Truck Use on Texas Toll Roads

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Metropolitan toll roads are a popular source of non-traditional funded highway investment, targeting automobile users. Toll rates have been traditionally derived from traffic and revenue (T&R) studies, which appear unable to accurately estimate truck demand even when a toll road offers an alternative route segment to interstate trucking. This paper examines the current failure of Texas toll road SH-130 to attract truckers from IH-35 in Austin, one of the most congested Texas corridors. CT-VCOST, a comprehensive vehicle operating cost toolkit, was used to calculate truck operating costs on both highways to investigate why few truckers are using the toll facility and whether the decision is based on toll rates or other factors.

INTRODUCTION

Transportation is characterized by substantial capital investment needs, variability in both demand and energy costs, and modest profitability. Those providing transportation services over a specific transportation network—such as running trucks on highways—have to carefully control costs to provide competitive services. Where the operator builds, maintains, and controls the use of the infrastructure (such as railroads), management has full control of when to undertake optimal maintenance and replacement by balancing revenue needs and timing.

When one entity provides the infrastructure and others use it, as with highways, the picture is more complicated. Typically, in providing public highways, costs are allocated among the various classes of users to reflect a degree of equity although such allocation can lead to alleged cross-subsidization biases, which favor trucks (Kapoor et al. 2005, Bilal et al. 2010, Parry et al. 2012). The pricing of trucks, whether on public or toll roads, is relatively primitive and bears little relationship to the metrics used by highway engineers when designing the pavements and bridges over which trucks operate. For example, pavement engineers use forecasts of equivalent standard axle loads over the lifecycle of a highway section to determine subgrade, materials, and layer thickness. The pricing of truck use on public roads is limited to average vehicle miles of travel (VMT) per truck category and fuel taxes, even though fuel consumption is weakly correlated with overweight axles. The toll road featured in this paper, SH-130, actually uses fixed prices on axle numbers, not axle or gross weight, a method that spans over 100 years.

The funding of public highways is predicted to worsen through (a) reductions in both auto and freight VMT, (b) adoption of hybrid technologies reducing fuel consumption, and (c) improved truck aerodynamics and the use of lower rolling resistance tires. Consequently, a number of states are evaluating the use of tolled facilities managed and operated either by the states or private-public partnerships. The evidence from traffic and revenue (T&R) studies suggests that many tolled highways are priced to stimulate auto use and not truck use. This may be appropriate for metropolitan tolls. But in those cases where trucks comprise part of the target users, T&R studies are unable to estimate either costs or benefits facing truckers contemplating toll road use. Clearly, benefits such as on-time delivery and customer satisfaction must exceed the per-mile cost of using tolled routes since most tractor-trailer drivers are paid by the mile.

Truck toll road use comprises several factors, which are dynamic and need to be incorporated into toll pricing. Where the benefits are clear for all trips, truckers will use the facility. They will also use it if an alternative highway is blocked or experiencing heavy delays and they have time-sensitive cargo. This paper argues that toll road authorities may fail in adequately estimating truck operating costs and inadvertently set prices that act as disincentives to truck use. The literature, however, shows that there are a relatively small number of cost models that can be used by toll authorities to set truck rates. The objective of this study is to introduce a methodology that can be used to determine truck operating cost over any user-defined route profile. A case study is also presented that illustrates how planners and toll entities can determine which routes trucking companies will choose based on factors such as distance, travel time, congestion levels, travel speeds, toll charges, and pavement conditions.

BACKGROUND

In 2003, a Minnesota Department of Transportation (MnDOT) commissioned report was released on the per-mile cost of truck and automobile operation (Barnes and Langworthy 2004). This cost estimate focused on variable rather than fixed costs as MnDOT sought to use it as a tool to compare costs in traffic planning—for example, a congested corridor versus a longer but less congested route. The study investigated the costs of both personal vehicles and commercial trucks. The cost estimate consisted of five main factors: fuel, routine maintenance, tires, unanticipated repairs, and depreciation. Because vehicle operating cost (VCOST) estimates are mileage-based costs, Barnes and Langworthy (2004) based depreciation cost solely on mileage, which is lower than a vehicle's overall depreciation, which is also based on the age of the car. The MnDOT VCOST analysis differs from many others in that it takes into account the lifecycle costs of cars. For example, Consumer Reports (2011), Intellichoice (2011), and Edmunds (2011) only take into account the first four-five years of vehicle life. The study also considered highway, urban, and congested-urban traffic conditions, as well as pavement roughness, via the use of multiplicative adjustment factors. The MnDOT report provided VCOST estimation flexibility as a spreadsheet calculation tool that can be adapted to future conditions rather than a static estimate that is prone to obsolescence.

Based on the literature (Levinson et al. 2005, Berwick 1997, American Transportation Research Institute (ATRI) 2011) it can be inferred that a key missing component of VCOST pertinent to transportation planning is the ability to determine operating costs over different route profiles. While emphasis has been laid on pavement conditions (Zaabar and Chatti 2010, Texas Research and Development Foundation (TRDF) 1982, Walls and Smith 1998), only the work by Barnes and Langworthy (2004) addresses route-based VCOST. However, the MnDOT approach involves many approximations, and did not analyze truck operating costs with as much detail and depth as the analysis for personal vehicles (Welter et al. 2011).

The wide variety of vehicle technologies adopted over the past 15 years rendered the last VCOST model developed in Texas (TRDF 1982) obsolete, and in 2006 the Texas Department of Transportation (TxDOT) conducted a study to update VCOST estimates (Matthews et al. 2012). The model, termed CT-VCOST, is a comprehensive vehicle operating cost toolkit capable of producing an array of results that allows planners to better estimate the economic consequences of various highway investment strategies. It has a software that is user-friendly and provides operating cost estimates for specific representative vehicles or vehicle fleets. It utilizes a unique vehicle identifier algorithm for data storage, cost calculations, and user interactions via its graphical user interface. This unique identification property also enables vehicles to retain their unique data values when dealing with multiple vehicles, vehicle classes, and vehicle fleets.

The toolkit's default data are based on verified secondary vehicle cost data and certified vehicle databases such as the EPA's Fuel Economy database and Annual Certification Test Results databases. The toolkit also allows users to change the parameters so that cost calculations are specific to any particular situation, and can be updated as the economic or technological landscape changes. Cost categories in the CT-VCOST toolkit include those associated with depreciation, financing, insurance, maintenance, fuel, driver, road use fees (e.g., tolls), and other capital costs such as annual vehicle registration and inspection fees. Analysis types that can be performed with CT-VCOST include single vehicle analysis, multi-vehicle comparisons, fleet vehicle analysis, growth rate and market penetration simulation, and route cost analysis. It also comes packaged with sophisticated fuel economy prediction models for heavy duty, light duty, and hybrid vehicles. The fuel prediction models, developed using both experimental and survey data, have the ability to measure fuel consumption for default or custom drive cycles specified by users. Outputs from the fuel prediction models can be used within the toolkit to perform route cost analyses, an example of which is presented as a case study in this paper. In summary, CT-VCOST was designed to be intuitive and flexible enough for simulating different scenarios and situations that planners may envision. CT-VCOST is updatable and can be calibrated for any state or region.

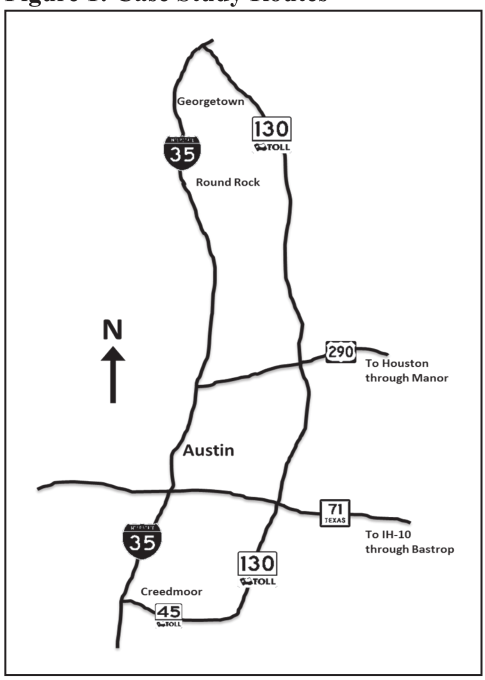
This paper shows that CT-VCOST can be used to determine truck operating cost over any user-defined route profile. A case study is also presented that illustrates how planners and toll entities can use CT-VCOST to determine which routes trucking companies will choose based on factors such as distance, travel time, congestion levels, travel speeds, toll charges, and pavement conditions.

CASE STUDY

As illustrated in Figure 1, Texas State Highway 130 (SH-130) connects with Interstate Highway 35 (IH-35) near Georgetown in the north and Buda in the south. SH-130 is being extended to reach Intestate Highway 10 (IH-10) near San Antonio in 2013. Currently, it is linked to IH-35 south by a toll road, State Highway 45 (SH-45). Critical for truckers, the SH-45/SH-130 route is approximately 12 miles longer than the alternate route on IH-35, even though travel times are shorter on it over much of a 24-hour period. The highway is a state-owned toll road and its extension is being developed in partnership with the toll road authority, the SH-130 Concession Company (TxDOT 2011a,b). Rapid growth in the city of Austin has led to an increase in congestion on IH-35, thus impacting transportation services to regions north and south of the city.

TxDOT representatives state that SH-130 has recorded both successes and failures in its effort to relieve congestion in Austin (Woodall 2011). SH-130 is servicing an acceptable amount of automobiles but TxDOT has not seen the same result for freight vehicles. A survey of trucking companies revealed that lowering toll rates on the highway could draw more freight vehicles but the elasticity of the toll rates was not determined (TheTrucker.com 2011). However, not all truckers are convinced that using this alternative tolled route has tangible benefits (Woodall 2011, New 2012). For example, even though IH-35 is shorter, some drivers have asserted that even if the toll were free, they will still not use it (Woodall 2011). In addition, it currently costs a six-axle truck with one truck and one trailer nearly $20 more to travel from SH-130's intersection with IH-35 south (via SH-45) to the SH-130 intersection with IH-35 north (TxTag 2011) (see Figure 1). Despite the inability of the toll facility to attract through truck traffic, a growing number of truckers use it when going east toward Houston via U.S. Highway 290 or to IH-10 via State Highway (SH-71) (see Figure 1).

Figure 1: Case Study Routes



Using CT-VCOST, it is possible to determine the actual cost and benefit of a route compared with another to evaluate the claims made by truckers. The following five existing routes were investigated and each was evaluated for both free flow and congested traffic conditions:

1. Through truck traffic through Austin using IH-35 versus SH-130
2. Northbound truck traffic using IH-35 or SH-130 to State Highway 71 East (SH-71E)
3. Southbound truck traffic using IH-35 or SH-130 to SH-71E
4. Northbound truck traffic using IH-35 or SH-130 to US Highway 290 East (US 290E)
5. Southbound truck traffic using IH-35 or SH-130 to US 290E

Comparing the costs to travel on these routes offers an understanding of why truckers prefer one route over another and also provides toll authorities with more accurate and equitable prices to stimulate truck demand, benefiting both the toll road and traffic flow on IH-35.

Toolkit Principles and Case Study Input

The CT-VCOST toolkit utilizes an object-oriented programming structure where "modules" are developed to perform particular tasks. For this case study, the following modules were used: the Scenario module, the Vehicle Utilization module, the Vehicle Maintenance module, and the Route Cost module. Pavement roughness for each roadway section can also be defined in the Route Cost module. The following sections of this paper discuss the modules and data used for this case study.

Vehicle Selection. The CT-VCOST database enables users to select from data reported on more than 5,000 default vehicles in the United States. Vehicles can be selected either by vehicle class, model, or year. If a vehicle cannot be found in the database, a custom vehicle can be built by the user and included in the database. For this case study, a custom Class 8 truck made up of a single wide-base tire tractor-trailer is used. Single wide-base tires are known to improve the fuel efficiency and stability of heavy-duty tractor-trailer trucks (Oak Ridge National Laboratory 2006). This particular vehicle was chosen because data for its fuel consumption measured in miles per gallon (mpg) as function of speed were readily available (Capps et al. 2008). Fuel cost calculation, discussed later in this paper, utilizes these kind of data.

Defining a Scenario. Once a vehicle is selected, a scenario must be defined using the Scenario module. This module enables users to input general parameters that influence VCOST such as the analysis period and fuel price. The analysis period defines the life span of the vehicle involved in the analysis. The specified number of years is used in determining the cut-off points for calculations such as vehicle depreciation, vehicles miles traveled, and scheduled maintenance. For this case study, an analysis period of 10 years is used. A diesel fuel price of $3.94 is also specified for this case study.

Vehicle Age and Utilization. As vehicles age, they tend to be driven less than newer vehicles (U.S. Department of Energy 2011) so the Vehicle Utilization module was developed to capture this change in vehicle use (annual mileage) over time. Users are able to input a vehicle's annual mileage for each year of its life span. Default data correlating vehicle utilization with age for passenger vehicles are available from the Transportation Energy Data Book (U.S. Department of Energy 2011) but data for trucking companies are much more difficult to find. Due to this limitation, truck utilization over the 10-year period of this case study is kept constant at 100,000 miles each year.

Maintenance and Repairs. The Vehicle Maintenance module seeks to simulate the actual maintenance activities of a vehicle. CT-VCOST enables maintenance activities to be set to either exact or range, depending on whether the maintenance activity occurs at a fixed mileage or within a certain mile range. For example, an oil change usually is performed at 10,000 miles for trucks; tire replacement varies between 50,000 to 100,000 miles per tire.

The difference between the two calculations is that with the exact interval option, repair cost is included in the cost calculation at the exact time the vehicle reaches the specified mileage. However, with the range interval, repair cost is distributed among the years between which the vehicle's mileage falls. For example, if tires need to be replaced somewhere between 60,000 and 100,000 miles, tire replacement costs are distributed equally between the years.

In addition, a repair may be set to be recurrent, which means that at the specified scheduled interval, the repair item will occur again. Using the tire replacement repair as an example, tire repair costs will be calculated again when the vehicle mileage reaches between the 120,000 to 200,000 mile range (see Figure 2). Using industry estimates for annual maintenance cost (ATRI 2011), this case utilizes the following maintenance schemes and cost:

- Oil change – every 10,000 miles at $600
- Tire replacement – every 100,000 miles at $2,600
- Scheduled service – every 100,000 miles at $6,000

Figure 2: Recurrent Tire Replacement Between 40,000 and 60,000 Miles and Corresponding Annual Maintenance Cost

Item Name	Schedule Interval		COST	Recurrent
Oil Change	Exact	10,000 miles	$600.00	Yes
Tire Replacement	Range	60,000 to 100,000 miles	$2,600.00	Yes
Hybrid Battery Replacement	Exact	0 miles	$0.00	No
Scheduled Service 1	Exact	100,000 miles	$6,000.00	Yes
Scheduled Service 2	Exact			
Scheduled Service 3	Exact			
Scheduled Service 4	Exact			
Scheduled Service 5	Exact			
Scheduled Service 6	Exact			
Scheduled Service 7	Exact			
Scheduled Service 8	Exact			
1st Major Repair Service	Range			
2nd Major Repair Service	Range			
3rd Major Repair Service	Range			
4th Major Repair Service	Range			
5th Major Repair Service	Range			

Year	Annual Maintenance Cost
Year 1	$14,600.00
Year 2	$12,000.00
Year 3	$12,000.00
Year 4	$14,600.00
Year 5	$12,000.00
Year 6	$12,000.00
Year 7	$12,000.00
Year 8	$14,600.00
Year 9	$12,000.00
Year 10	$12,000.00

Fuel Consumption. CT-VCOST is packaged with two different algorithms to calculate fuel consumption as a function of vehicle speed: 1) the slope-based approach and 2) the lookup table approach.

Slope-Based Approach. Fuel consumption, $f(v)$ is calculated as a function of speed v (i.e. $f(v)$), using at least two points: city miles per gallon (mpg_{city}) and highway miles per gallon (mpg_{hwy}). This approach assumes that mpg_{city} and mpg_{hwy} are achieved at average speeds of 21.2 mph ($\bar{v}_{city}$) and 48.3 mph ($\bar{v}_{hwy}$) respectively according to EPA test results (EPA 2011). The user then specifies an optimum fuel consumption speed (v_o) and using Equations 1 and 2, the possible fuel consumption estimates are calculated. Equation 1 determines fuel economy at any speed (v) by using a linear function, which is dependent on whether v is: (a) lesser than or equal to optimum speed (v_o), or (b) v is greater than optimum speed (v_o). If $v \leq v_o$, fuel consumption $f(v)$ will be between the vehicle's EPA specified city miles per gallon (mpg_{city}) and highway miles per gallon (mpg_{hwy}), where mpg_{hwy} is assumed to be equal to the optimum fuel economy $f(v_o)$. The slope (m) is determined by the corresponding highway and city fuel consumptions mpg_{hwy}, mpg_{city}) and speeds ($\bar{v}_{hwy}$, $\bar{v}_{city}$). To ensure that $f(v_o)$ remains the optimum (or maximum) fuel consumption, fuel consumption $f(v)$ is calculated using a negative slope when $v > v_o$. As illustrated in Figure 3, the slope-based approach, though simple and replicable for most vehicles, is not entirely accurate as optimum fuel consumption varies between 25 to 55 miles per hour when using actual fuel economy data.

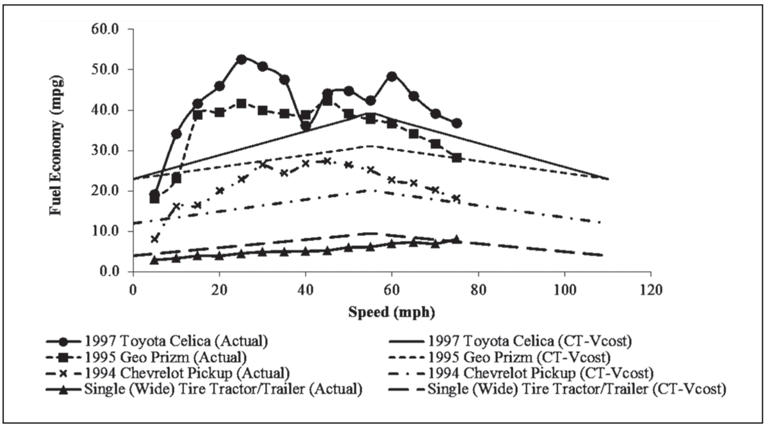
$$(1) \quad f(v) = \left\{ \begin{array}{ll} (v * m) + mpg_{city} & if\, v \leq v_o \\ f(v_o) - m\,(v - v_o) & if\, v > v_o \end{array} \right\}$$

$$(2) \quad m = \frac{mpg_{hwy} - mpg_{city}}{\bar{v}_{hwy} - \bar{v}_{city}}$$

Lookup Table Approach. The lookup table approach provides a much better estimate of fuel consumption as function of speed (see Table 1). This approach, though more accurate, is dependent on the availability of data. For each speed (v) on the specified route profile, CT-VCOST iterates through each row of the column matching the vehicle model and returns the vehicle's fuel consumption, $f(v)$ using linear interpolation. When the vehicle speed (v) falls within the range of two successive speeds $[(v_i)$ and $(f(v_{i+1})]$, the fuel consumption for those speeds $f(v_i)$ and $(f(v_{i+1})$ are used in determining the vehicles' fuel consumption $f(v)$ as illustrated in the linear interpolation shown in Equation 3.

$$(3)\quad f(v) = \left[\left(\frac{f(v_{i+1}) - fv_i)}{v_{i+1} - v_i} \right) \times (v - v_i) \right] + f(v_i)$$

Figure 3: Comparison of Slope-Based Approach With Actual Fuel Economy Data



(Source: Matthew et al. 2011)

Driver Costs. CT-VCOST provides users with two alternatives for capturing driver cost: Hourly driver cost and per-mile driver cost. Hourly driver cost captures the cost of delay during congested conditions. This is useful for time sensitive deliveries such as perishables and high value commodities. This case study however uses only the per-mile driver cost as it represents the majority of truckers using IH-35 (Woodall 2011). An industry average value in 2010 of \$0.40 a mile is used (ATRI 2011).

Depreciation, Financing, Insurance, Registration, and Permit Fees. Typical vehicle depreciation for light-duty vehicles was found to be at around 20% for the first year and 15% or less for the subsequent years (Sandler 2003, Edmunds.com 2011). This assumption was used for this case study due to lack of credible data for heavy-duty vehicles. Financing was also based on a 1.5% down payment and a 60-month loan at an interest rate of 4.55%. The insurance cost was based on industry estimates, which ranged from \$4,000 to \$7,500 annually. A value of \$5,500 is used for this case study. Registration and permit fees were calculated using industry estimates (ATRI 2011), and an annual value of \$2,300 was assigned.

Specifying Route Conditions. The route cost module enables users to simulate the cost of moving a vehicle or a fleet of vehicles via certain routes. Multiple routes and their characteristics such as distance, speed, congestion level, pavement roughness (Zaabar and Chatti 2010), and travel time are defined by the user. VCOST via each route is then calculated and presented for comparison.

Table 1: Sample Fuel Economy Lookup Table in MPGs

Speed (mph)	1994 Chevrolet Pickup	1994 Jeep Grand Cherokee	1997 Toyota Celica	Dual Tire Tractor - Dual Tire Trailer	Dual Tire Tractor - Single Wide Tire Trailer	Single Wide Tire Tractor - Dual Tire Trailer	Single Wide Tire Tractor - Single Wide Tire Trailer
5	7.9	8.2	19.1	2.8	2.9	3.0	3.0
10	16.0	11.2	34.1	3.4	3.6	3.3	3.4
15	16.3	17.5	41.7	3.8	4.0	3.9	4.0
20	19.9	24.7	46.0	3.7	4.0	4.0	4.0
25	22.7	21.8	52.6	4.1	4.3	4.6	4.6
30	26.3	21.6	50.8	4.4	4.6	5.0	4.9
35	24.3	25.0	47.6	4.4	4.9	5.2	5.0
40	26.7	25.5	36.2	4.8	5.2	5.3	5.1
45	27.3	25.4	44.1	5.1	5.4	5.6	5.3
50	26.3	24.8	44.8	5.4	5.8	6.2	6.0
55	25.1	24.0	42.5	5.8	6.1	6.2	6.2
60	22.6	23.2	48.4	6.3	6.8	6.9	7.0
65	21.8	21.3	43.5	6.6	7.2	7.1	7.3
70	20.1	20.0	39.2	7.0	7.7	7.0	7.0
75	18.1	19.1	36.8	7.5	7.9	7.9	8.1

Table 2 presents all the case study routes and their respective characteristics while Table 3 summarizes the input data. Traffic conditions from Google Maps for both routes at 7:30 a.m. were used for the congested scenarios in this case study.

Case Study Findings

In this case study, it was determined that total route cost was dependent on distance, speed, fuel consumption, and per-mile driver cost. Based on average 2008 fuel prices of $3.814 a gallon (U.S. Energy Information Administration [EIA] 2011), the American Transportation Research Institute (2011) reported average truck fuel and oil cost to be $0.63 per mile. In comparison, per-mile fuel cost from CT-VCOST for this case study ranged between $0.56 to $0.77 per mile. Additional dependent variables that CT-VCOST could have captured but were not considered in this case study include pavement roughness and hourly driver cost.

Annual cost variables found to be independent of route cost were depreciation, finance, insurance, maintenance (including tires), and other costs (vehicle registration and permits). Per-mile cost for each of these variables were $0.09, $0.13, $0.05, $0.14, and $0.02, respectively ($0.43 total). Similar per-mile cost reported by the American Transportation Research Institute (2011) for those same variables in the first quarter of 2010 were $0.21 (finance), $0.05 (insurance), $0.15 (maintenance and tires) and $0.02 (vehicle registration and permits).

IH-35 versus SH-130 Through Traffic. In this scenario, through truck traffic using 55 miles of SH-130 compared with 43.4 miles of IH-35 were analyzed. Under free flow conditions, per-mile cost (excluding toll charges) for both routes was found to be $1.40 (including $0.56 fuel, $0.40 driver cost). However, total route costs and travel time were found to be $77.06 and 55.20 minutes for SH-130, compared with $60.67 and 43.20 minutes for IH-35. The vehicle consumed 7.87 gallons

Table 2: Route Data Input for IH-35 / SH-130 Case Study

Route Name	Section	Distance (miles)	Condition	Speed (mph)	Travel Time (minutes)	Toll
IH-35 vs. SH-130 (through Austin)						
SH-130 (Free flow)		55.0	Free Flow	60	55.2	$19.20
IH-35 (Free flow)		43.4	Free Flow	60	43.2	–
SH-130 (2011 Cong.)		55.0	Free Flow	60	55.2	$19.20
IH-35 (2011 Cong.)	*Section 1*	4.0	Free Flow	60	4.2	–
	Section 2	7.9	Congested	24	19.8	–
	Section 3	31.5	Moderate	36	52.8	–
North Bound to SH 71 E						
SH-130 (Free flow)		25.0	Free Flow	60	25.2	$7.05
IH-35 (Free flow)		25.0	Free Flow	60	25.2	–
IH-35 (Congested)		5.0	Free Flow	60	4.8	–
	Section 1	5.0	Moderate	40	7.8	–
	Section 2	15.0	Free Flow	60	15.0	–
South Bound to SH 71 E						
SH-130 (Free flow)		47.0	Free Flow	60	46.8	$12.15
IH-35 (Free flow)		52.0	Free Flow	60	52.2	–
IH-35 (Congested)	*Section 1*	37.0	Free Flow	60	37.2	–
	Section 2	15.0	Moderate	45	19.8	–
North Bound to US 290 E						
SH-130 (Free flow)		32.0	Free Flow	60	31.8	$11.10
IH-35 (Free flow)		28.0	Free Flow	60	28.2	–
IH-35 (Congested)	*Section 1*	7.0	Free Flow	60	7.2	–
	Section 2	8.0	Moderate	40	12.0	–
	Section 3	5.0	Congested	20	15.0	–
	Section 4	8.0	Moderate	40	12.0	–
South Bound to US 290 E						
SH-130 (Free flow)	*Section 1*	28.0	Free Flow	60	28.2	$ 8.10
	Section 2	3.0	Free Flow	60	3.0	–
IH-35 (Free flow)	*Section 1*	30.0	Free Flow	60	30.0	–
	Section 2	10.0	Free Flow	50	12.0	–
IH-35 (Congested)	*Section 1*	20.0	Free Flow	60	19.8	–
	Section 2	5.0	Moderate	40	7.8	–
	Section 3	5.0	Free Flow	60	4.8	–
	Section 4	10.0	Free Flow	50	12.0	–

Table 3: Summary of Input Data

Variable	Input Data
Diesel price	$3.92
Utilization curve	Kept constant. Annual mileage was therefore 100,000 miles each year for 10 years
Maintenance cost (tire & oil change only)	Average Annual: $14,600 Average Per Mile: $0.15 per mile
Fuel economy calculation	Slope based approach
Driver wage	$0.40 per mile
Depreciation:	20% first year, 15 % subsequent years
Financing	1.5% down payment and a 60-month loan at an interest rate of 4.55%
Insurance	$5,500 a year
Registration and Permit Fees:	$2,300 a year
Toll charges	Based on 2011 values from Austin Toll Calculator (TxTag, 2011)
Vehicle Body Shape:	Tractor plus One Trailer
Vehicle Axle Count:	5 axle
Payment Type:	TxTag Electronic Toll Tag

of fuel on SH-130 compared with 6.21 gallons on IH-35. Under current 2011 congested conditions, per-mile costs were found to be $1.40 for SH-130 and $1.58 for IH-35. Fuel cost, gallons of fuel, driver cost, and travel time remained unchanged for SH-130, as it does not currently experience any congestion. However, total route cost and travel time on IH-35 increased by $7.75 and 33.60 minutes, respectively. Gallons of fuel consumed, per-mile fuel cost and driver costs increased by 1.98 gallons, $0.18, and $4.69, respectively, on IH-35. Based on the above analysis, it can be inferred that IH-35 is the most favorable route for free flow conditions and non-time sensitive commodity flows. Despite the congested conditions on IH-35, it still costs drivers $8.64 more (excluding tolls) to use SH-130 because of the additional 11.6 miles they have to drive on SH-130. If the $19.20 toll is accounted for, drivers will have to pay an additional $27.84 to use SH-130 instead of IH-35.

Northbound and Southbound Traffic to SH-71E via IH-35 and SH-130. This scenario sought to determine if truckers may prefer to use SH-130 instead of IH-35 when heading east to Bastrop via SH-71. During free flow conditions for northbound traffic, total route cost and travel time for both IH-35 and SH-130 to SH-71E were both the same ($35.03 and 25.20 minutes respectively) because both routes have similar distances. However, if the toll charged on SH-130 is included in the total route cost, SH-130 was $7.05 more costly than IH-35. Per-mile cost (excluding toll charges) was $1.40, fuel consumed was 3.58 gallons, and per-mile fuel cost was $0.56. For congested conditions, per mile fuel cost increased to $0.63 for IH-35, thus increasing total route cost by $1.73. Travel time on IH-35 also increased by 2.40 minutes.

For southbound traffic, route distance to SH-71E via SH-130 was 47 miles and that of IH-35 was 52 miles. Per-mile cost (excluding toll charges) was $1.40 for both routes, and total fuel consumed was 6.72 and 7.44 gallons for SH-130 and IH-35, respectively. During free flow conditions, total route cost on IH-35 was determined to be $72.82 ($7.00 more than SH-130). However, if the $12.15

toll charged on SH-130 is included, then using SH-130 will cost $5.15 more than using IH-35. For congested conditions, total route cost on IH-35 increased by $4.62, thus costing $11.62 more to use IH-35 instead of SH-130.

Northbound and Southbound Traffic to US-290E via IH-35 and SH-130. Similar to the SH-71E analysis, the US-290E scenario sought to determine if truckers may prefer to use SH-130 instead of IH-35 when heading east to Houston. For northbound free flow conditions, it was determined that it costs drivers $5.61 more (excluding tolls) to use SH-130 instead of IH-35 because of the additional four miles that need to be driven. Including tolls, drivers have to pay $16.71 more to use SH-130 instead of IH-35. In congested conditions, the difference in total route cost between SH-130 and IH-35 decreases to $3.66 (excluding tolls) or $14.76 when including tolls. Per-mile fuel cost for IH-35 increased by $0.21 and total driver cost increased by $1.62.

For southbound traffic, route distance to US-290E via SH-130 was 31 miles and that of IH-35 was 40 miles. It was determined that for both free flow and congested conditions, SH-130 was the more favorable route despite the additional $8.10 toll. IH-35 cost drivers an additional $5.00 even when SH-130 is tolled or $13.00 when SH-130 is not tolled.

CONCLUSION

CT-VCOST was developed so planners at the Texas Department of Transportation could better estimate the economic consequences of various engineering strategies and assist in policy making. CT-VCOST can be used, with minor calibration, in any state or region where a transportation planning entity needs to examine policies relating to setting toll charges, projecting future fuel consumption and fuel tax revenue, and examining the effects of pavement condition on vehicle operating costs.

CT-VCOST was used in validating claims by truck drivers concerning the use of the SH-130 toll facility, which runs parallel to IH-35. Despite congested conditions on IH-35, drivers pay an additional $27.84 when using the tolled SH-130 facility when traveling through Austin. Should the current toll of $19.20 not exist, drivers will still pay an additional $8.64 when using SH-130 because of the extra 11.6 miles they must drive.

Northbound traffic to SH-71E via SH-130 was competitive to IH-35 both in terms of cost and travel time. However, the additional $5.15 toll on SH-130 could be a disincentive to truck drivers if travel time is not a factor. For southbound traffic to SH-71E, IH-35 was less costly than the tolled facility on SH-130 but drivers experienced greater travel time delays especially in congested conditions.

Northbound traffic to US-290 E favored IH-35 more than SH-130 during both congested and free flow conditions from a cost-only perspective (IH-35 cost $16.90 less). However, travel time on IH-35 was 14.4 minutes more than SH-130 during congested periods. Southbound traffic, on the other hand, favored SH-130 as it remained less expensive ($4.50) and faster (13.2 minutes) than IH-35 even in congested conditions.

In summary, it can be inferred from CT-VCOST and the case study that not all new tolled facilities are setting prices favorable to truckers from a cost saving perspective. This is not simply a case of overestimating truck toll fees – which is generally the case with current traffic and revenue analysis – but may occur even when the toll is set at zero. However, for deliveries where travel time is a major consideration, using tolled facilities seems beneficial if the cost associated with using the facility does not offset the time savings. In addition, most truck drivers are paid by the mile, and longer tolled routes are a disincentive in comparison with the shorter and free alternative route because of additional mileage and toll fees. Truckers are rational and toll authorities should be using updated—even dynamic—vehicle operating cost information to induce truck demand. Truck toll road pricing should be substantially more equitable and based on fuel consumption and congestion impacts.

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