
	HISPANIC	The dummy variable used to describe if the respondent's ethnicity was Hispanic	0.52	0.00
	HINC	The dummy variable used to describe if the respondent's income was 100k or higher	0.46	0.00
	ONCEDAY	The dummy variable used to describe if the respondent's frequency of travel on I-30 was once a day	-1.17	0.00
	SPINC1	The value of incentive 1 in the stated preference question	3.01	0.05
	SPINC2	The value of incentive 2 in the stated preference question	-0.61	0.88
	SPINC3	The value of incentive 3 in the stated preference question	0.01	0.18

MLCP (Managed Lane Carpool)	ONE	The alternative specific coefficient	-4.02	0.00
	COMMUTE	The dummy variable used to describe if the respondent's trip purpose was commuting	-0.70	0.00
	ASIAN	The dummy variable used to describe if the respondent's ethnicity was Asian	1.46	0.00
	HISPANIC	The dummy variable used to describe if the respondent's ethnicity was Hispanic	0.52	0.00
	LOWINC	The dummy variable used to describe if the respondent's income was 25k or less	1.01	0.00
	OCC	The number of vehicle occupants	0.90	0.00
	INCINV1	The inverse of the value of incentive 1 in the stated preference question	3.01	0.05
	INCINV2	The inverse of the value of incentive 2 in the stated preference question	-0.61	0.88
	SPINC3	The value of incentive 3 in the stated preference question	0.01	0.18
Transit	ONE	The alternative specific coefficient	-4.47	0.00
	LMIDINC	The dummy variable used to describe if the respondent's income was between 25k and 50k	0.65	0.01
	AGE24	The dummy variable used to describe if the respondent's age was between 18 and 24	0.68	0.08
	AGE34	The dummy variable used to describe if the respondent's age was between 25 and 34	1.13	0.00
	MALE	The dummy variable used to describe if the respondent was male	0.58	0.01
	INCINV4	The inverse of the value of incentive 4 in the stated preference question	-2.23	0.83
	SPINC5	The value of incentive 5 in the stated preference question	0.02	0.08
	SPINC6	The dummy variable used to describe if incentive 6 was offered	0.30	0.37
$\rho^2 = 0.433$	**Log likelihood function = -2001.4**		**Chi-squared = 437.3**	
Adjusted $\rho^2 = 0.426$	**Number of observations = 2691, skipped 147**		**VTTS = $70.42/hour**	

Table 3: Model 2 - Incentives Entered as Dummy Variables

Utility Function for Mode:	Variable Name	Description	Coefficient	P-Value
All Modes	TTIME	Travel time	-0.10	0.00
	TOLL	Toll (for driving) or fare (for transit)	-0.09	0.02
MLDA (Managed Lane Drive Alone)	ONE	The alternative specific coefficient	-2.37	0.00
	SPORTS	The dummy variable used to describe if the respondent's trip purpose was to attend a major sporting event (Rangers or Cowboys)	0.86	0.01
	HISPANIC	The dummy variable used to describe if the respondent's ethnicity was Hispanic	0.53	0.00
	HINC	The dummy variable used to describe if the respondent's income was 100k or higher	0.46	0.00
	ONCEDAY	The dummy variable used to describe if the respondent's frequency of travel on I-30 was once a day	-1.16	0.00
	INCDUM1	The dummy variable used to describe if incentive 1 was offered	0.30	0.06
	INCDUM2	The dummy variable used to describe if incentive 2 was offered	0.03	0.87
	INCDUM3	The dummy variable used to describe if incentive 3 was offered	0.29	0.04

MLCP (Managed Lane Carpool)	ONE	The alternative specific coefficient	-4.05	0.00
	COMMUTE	The dummy variable used to describe if the respondent's trip purpose was commuting	-0.70	0.00
	ASIAN	The dummy variable used to describe if the respondent's ethnicity was Asian	1.46	0.00
	HISPANIC	The dummy variable used to describe if the respondent's ethnicity was Hispanic	0.53	0.00
	LOWINC	The dummy variable used to describe if the respondent's income was 25k or less	1.02	0.00
	OCC	The number of vehicle occupants	0.91	0.00
	INCDUM1	The dummy variable used to describe if incentive 1 was offered	0.30	0.06
	INCDUM2	The dummy variable used to describe if incentive 2 was offered	0.03	0.87
	INCDUM3	The dummy variable used to describe if incentive 3 was offered	0.29	0.04
Transit	ONE	The alternative specific coefficient	-4.50	0.00
	LMIDINC	The dummy variable used to describe if the respondent's income was between 25k and 50k	0.65	0.01
	AGE24	The dummy variable used to describe if the respondent's age was between 18 and 24	0.68	0.08
	AGE34	The dummy variable used to describe if the respondent's age was between 25 and 34	1.14	0.00
	MALE	The dummy variable used to describe if the respondent was male	0.58	0.01
	INCDUM4	The dummy variable used to describe if incentive 4 was offered	0.03	0.94
	INCDUM5	The dummy variable used to describe if incentive 5 was offered	0.49	0.11
	SPINC6	The dummy variable used to describe if incentive 6 was offered	0.31	0.36
$\rho^2 = 0.432$	**Log likelihood function = -2000.9**		**Chi-squared = 438.3**	
Adjusted $\rho^2 = 0.426$	**Number of observations = 2691, skipped 147**		**VTTS = $73.47/hour**	

RESULTS

Based on both models, the incentives did have a small impact on respondent choice. The ρ-squared values of both models were around 0.433, which was the best value without over-complicating the model with excessive variables. The value of time obtained was $70.40/hour and $73.47/hour for each model. Although this is rather high, there are many examples of high VOT in ML situations.

ELASTICITIES

Elasticities were obtained via two methods, Limdep output and Excel 'hand' calculation. Although the Limdep elasticities seemed reasonable, it was important to double check to make sure they were correct. After testing a few respondents, we were unable to replicate the elasticities provided by Limdep. Therefore, the elasticities were manually calculated. This was done in Excel using the coefficients developed from the Limdep model and the attributes of each traveler obtained from the survey responses. The steps taken will be outlined below and will be accompanied by an example from: Model 1, respondent 6, stated preference question 1, incentive 3 for MLDA (managed lane drive alone), and the incentive value changing from 10% to 15%.

The first step was to calculate the utilities of every mode for every possible incentive scenario. Every incentive except for Incentive 6 had multiple levels that could be offered. Furthermore, incentives 1, 2 and 3 were offered for more than one travel mode so these incentives had to be calculated twice, once for each mode. The example shown below looks at incentive 3 when it was offered to encourage the MLDA mode. It was also offered to encourage the MLCP mode.

Also, incentives 1, 2, and 4 had to be treated differently because of the value of the incentive. While incentive 3 (5%, 10%, 15%, 20%, or 25% discount offered through select businesses) becomes more valuable the larger the number, incentives 1, 2, and 4 become less valuable the larger the number. For incentive 1 (Earn a free trip for every 8, 9, 10, 11, or 12 paid trips taken on the Express Lanes), gaining a free trip every 8 paid trips is better than having to take 12 trips before earning a free trip. Therefore, these incentives were inversed so the incentive increased in value as the variable increased. Another way of looking at it would be to say that 1/12, 1/11, 1/10, 1/9, or 1/8 of a free trip was gained for every paid trip. The utility functions for the different modes in Model 1 are as follows:

U(GPL) = (-0.108)*TTIME + (-0.0917)*TOLL
U(MLDA) = -2.34 + -0.108*TTIME + -0.0917*TOLL + 0.862*SPORTS + 0.517*HISP + 0.463*HINC + -1.167*ONCEDAY + 3.008*INCINV1 + -0.611*INCINV2 + 0.012*INCVAL3
U(MLCP) = -4.023 + -0.108*TTIME + -0.0917*TOLL + -0.701*COMMUTE + 1.459*ASIANAM + 0.517*HISP + 1.013*LOWINC + 0.904*OCC + 3.008*INCINV1 + -0.611*INCINV2 + 0.012*INCVAL3
U(Transit) = -4.471 + -0.108*TTIME + -0.0917*TOLL + 0.646*LMIDINC + 0.681*AGE24 + 1.134*AGE34 + 0.577*MALE + -2.228*INCINV4 + 0.023*INCVAL5 + 0.297*INCVAL6

Entering respondent 6's characteristics along with the time and toll from their stated preference question number 1 into the equations above yielded the following utility values:

UTILITIES

MLDA Incentive 3 = 10%
U(GPL) = -2.916
U(MLDA) = -3.564
U(MLCP) = -5.316
U(Transit) = -5.729

MLDA Incentive 3 = 15%
U(GPL) = -2.916
U(MLDA) = -3.504
U(MLCP) = -5.316
U(Transit) = -5.729

Once the utilities were calculated, the probability that respondent 6 would take the various modes could be calculated. The following equation was used:

$$P(x_i) = \frac{e^{U(x_i)}}{\sum_{i=1}^{4} e^{U(x_i)}}$$

Probabilities
MLDA Incentive 3 = 10%
P(GPL) = 59.75
P(MLDA) = 31.24
P(MLCP) = 5.42
P(Transit) = 3.59

MLDA Incentive 3 = 15%
P(GPL) = 58.62
P(MLDA) = 32.54
P(MLCP) = 5.32
P(Transit) = 3.52

Based on these probabilities, the elasticities of the incentives were calculated using the following equation:

$$E = \frac{\%Change\ in\ Demand}{\%Change\ in\ Price}$$

$$E(Incentive\ 3_{MLDA:\ 10\%\ to\ 15\%}) = \frac{\frac{Probability(MLDA_{15\%}) - Probability(MLDA_{10\%})}{Probability(MLDA_{10\%})}}{\frac{15\% - 10\%}{10\%}}$$

$$E(Incentive\ 3_{MLDA:\ 10\%\ to\ 15\%}) = \frac{\frac{0.3254 - 0.3124}{0.3124}}{\frac{15\% - 10\%}{10\%}}$$

= 0.0834

An example of Incentive 1, which had an inversed incentive value:

$$E(Incentive\ 1_{MLDA:12\ to\ 11}) = \frac{\frac{Probability(MLDA_{11}) - Probability(MLDA_{12})}{Probability(MLDA_{12})}}{\frac{Price(MLDA_{11}) - Price(MLDA_{12})}{Price(MLDA_{12})}}$$

$$E(Incentive\ 1_{MLDA:12\ to\ 11}) = \frac{\frac{0.3463 - 0.3411}{0.3411}}{\frac{\frac{1}{11} - \frac{1}{12}}{\frac{1}{12}}}$$

= 0.1657

ELASTICITIES

Respondent 6. MLDA Incentive 3 from 10% to 15%
E(GPL) = -0.379
E(MLDA) = 0.0834
E(MLCP) = -0.379
E(Transit) = -0.379

Once the elasticities were calculated for each change (10%-15%, 15%-20%, etc), they were averaged over all changes and all three stated preference questions to get a single elasticity per incentive.

Respondent 6. MLDA Incentive 3
E(GPL) = -0.0352
E(MLDA) = 0.117
E(MLCP) = -0.0352
E(Transit) = -0.0352

Finally, the averages from every respondent were combined to obtain an average for the whole survey.

All Respondents. MLDA Incentive 3
E(GPL) = -0.024
E(MLDA) = 0.129
E(MLCP) = -0.024
E(Transit) = -0.024

This was done for all the incentives except for incentive 6 since incentive 6 (Express bus service to downtown) did not have multiple levels. For incentive 6 the percent change in demand when the incentive was offered was calculated (See Table 4)

Table 4: Elasticities of Incentive 1-5 and Percent Changes

Incentive	Mode	Model 1: Limdep Elasticity	Model 1: Calculated Elasticity	Model 2: Percent Change
MLDA Inc1	GPL	-0.006	-0.050	-4.4
	MLDA	0.028	0.243	29.1
	MLCP	-0.006	-0.050	-4.4
	Transit	-0.006	-0.050	-4.4
MLCP Inc1	GPL	-0.002	-0.039	-3.5
	MLDA	-0.002	-0.039	-3.5
	MLCP	0.014	0.254	30.4
	Transit	-0.002	-0.039	-3.5
MLDA Inc2	GPL	0.000	0.003	-0.3
	MLDA	-0.002	-0.018	2.2
	MLCP	0.000	0.003	-0.3
	Transit	0.000	0.003	-0.3
MLCP Inc2	GPL	0.000	0.002	-0.3
	MLDA	0.000	0.002	-0.3
	MLCP	-0.002	-0.019	2.3
	Transit	0.000	0.002	-0.3
MLDA Inc3	GPL	-0.003	-0.024	-4.3
	MLDA	0.017	0.129	28.4
	MLCP	-0.003	-0.024	-4.3
	Transit	-0.003	-0.024	-4.3
MLCP Inc3	GPL	-0.003	-0.019	-3.4
	MLDA	-0.003	-0.019	-3.4
	MLCP	0.018	0.135	29.6
	Transit	-0.003	-0.019	-3.4
Transit Inc4	GPL	0.000	0.002	-0.1
	MLDA	0.000	0.002	-0.1
	MLCP	0.000	0.002	-0.1
	Transit	-0.008	-0.073	3.1
Transit Inc5	GPL	-0.003	-0.017	-1.9
	MLDA	-0.003	-0.017	-1.9
	MLCP	-0.003	-0.017	-1.9
	Transit	0.051	0.366	60.4
Transit Inc6 (%Change only)	GPL	-0.001	-0.011	-1.1
	MLDA	-0.001	-0.011	-1.1
	MLCP	-0.001	-0.011	-1.1
	Transit	0.031	0.331	34.2

For model 1, most of the incentives encouraged travelers to shift from the GPL and to the ML, either as an auto traveler or on transit – depending on the incentive offered. For Model 2, every incentive pulled travelers away from the general purpose lanes as expected.

The elasticities (column 3) shown in Table 4 represent the percentage change in mode share based on a one percent change in the incentive. Column 4 represents the change in mode share based on the incentive going from not offered to offered. If, an incentive going from not offered to offered was considered a 100% change (instead of an infinite change) then the percent change in column 4 would, in theory, be about 100 times greater than the calculated elasticities in column 3. As seen in table 4 this is often the case, further confirming the results.