

**Value of Delay Time for
Use in Mobility Monitoring Efforts**

by

**David R. Ellis, Ph.D.
Senior Research Scientist
Infrastructure Investment Analysis Program
Texas A&M Transportation Institute**

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Summary

The 2016 value of delay time estimate for passenger vehicle motorists and truck drivers incorporates several changes from previous estimates. The value of delay time for passenger vehicle motorists now uses the median hourly wage rate for all occupations as produced by the Bureau of Labor Statistics (BLS) as a base. **Researchers estimate the 2016 value of delay time for personal travel at \$17.81 per person. The commercial value of travel time is now based on the American Transportation Research Institute (ATRI) annual survey modified by speed, type of vehicle, and vehicle occupancy and is estimated to be \$53.69 per vehicle per hour for 2016. Neither the value of delay time for personal nor commercial vehicles include the cost of fuel.**

What Changed and Why?

There is a major change in this report with respect to value of delay time for passenger vehicles.

In previous reports, a value of delay time, first calculated in 1986, was simply inflated by the Consumer Price Index (CPI). From this point forward, the median hourly wage rate for all occupations as published by the Bureau of Labor Statistics will be used. It is believed this wage rate will prove more representative of the value of personal delay time. This report provides the value of time for an individual traveling in delay conditions. This value should be multiplied by the occupancy rate of passenger cars to determine the value of delay time for a passenger vehicle.

There is one major change in the calculation of the commercial value of delay time.

In previous years, the commercial truck value of delay time has gone through several revisions, but relied fundamentally on a value produced by a now dated study and subsequently adjusted by the CPI and, in more recent years, by the Producer Price Index (PPI). This and subsequent reports will use the American Trucking Association Institute's (ATRI) annual study of operational costs in trucking as a basis for estimating the commercial truck value of delay time. This change was made because it is believed the ATRI survey of its membership relative to operating costs is timelier and more representative of the actual operating cost borne by commercial truckers.

Introduction

The value of delay time is an estimate of the average differential cost of the extra travel time resulting from congestion. As it relates to the *Urban Mobility Report (UMR)* methodology, this congestion cost is a function of both the time and fuel used while the motorist is in congested traffic. The cost of extra fuel consumed during congestion is computed separately from the time spent (wasted) in congestion – fuel cost is not a subject of this report. This report focuses on the computation of an updated value of delay time for passenger cars and

trucks. This value of delay time serves as an input to compute urban area congestion cost from urban area delay.

For passenger car motorists, this value of delay time is based upon hourly wage rates. For truck drivers, the value of delay time is expressed as the wage rate of the driver multiplied by truck occupancy plus the various operating cost components associated with a straight truck or tractor-trailer. This report summarizes the components of each value of delay time cost estimate and the updated values of time used in the *UMR* calculations beginning with 2016 data.

Previous Methodology for Passenger Vehicle Motorist's Value of Delay Time

In earlier iterations of value of delay time calculations a speed choice model developed by Chui and McFarland (1986) of the Texas Transportation Institute (TTI) is used by the Texas Department of Transportation. The model derives its utility from the notion that speed is regarded as one of the most important factors in any traveler's choice. Travel time is directly related to the choice of speed that one chooses to travel. The first attempts to discern any relationship between speed and the value of travel time were made by Mohring (1965, 1976). The speed choice model assumes that a rational driver chooses to drive at a speed which minimizes his or her total trip cost (i.e., a speed at which his or her marginal cost is equal to or less than the marginal benefit).

The travel characteristics in Texas during the development of the speed choice model included a relatively small number of toll roads and small percentage of people using mass transit systems in Texas. The model was developed to analyze the nature of traffic in Texas at that time. More or less the same conditions exist today with the exception of a significant increase in truck traffic in some border areas and the I-35 corridor. The research indicated the value of delay time was \$11.98 in 1997 in Texas and was consistent at the time with estimates produced by other states.

Using this methodology, Column 2 of Table 1 takes the \$11.98 value of delay time found in 1997 and adjusts it for inflation by the Consumer Price Index (CPI) back to 1982 as well as forward to 2016. CPI is shown in Column 3 of Table 1.

So, using the previous calculation method, the value of delay time per person for passenger vehicle travel is estimated to be \$17.91 for 2016.

Table 1: Value of Passenger Vehicle Motorist's Time

	Column 2	Column 3	Column 4
Year	Personal Value of Time	Consumer Price Index (1982-1984 base year)	Bureau of Labor Statistics Median Hourly Wage
1980	\$6.15	82.4	
1981	\$6.78	90.9	
1982	\$7.20	96.5	
1983	\$7.43	99.6	
1984	\$7.75	103.9	
1985	\$8.03	107.6	
1986	\$8.18	109.6	
1987	\$8.48	113.6	
1988	\$8.83	118.3	
1989	\$9.25	124.0	
1990	\$9.75	130.7	
1991	\$10.17	136.2	
1992	\$10.47	140.3	
1993	\$10.78	144.5	
1994	\$11.06	148.2	
1995	\$11.37	152.4	
1996	\$11.71	156.9	
1997	\$11.98	160.5	
1998	\$12.17	163.0	
1999	\$12.43	166.6	
2000	\$12.85	172.2	
2001	\$13.22	177.1	
2002	\$13.43	179.9	
2003	\$13.73	184.0	\$13.53
2004	\$14.10	188.9	\$13.83
2005	\$14.58	195.3	\$14.15
2006	\$15.06	201.8	\$14.61
2007	\$15.47	207.3	\$15.10
2008	\$16.07	215.3	\$15.57
2009	\$16.01	214.5	\$15.95
2010	\$16.28	218.1	\$16.27
2011	\$16.79	224.9	\$16.57
2012	\$17.14	229.6	\$16.71
2013	\$17.39	233.0	\$16.87
2014	\$17.67	236.7	\$17.09
2015	\$17.69	237.0	\$17.40
2016	\$17.91	240.0	\$17.81

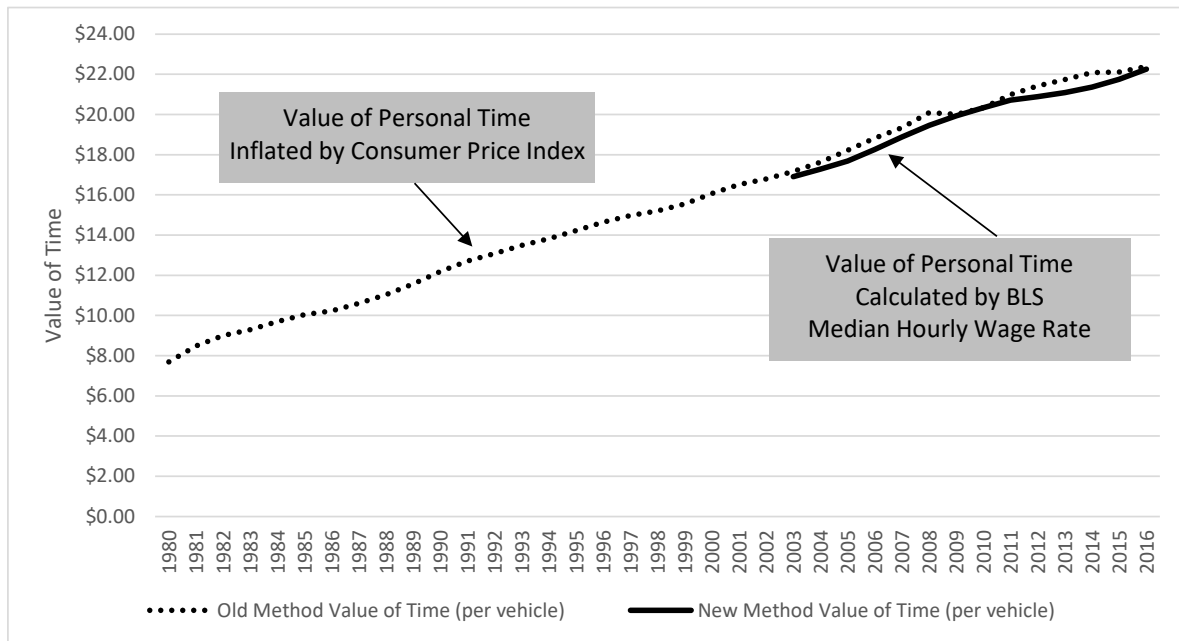
New Methodology for Passenger Vehicle Motorist's Value of Delay Time

There has long been a concern that simply taking the perceived value of delay time from an earlier study and adjusting it forward and backward by the CPI might prove to be problematic over time in that the CPI (a rate of change based on a market basket of goods for all urban consumers) may not be reflective of the actual value of passenger vehicle travel.

As an alternative, the decision has been made to use data published in the Occupational Employment Statistics series by the Bureau of Labor Statistics that provide both a mean and median hourly wage for all job classifications taken together. The median hourly wage was chosen for use in this study because the median value eliminates the effect of extremes at either end of the wage range.

As shown in Column 4 of Table 1 and graphically in Chart 1, the two values (the previous measure in Column 2 and the method using wage data shown in Column 4) have been very similar historically. Therefore, from this point forward the median hourly wage for all occupations should be used as a surrogate for perceived value of delay time for passenger vehicle motorists because it is measured independently and annually as opposed to an adjustment by the CPI inflation measure.

Chart 1. Value of Personal Travel: 1980-2016



Using the new methodology for passenger vehicles, the value of delay time for 2016 is \$17.81 per person.

Previous Methodology for Commercial Truck Value of Delay Time

Historically, commercial truck costs for use in the *UMR* were calculated on a cost-per-mile basis. The original base-year cost-per-mile value of \$1.65 per mile used by TTI was obtained from the American Trucking Association in 1986. The per mile value includes costs for depreciation, interest, general maintenance, tires, repairs, and other similar costs, but did not include the cost of fuel. The amount of fuel used per mile was then multiplied by the cost of fuel to determine the fuel cost-per-mile. In subsequent years, and like in the case of personal travel, the value was adjusted by an approximation of the general rate of inflation as measured by the CPI.

Later, researchers made adjustments to the value of delay time calculation for truck drivers. Two primary sources of data were identified for determining true road user costs for trucks and for use as a check against values used in the *Urban Mobility Report*: The first was *Operating Costs for Trucks 2000* published by Transport Canada. The second was *An Evaluation of Expenses per Ton-Mile, Expenses per Mile and Expenses per Ton for Major Commercial Carriers in Numerous Segments of For-Hire Trucking* produced by Transportation Technical Services, Inc. for the Federal Highway Administration Office of Freight Management and Operations.

Based on these reports and other data, researchers performed several updates and produced new cost-per-mile estimates beginning with the 2004 *UMR* data. The updates included:

- developing a “new” cost-per-mile figure using the Consumer Price Index for the years 1982 through 2003,
- using the Producer Price Index for general freight trucking to adjust operating costs,
- updating diesel fuel prices using data from the Energy Information Administration, and
- revising fuel cost-per-mile values using the new fuel price values.

By taking the cost-per-mile calculations and multiplying them by the average peak-period speed (i.e., congested speed) weighted by vehicle-miles of truck travel, a truck operating value of delay time was computed on a per-hour basis. New weighted average speeds were calculated as a part of the *Urban Mobility Report* process as well.

New Methodology for Truck Driver’s Value of Delay Time

Since the last major revision to the *UMR* commercial travel time methodology, the American Transportation Research Institute (ATRI) began an annual survey of their membership to determine estimates of operational trucking costs. TTI has closely followed ATRI’s survey and has determined it currently provides the most accurate data available for commercial truck operating costs and should serve as the basis for the truck value of delay time estimate used in the *UMR*.

The ATRI survey disaggregates variable costs into nine categories: fuel, lease/purchase payments, repairs and maintenance, insurance, permits and licenses, tires, tolls, and driver wages and benefits. (For purposes of this report, fuel costs are eliminated at this point in the calculation process and added back at the end of the process as a separate cost item.) Values are calculated on a per-mile and per-hour basis. Table 2 provides a summary of the survey results for the period 2008 through 2015 published by ATRI, which indicates a truck value of delay time (excluding fuel cost) of \$1.19 per mile or \$47.59 per hour for 2015.

Table 2: Estimates of Truck Costs per Mile Published by ATRI

ATRI Costs Per Mile	2008	2009	2010	2011	2012	2013	2014	2015
Truck/Trailer Lease or Purchase Payments	\$0.213	\$0.257	\$0.184	\$0.189	\$0.174	\$0.163	\$0.215	\$0.230
Repairs and Maintenance	\$0.103	\$0.123	\$0.124	\$0.152	\$0.138	\$0.148	\$0.158	\$0.156
Truck Insurance Premiums	\$0.055	\$0.054	\$0.059	\$0.067	\$0.063	\$0.064	\$0.071	\$0.092
Permits and Licenses	\$0.016	\$0.029	\$0.040	\$0.037	\$0.022	\$0.026	\$0.019	\$0.019
Tires	\$0.030	\$0.029	\$0.035	\$0.042	\$0.044	\$0.041	\$0.044	\$0.043
Tolls	\$0.024	\$0.024	\$0.012	\$0.017	\$0.019	\$0.019	\$0.023	\$0.020
SUBTOTAL	\$0.441	\$0.516	\$0.454	\$0.504	\$0.460	\$0.461	\$0.530	\$0.560
Driver Wages	\$0.435	\$0.403	\$0.446	\$0.460	\$0.417	\$0.440	\$0.462	\$0.499
Driver Benefits	\$0.144	\$0.128	\$0.162	\$0.151	\$0.116	\$0.129	\$0.129	\$0.131
SUBTOTAL	\$0.579	\$0.531	\$0.608	\$0.611	\$0.533	\$0.569	\$0.591	\$0.630
TOTAL	\$1.020	\$1.047	\$1.062	\$1.115	\$0.993	\$1.030	\$1.121	\$1.190

Source: American Transportation Research Institute

Table 3: Estimates of Truck Costs per Hour Published by ATRI¹

ATRI Costs Per Hour	2008	2009	2010	2011	2012	2013	2014	2015
Truck/Trailer Lease or Purchase Payments	\$8.52	\$10.28	\$7.37	\$7.55	\$6.94	\$6.52	\$8.59	\$9.20
Repairs and Maintenance	\$4.11	\$4.90	\$4.97	\$6.07	\$5.52	\$5.92	\$6.31	\$6.23
Truck Insurance Premiums	\$2.22	\$2.15	\$2.35	\$2.67	\$2.51	\$2.57	\$2.89	\$3.70
Permits and Licenses	\$0.62	\$1.15	\$1.60	\$1.53	\$0.88	\$1.04	\$0.76	\$0.78
Tires	\$1.20	\$1.14	\$1.42	\$1.67	\$1.76	\$1.65	\$1.76	\$1.72
Tolls	\$0.95	\$0.98	\$0.49	\$0.69	\$0.74	\$0.77	\$0.90	\$0.79
SUBTOTAL	\$17.62	\$20.60	\$18.20	\$20.18	\$18.35	\$18.47	\$21.21	\$22.42
Driver Wages	\$17.38	\$16.12	\$17.83	\$18.39	\$16.67	\$17.60	\$18.46	\$19.95
Driver Benefits	\$5.77	\$5.11	\$6.47	\$6.05	\$4.64	\$5.16	\$5.15	\$5.22
SUBTOTAL	\$23.15	\$21.23	\$24.30	\$24.44	\$21.31	\$22.76	\$23.61	\$25.17
TOTAL	\$40.77	\$41.83	\$42.50	\$44.62	\$39.66	\$41.23	\$44.82	\$47.59

¹Calculations assume an average speed of 40 mph.

Source: American Transportation Research Institute

Researchers used the ATRI estimates as a basis for calculating the 2016 commercial truck value of delay time for use in the UMR and other studies. To do so, it was necessary to make several adjustments to the ATRI estimates to update them to 2016. Researchers made the following methodological adjustments:

1. Segregated non-fuel and non-labor marginal costs from other costs.
2. Subtracted fuel costs.
3. Calculated the mean and median average percent increase in non-fuel, non-labor marginal costs.
4. Selected the median average percent increase in non-fuel, non-labor marginal cost and apply the increase to the ATRI 2015 non-fuel, non-labor costs to determine cost-per-mile operating costs for 2016.
5. Determined an estimate of fuel efficiency (miles/gallon) for tractor-trailer and straight trucks.
6. Determined an estimate of percent of commercial trucks that are tractor-trailer trucks and straight trucks.
7. Determined a labor cost estimate.
8. Estimated the cost of driver benefits.
9. Estimated an average speed for tractor-trailer trucks and straight trucks.

In the ATRI survey, the mean annual increase from 2008 through 2015 in non-fuel, non-labor costs per mile was calculated at 4.0 percent and the median annual increase calculated to be 5.7 percent. The annual percent change ranged from -11.7 percent to +16.7 percent annually. Given the wide range in annual percent change, the median value was used to calculate an estimate for non-fuel, non-labor cost-per-mile estimate for 2016 because the median is less impacted by outliers in the data.

The mean annual percentage of the cost of driver benefits as a percent of driver wages was calculated at 30.7 percent per and the median was calculated to be 30.5 percent for the period 2008 through 2015. The annual percent change ranged from 26.2 percent to 36.3 percent. Again, the median value of 30.5 percent was chosen as an estimate of the cost of driver benefits as a percentage of driver wages because it is less impacted by the outliers in the data.

As noted above, several additional estimates were made based on conversations with industry members and the past experience of research professionals to produce a 2016 estimate of truck value of delay time. They are as follows:

Percent of trucks by type in an urban area –

Tractor-trailer trucks: 60 percent
Straight trucks: 40 percent

Average truck occupancy in an urban area –

Tractor-trailer trucks: 1.1 persons per truck
Straight trucks: 1.2 persons per truck
Weighted average: 1.14 persons per truck

Average vehicle speed –

Tractor-trailer trucks: 45 miles per hour
 Straight trucks: 30 miles per hour
 Weighted average: 39 miles per hour

Finally, researchers obtained 2016 driver wages from the National Occupational Employment and Wage Estimates for the United States published by the U.S. Department of Labor, Bureau of Labor Statistics. The median hourly driver wage reported by the BLS for a heavy truck or tractor-trailer truck driver was reported to be \$19.87 with the median driver wage for a light or delivery truck driver reported as \$14.70 per hour. Weighting the wages by the distribution of truck by type produces a blended wage rate of \$17.80 per hour. However, using previously reported driver wage rates produced by the ATRI surveys, calculating the median annual change in wage rate and then applying that increase to the 2015 rate produced an estimate for 2016 of \$20.57 per hour. Given the disparity between the BLS and ATRI estimates, researchers selected the ATRI wage rate for use in 2016. The basis for this decision is two-fold. First, it is believed the ATRI survey more accurately reflects market conditions given the shortage of truck drivers and provides the most recent data available.

Taken together, these estimates produced a 2016 value of delay time for truck drivers of \$1.38 per mile for use in the *UMR* urban area statistics compared to the 2015 ATRI estimate of \$1.19 per mile as seen in Table 3. Again, these per mile costs do not include fuel.

Table 3: Estimates of 2016 Truck Value of Delay Time in Dollars per Mile

Cost Per Mile	ATRI Estimate	TTI Estimate
	2015	2016
Truck/Trailer Lease or Purchase Payments	\$0.230	\$0.243
Repairs and Maintenance	\$0.156	\$0.165
Truck Insurance Premiums	\$0.092	\$0.097
Permits and Licenses	\$0.019	\$0.020
Tires	\$0.043	\$0.045
Tolls	\$0.020	\$0.021
Driver Wages	\$0.499	\$0.601
Driver Benefits	\$0.131	\$0.183
TOTAL	\$1.190	\$1.377

NOTE: The 2016 TTI Estimate for driver wages and benefits includes an average vehicle occupancy of 1.14 persons per vehicle.

Table 4 below uses the per mile calculation multiplied by the weighted speed (39 miles per hour) to produce an hourly to produce an estimate of commercial truck value of delay time of \$53.69 for 2016 compared to the ATRI estimate of \$47.59 per hour for 2015.

Table 4: Estimates of 2016 Truck Value of Delay Time in Dollars per Hour

Cost Per Hour	ATRI Estimate	TTI Estimate
	2015	2016
Truck/Trailer Lease or Purchase Payments	\$9.20	\$9.48
Repairs and Maintenance	\$6.23	\$6.43
Truck Insurance Premiums	\$3.70	\$3.79
Permits and Licenses	\$0.78	\$0.78
Tires	\$1.72	\$1.77
Tolls	\$0.79	\$0.82
Driver Wages	\$19.95	\$23.45
Driver Benefits	\$5.22	\$7.15
TOTAL	\$47.59	\$53.69

NOTE 1: The 2016 TTI Estimate for driver wages and benefits includes an average vehicle occupancy of 1.14 persons per vehicle.

Note 2: Total cost per hour is \$53.69. The sum of the individual costs is \$53.67 due to rounding.

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