Value of Travel Time

Knowingly or not, people generally place economic value on their time. Wage workers are paid a rate per hour, and service providers may charge per hour of their time. In the transportation realm, travelers place a value on their travel time and have shown a willingness to pay if there is a chance of lowering their travel time.

For example, if someone is in the central business district of a large city, it might be cheapest to walk to a given destination. However, if the traveler has a particularly high value of travel time, the person might elect to pay for a ride to get to his or her destination faster. Similarly, a person driving a car might be faced with the choice between sitting in congestion or electing to pay to travel on a congestion-free toll facility (assuming one is available). Travelers with high values of time will likely choose to take the tolled route.

The value of a particular driver's travel time largely dictates his or her travel decisions, with factors such as availability of travel options and ability to pay also influencing those decisions. The value of travel time for a particular person varies significantly based on any number of factors, such as:

- The purpose and type of trip (e.g., commuting, recreational, or business related).
- The characteristics of the traveler (e.g., income).
- The transportation mode (e.g., bus, car, or walk).
- Travel conditions (e.g., poor weather or the presence of congestion).
- The time of the year, week, or day (e.g., going home at the end of the day versus going to work in the morning).
- The location (intercity/interstate versus local trips).

The value of travel time might also be different for two commercial vehicles sitting next to each other on the freeway if one is scheduled to make a delivery within the hour and the other is just beginning a long, multi-state trip.

What Are VOT and VOR?

The value of travel time is an important factor in many of the decisions made by travelers in terms of the modes they use, the routes they take, and the times they travel. Transportation planners, engineers, and economists therefore try to estimate travelers' value of travel time savings (VOT). VOT is the equivalent amount of money a traveler would pay to reduce the *amount of time* to complete a trip. For example, if a traveler would pay $1 to reduce travel time by six minutes, then the traveler has a VOT of $10 per hour.

VOT allows for the measurement of benefits derived from transportation projects that reduce congestion and travel time. A similar metric is the value of travel time reliability (VOR). VOR is the equivalent amount of money a traveler would pay to reduce the *variation* in his or her expected travel time. Essentially, it measures how much a traveler would be willing to pay to have a predictable time for making a trip.

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>
> ***Value of travel time reliability (VOR):*** *the equivalent amount of money a traveler would pay to reduce the variation in the expected travel time.*

How Is VOT Used, and Why Is It Important?

Providing improved travel time and travel time reliability is generally among the largest societal benefits from transportation infrastructure projects. Accurate estimates of traveler VOT and VOR help quantify the potential value of those benefits relative to the required monetary investment. VOT and VOR are essential for the state to conduct cost/benefit analyses for transportation infrastructure investment.

Furthermore, the Texas Department of Transportation (TxDOT) requires accurate estimates of traveler VOT and VOR because they are critical components for construction contracting. For example, TxDOT uses VOT for the following:

- **A + B bidding**. This is a contract bidding process where a contractor bids on a project and is awarded the project based on the cost of construction (A) and the cost to travelers due to construction-related traffic delays (B). VOT is a component in the calculation of costs due to these anticipated delays.
- **Lane rental**. Contractors on state transportation projects can rent a traffic lane for use in speeding up construction and/or reducing the cost of construction. The cost of renting that lane is based on the cost of delay to travelers caused by the loss of that lane, which requires an accurate estimate of VOT.
- **Incentive provision**. TxDOT provides incentives for the early completion of construction projects and levies penalties for construction projects that are not completed on time. These incentives and penalties can be based, in part, on the additional costs to travelers of delay due to the construction project, which requires an estimate of VOT.

How Is VOT Calculated, and What Is the VOT for Texas Travelers?

VOT has been used in the transportation sector for decades. The first analysis of VOT was a 1925 Bureau of Public Roads report, which estimated VOT to be $3 per hour in 1925 dollars (*1*). If adjusted for inflation to 2015 dollars, that would be a VOT of approximately $41 per hour. Early estimates of VOT were calculated in one of two ways:

- Assume VOT is equal to the traveler's wage rate.
- Estimate how much travelers would be willing to pay to use a faster mode of travel. For example, one might ask a traveler how much he or she would be willing to pay to travel by car rather than by bus.

Most studies in the last 40 years have used similar stated-preference (SP) methods to estimate VOT. Travelers participating in an SP survey are generally given a set of predetermined, hypothetical travel alternatives and asked to give their preference. For example, would they choose option 1, which takes 10 minutes and requires a $2 toll, or option 2, which takes 15 minutes but has no toll (*2*)? The results of these surveys are generally used to develop logit equations that predict mode choice and estimate VOT.

As of March 2014, TxDOT used a VOT of $21.73 per hour for passenger cars and $31.71 per hour for commercial vehicles. These values are similar to values used by many other state departments of transportation and metropolitan planning organizations, and their modeling methodologies are generally similar (*3*). Texas' VOT values are also generally in line with federal guidance on VOT.

However, it may be time to reexamine how VOT is estimated and update the numbers used in Texas. The original data supporting the state's current VOT estimate for passenger vehicles are at least 30 years old and were gathered through a 1985 telephone survey of 500 randomly selected Texas residents. The survey asked questions regarding driving habits, personal characteristics, and willingness to pay for driving on a safer road.

Are There Better Ways of Estimating VOT?

New technologies and new data sources may allow transportation professionals to use revealed-preference (RP) methods that identify *actual* (rather than *stated*) preferences. These RP methods tend to rely on actual consumer behavior data as opposed to having travelers self-select their preferences from among various predetermined scenarios.

Researchers at the Texas A&M Transportation Institute (TTI) recently conducted a study that attempted to generate new, more accurate VOT estimates with RP methods using data collected from the Katy Freeway managed lanes in Houston. The facility's four managed lanes (two in each direction) run along the inside of the general-purpose lanes and are separated from the general-purpose lanes by special striping and plastic barriers. For most of the day, high-

occupancy vehicles with two or more occupants can access the managed lanes for free and potentially bypass congestion. People traveling alone (as a single-occupant vehicle) can also access the managed lanes but must pay a toll.

The TTI research team used data from 2012 to 2014 and developed a data set of over 100 million trips taken along the Katy Freeway general-purpose and managed lanes. Of these, 7 million trips involved the payment of a toll on the managed lanes. Thus, the data set included millions of travel decisions that involved either taking the toll-free general-purpose lanes or paying a toll to use the managed lanes in anticipation of saving travel time. The study used data from vehicles travelling I-10 with toll transponders. Personally identifiable information was not collected or kept.

Results of VOT Analysis

What is interesting about this effort is that the estimated VOT was obtained from real people making real-world travel decisions (as opposed to completing surveys). However, the resulting VOT estimates were very different than what is normally observed and what is used by TxDOT.

The initial results of the VOT analysis ranged from $1.96 per hour to $8.06 per hour for all of those travelers with transponders. This is considerably lower than most research results and what is generally used in practice. Much of this was initially attributed to high incidences of uneconomic behavior that was contrary to what economics would predict. For example, approximately 11 percent of travelers in the data set chose to pay to use the managed lanes even when the speed in those lanes was slower than the speed in the free, general-purpose lanes. Furthermore, the research team observed that a large percentage of travelers never changed lanes, regardless of travel times in the managed lanes or general-purpose lanes. New models were developed that removed these uneconomic trips, but these models still generated wide-ranging VOT estimates of approximately $0 per hour to over $26 per hour.

The analysis showed that the vast majority of travelers within the corridor were simply not using the managed lanes, regardless of the conditions in the general-purpose lanes. This means that from the perspective of *all travelers in the corridor*, the average VOT was very low. However, the data showed that a small number of people that use the managed lanes facility do so on a very frequent basis. Those travelers have a very high VOT but are a small percentage of the users within the wider corridor.

Possible Explanations for Variance

There are a few reasons that this phenomenon could be occurring. TTI researchers used data from the Katy Freeway managed lanes facility in Houston, which is one of very few roads in the world that features toll lanes that are adjacent to general-purpose lanes. Most of the roadways used by Texas drivers on a day-to-day basis are simply general purpose in nature and do not have a tolling component.

Furthermore, the new VOT estimates that TTI generated were for a very specific set of transportation system users, namely Katy Freeway travelers who own a transponder. It could be that these travelers have very different VOTs compared to most travelers. It may also be that the VOT estimates in this research are more accurate than past results since these represent real travel choices made by drivers.

The TTI research team conducted additional analyses to see if there were any patterns to the uneconomic trips taken by drivers in the data set. The research team found that drivers using the managed lanes for a long-distance trip of more than 20 miles were more likely to stay in the managed lanes regardless of congestion in the adjacent general-purpose lanes, which could be due to the perceived difficulty of continually entering and exiting the tolled lanes in response to congestion. Drivers making long-distance trips may just want to get into the managed lanes and not worry about getting out of them, even if the adjacent lanes are uncongested.

The team also found that westbound trips (traveling away from downtown Houston) had a higher percentage of uneconomical trips. The research team did not have information about why this behavior occurred, but one explanation could be that commuters have a stronger desire to avoid traffic when leaving downtown, such as during the evening commute when they are going home, than they do when heading into downtown.

Managed lane trips that occurred during the off-peak period, particularly from midnight to 6 a.m., had a higher percentage of uneconomical trips. This could be the result of perceived safety value, with the managed lanes being viewed as safer to the point of using them even in the off-peak period.

Conclusions

The value that a driver places on his or her time influences that driver's travel decisions, so VOT is an essential component of transportation project selection and planning. But VOT is both subjective and contextual. It can vary depending on the person and on the circumstances. In addition, current Texas VOT estimates are based on limited data more than 15 years old. These limitations make arriving at a single, broadly applicable VOT difficult at best.

This research attempted to estimate VOT through the travel choices made by travelers on the Katy Freeway. The results were far lower than expected and also lower than what is now used in practice, and there appears to be no clear reason for the difference. However, the fact that a fairly small share of Katy Freeway travelers are willing to pay to use the managed lanes may help to explain the discrepancy because the high percentage of travelers not willing to pay to use the managed lanes depresses the average VOT.

As the issue relates to policy making, the central question should be: what is the context within which VOT is being used? Current VOT estimation methods can predict toll road demand reasonably well, and will likely continue to work well in estimating the benefit of transportation improvements on a large scale for millions of drivers. However, traditional VOT estimation

techniques are less likely to accurately predict travel behavior at a detailed level. And as these findings illustrate, the complexity of individual travel decisions makes the calculation of accurate and reliable VOT exceedingly complex, even when detailed trip data are available.

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Date Published

August 2016

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