**Develop proposals for how to alleviate traffic growth issues**

Utilize fluid dynamic principals to control the flow of traffic.

Congestion pricing:

* Variable Road Pricing
  + Variable toll charged to use a roadway
* Lane Pricing
  + Variable toll charged to drive on separated highway High Occupancy Toll (HOT) lane
* Cordon Pricing
  + Fixed or variable toll charged to use a particular section of road
* Area-wide Pricing
  + Per-mile based toll charged on an entire section of roadway

**Develop a preliminary calculation plan for economic impact**

District 7 Data

**Gas price summary:**

Min. 1.146

1st Qu. 2.203

Median 3.012

Mean 2.919

3rd Qu. 3.617

Max. 4.707

**Income:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| County | Returns | AGI | Median.Income | Taxable.Assessed | Population |
| Los Angeles | 4,255,233 | $310,621,984,000 | $33,369 | $16,810,162,000 | 10,185,487 |
| Ventura | 368,649 | $28,620,713,000 | $39,799 | $1,420,942,000 | 852,013 |

**Economic Impact:**

Median Income / TWHPY (Total Work Hours Per Yr)

Median Gas Price \* Total Delay Hours

Potential costs of congestion have wide reaching implications on the economy. Potential costs due to heavy congestion should consider emissions, excess vehicle operating costs, productivity losses, unreliability, and delay to cargo creating increased inventory costs.

The three categories to consider are as follows:

* Expected Delays
* Unexpected Delays
* Variable Delays with variance in expected/unexpected delays

The list of most prominent costs associated with traffic congestion delays:

1. Increased travel time

Cost of traffic congestion associated with lower travel speeds, start-and-stop traffic flow, and gridlock.

1. Greater travel time unreliability

Cost associated with driver having to deal with travel times made unpredictable by congestion. This includes leaving early, and the inconvenience of arriving late.

1. Excess fuel usage

Averaging fuel consumption of acceleration rates: .72 gal/hr

Average fuel consumption of idle: .58 gal/hr

1. Increased emissions

Exhaust emissions causing pollution and a wide range of social costs.

1. Higher accident rates
2. Increased vehicle maintenance costs
3. Excess vehicle operating costs
4. Loss of productivity
5. Higher inventory costs
6. Higher frequency of cargo delays

Peak traffic hours are from 6-10am and 3-7pm creating an 8 hour peak period.

<https://www.transportation.gov/sites/dot.dev/files/docs/Costs%20of%20Surface%20Transportation%20Congestion.pdf>

**Estimation of Fuel Consumption**

Based on the UMR the following equation predicts the average miles-per-gallon (mpg) for potentially congested portion of peak periods:

*Average MPG = 8.8 + 0.25 \* Average Speed*

The methodological appendix to the UMR indicates that on the right-hand side of this equation, the average speed is measured exclusive of incident delay and for the entire eight hours of the peak period. Fuel economy, on the left of the equation, is measured for potentially congested portion of the peak period, a span of less than eight hours as determined by the Roadway Congestion Index

Average MPG (35 MPH) = 17.55

Average MPG (40 MPH) = 18.8

Average MPG (45 MPH) = 20.05

Average MPG (50 MPH) = 21.3

Average MPG (55 MPH) = 22.5

Average MPG (60 MPH) = 23.8

**Travel Time Cost Equation:**

*Travel Time in peak congestion period = Daily VHT in peak congestion/Daily VMT in peak congestion*

Vehicle Hours Traveled (VHT)

Vehicle Miles Traveled (VMT)

Currently US vehicle average MPG = 24.7

<https://www.reuters.com/article/us-autos-emissions/u-s-vehicle-fuel-economy-rises-to-record-24-7-mpg-epa-idUSKBN1F02BX>

Average MPG during acceleration:

1 mph/sec: 259.4 cc or .068 gal/mile

2 mph/sec: 270.9 cc or .071 gal/mile

3 mph/sec: 274.1 cc or .072 gal/mile

4 mph/sec: 286.4 cc or .075 gal/mile

5 mph/sec: 282.4 cc or .074 gal/mile

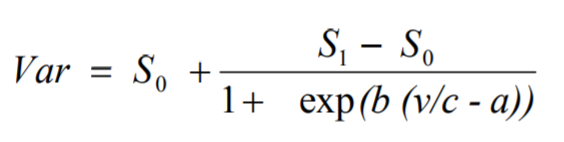
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**SUPPORTING INFORMATION**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| VEHICLE TYPE | FUEL TYPE | ENGINE SIZE (LITER) | GROSS VEHICLE WEIGHT (GVW) (LBS) | IDLING FUEL USE (GAL/HR WITH NO LOAD) |
| Compact Sedan | Gas | 2 | - | 0.16 |
| Large Sedan | Gas | 4.6 | - | 0.39 |
| Compact Sedan | Diesel | 2 | - | 0.17 |
| Medium Heavy Truck | Gas | 5-7 | 19,700-26,000 | 0.84 |
| Delivery Truck | Diesel | - | 19,500 | 0.84 |
| Tow Truck | Diesel | - | 26,000 | 0.59 |
| Medium Heavy Truck | Diesel | 6-10 | 23,000-33,000 | 0.44 |
| Transit Bus | Diesel | - | 30,000 | 0.97 |
| Combination Truck | Diesel | - | 32,000 | 0.49 |
| Bucket Truck | Diesel | - | 37,000 | 0.90 |
| Tractor-Semitrailer | Diesel | - | 80,000 | 0.64 |
| Source: Argonne National Laboratory, [Idling Reduction Savings Calculator](http://www.anl.gov/energy-systems/downloads/vehicle-idle-reduction-savings-worksheet), accessed December 2014. | | | | |

<https://www.energy.gov/eere/vehicles/fact-861-february-23-2015-idle-fuel-consumption-selected-gasoline-and-diesel-vehicles>

**Unreliability Equation:**



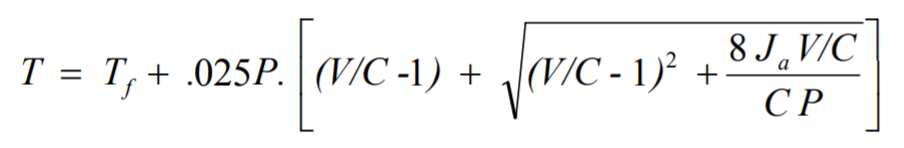
Var = Variability (or the standard deviation)

S1 = Maximum level of the standard deviation of travel time

S0 = Minimum level of standard deviation of travel time (standard deviation at free flow speed)

V/C = Volume to capacity ratio

a,b = Constants that vary for freeways and arterials.



T = Average travel time

Tf = Travel time at free flow speed

Ja = Delay parameter

V/C = Volume to capacity ratio

C = Capacity

P = Flow analysis period

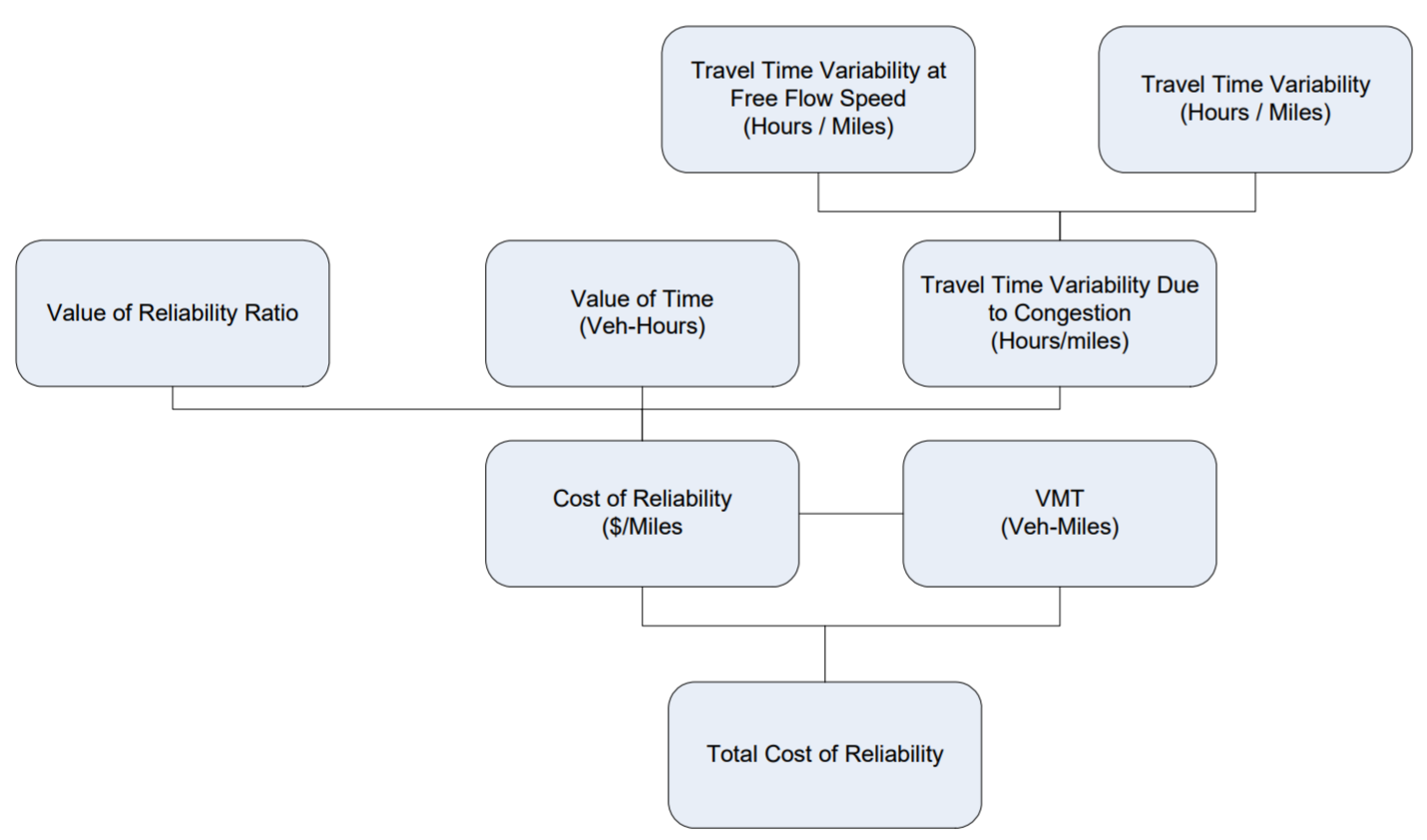
The cost of reliability can be written as:

*Total Cost of Reliability = (Var - S0 )×VOT ×VOR × Peak Congested VMT*

Where, Var-S0 is the variability caused by congestion.

The values assumed for the ratios are 0.9 for personal travel, 1.3 for business travel, and 2.2 for truck travel, as prescribed by Small and Verhoef (2007).

This method of valuing trip variability is relatively conservative due to the fact that only one unit of variation (or one standard deviation) was used to estimate the cost of reliability. In addition, this method does not take into consideration that the cost of being late is greater than the cost of being early, according to research by Brownstone and Small (2003).



Reduced Mobility Equation:

*C = Time Cost + Vehicle Operating Cost + Reliability Cost*

An example of the costs of reduced mobility is the productivity losses that occur when congestion limits how far a commuter is willing to travel from home. Because of this constraint, workers will sometimes decline employment at workplaces where they would be productive. This along with other costs from reduced traveler mobility will be captured by our measure of consumer surplus.

