5.2 Travel Time

This chapter examines the value of travel time, and travel time savings. Travel time is one of the largest costs of transportation, and travel time savings are often the primary justification for transportation infrastructure improvements. Various studies have developed estimates of travel time values for different user types and travel conditions. Note: all monetary units are in U.S. dollars unless indicated otherwise.

5.2.1 Index

5.2.2 Definitions

The *Value of Travel Time* (VTT) refers to the cost of time spent on transport, including waiting as well as actual travel. It includes costs to consumers of personal (unpaid) time spent on travel, and costs to businesses of paid employee time spent in travel. The *Value of Travel Time Savings* (VTTS) refers to the benefits from reduced travel time.

5.2.3 Discussion

Travel time is one of the largest categories of transport costs, and time savings are often claimed to be the greatest benefit of transport projects such as new and expanded roadways, and public transit improvements. Factors such as traveler comfort and travel reliability can be quantified by adjusting travel time cost values.

On average people devote 60-90 minutes a day to travel. Most people seem to enjoy a certain amount of personal travel, about 30 minutes a day, and dislike devoting more than about 90 minutes a day.[1]

Time Valuation Perspectives

There are several types of travel time, as summarized in Table 5.2-1. *Clock time* is measured objectively, while *perceived* (also called *cognitive*) *time* is how users experience travel. Paid travel time costs should be calculated based on clock time, but personal travel time costs should be calculated based on perceived time. The *generalized cost of travel* refers to the sum of time and financial costs. *Effective speed* (also called *social speed*) refers to overall travel speed, including both time spent traveling and devoted to maintaining vehicles and working to pay transport expenses.[2]

Table 5.2.3-1 **Transport Time Valuation Perspectives**

Name	Description	Implications
Travel Time	Any time devoted to travel.	This is the least specific definition.
Clock Time	Travel time measured objectively.	This is how time is usually quantified.
Perceived Time	Travel time as experienced by users, which can vary greatly from clock time	This reflects traveler comfort.
Paid (also called *On-the-Clock* or *commercial*)	When workers are paid for their travel time (for deliveries, traveling to worksites etc.).	This type of travel tends to have a relatively high value per hour.
Personal Travel Time	Time devoted to personal travel (commuting, errands, etc.).	This is the largest category of time value in most economic studies.
Generalized Costs	Combined travel time and financial costs.	This is how travel time is incorporated into traffic models.
Effective Speed	Total time devoted to travel and paying for transport equipment and services.	Higher costs for more expensive modes.

This table summarizes various perspectives for valuing travel time and travel time savings. Different perspectives may result in very different valuations.

[1] Patricia Mokhtarian and Ilan Salomon (2001), "How Derived is the Demand for Travel? Some Conceptual and Measurement Consideration" *Transportation Research A*, Vol. 35, No. 8 (www.elsevier.com), September 2001, pp. 695-719.

[2] Paul J. Tranter (2004), *Effective Speeds: Car Costs are Slowing Us Down*, University of New South Wales, for the Australian Greenhouse Office (www.climatechange.gov.au); at www.environment.gov.au/settlements/transport/publications/effectivespeeds.html . This concept was discussed by earlier writers such as Henry David Thoreau and Ivan Illich.

Total travel time costs are the product of time spent traveling (measured as minutes or hours) multiplied by unit costs (measured as cents per minute or dollars per hour). Travel time unit costs vary depending on type of trip, travel conditions, and traveler preferences.[3] For example, ten minutes spent relaxing on a comfortable seat imposes less cost than the same amount of time spent driving in congestion or standing on a crowded bus. Travel time costs often vary for different parts of a trip. For example, walking to a bus stop, waiting for a bus, riding an uncrowded bus, and riding a crowded bus may each have different unit costs. Travel time costs also vary depending on traveler needs and preferences. For example, a person might one day enjoying a relaxed recreational walk or drive, but another day pay generously for faster travel when rushing to an important event. Travel time unreliability (uncertainty how long a trip will take, and unexpected delays) imposes additional costs.

Various studies have quantified travel time unit costs and the value of travel time savings, based on analysis of business costs, traveler surveys, and by measuring behavioural responses by travelers faced with a tradeoff between time and money, for example, when offered the option of paying extra for a faster trip.[4]

Table 5.2.3-2 indicates the estimated *effective speed* of various vehicles, including time spent earning money to pay vehicle expenses, time devoted to transport and support time (such as walking to and from the vehicle, vehicle maintenance and cleaning). These costs vary depending on actual income, costs, travel speeds and annual mileage.

Table 5.2.3.2 **Effective Speed**[5]

	Luxury Car	Sport Utility Vehicle	Average Car	Economy Car	Public Transit	Bicycle
Annualized costs (Aus$)	$14,161	$17,367	$9,753	$5,857	$966	$500
Hours worked to pay costs*	644	790	444	266	44	23
Average travel speed (km/hr)	45	45	45	45	2	20
Hours of travel time	333	333	333	333	600	750
Support activity time (walking to vehicle, maintenance, etc.)	51	51	50	51	60	55
Total time	1,028	1,174	827	650	704	828
Effective speed (km/hr)	*14.6*	*12.8*	*18.1*	*23.1*	*21.3*	*18.1*

This table compares the estimated effective speed of various vehicles. Lower-speed modes, such as public transit and cycling, often have higher effective speeds than driving.
* Assumes $40,100 annual income.

[3] Kenneth Small, Cliford Winston and J. Yan (2005), *Uncovering the Distribution of Motorists' Preferences for Travel Time and Reliability: Implications for Road Pricing*, University of Irvine (www.economics.uci.edu); at www.socsci.uci.edu/~ksmall/Value%20of%20time%20note.pdf.

[4] Peter Mackie, et al. (2003), *Values of Travel Time Savings in the UK*, Institute for Transport Studies, University of Leeds (www.its.leeds.ac.uk).

[5] Paul J. Tranter (2004), *Effective Speeds: Car Costs are Slowing Us Down*, University of New South Wales, for the Australian Greenhouse Office (www.climatechange.gov.au); at www.environment.gov.au/settlements/transport/publications/effectivespeeds.html

Valuation Factors

Below are factors that tend to affect travel time values.

- Commercial (paid) travel costs include driver wages and benefits, and the time value of vehicles and cargo, reflecting efficient use of assets and ability to meet delivery schedules.
- Personal travel time is usually estimated at 25% to 50% of prevailing wages, but varies by factors such as type of trip, traveler and conditions. Most studies focus on commute travel and so may unrepresent other types of travel, such as personal errands and recreational travel.
- There are often substantial differences between objectively measured (clock) travel time and *perceived* travel time,[6] which tends to increase with congestion, discomfort and insecurity.[7, 8]
- Travel time costs tend to increase with income, and are lower for children and unemployed people (put differently, employed people are often willing to pay more for travel time savings).
- The first few minutes of a trip often has minimal time cost since people generally seem to enjoy a certain amount of daily travel, but unit costs usually increase if trips exceed about 20 minutes in duration or total personal travel exceeds about 90 minutes per day.[9]
- Travel time unit costs tend to increase with variability and arrival uncertainly,[10] and are particularly high for unexpected delays during activities with strict schedules.[11, 12]
- Some travel time has a low cost or positive value because people enjoy the experience, including recreational travel and errands that involve social activities.[13]
- Under pleasant conditions walking, cycling and waiting can have low or positive value, but under unpleasant conditions (walking along a busy highway or waiting for a bus in an area that seems dirty and dangerous), costs are two or three times higher than in-vehicle time.[14]

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[6] Yuen-wah Li (2003), "Evaluating the Urban Commute Experience: A Time Perception Approach," *Journal of Public Transportation*, Vol. 6, No. 4, pp. 41-67; at www.nctr.usf.edu/jpt/pdf/JPT%206-4%20Li.pdf.

[7] Richard Wener, Gary W. Evans and Jerome Lutin (2006), *Leave The Driving To Them: Comparing Stress Of Car And Train Commuters*, American Public Transportation Associaiton (www.apta.com); at www.apta.com/passenger_transport/thisweek/documents/driving_stress.pdf

[8] Karin Brundell-Freij (2006), *User Benefits and Time in Road Investment and Maintenance: The Role of Speed Choice and Driving Comfort*, TRB Annual Meeting, TRB (www.trb.org).

[9] Michael Welch and Huw Williams (1997), "Sensitivity of Transport Investment Benefits to the Evaluation of Small Travel-Time Savings," *Journal of Transport Economics and Policy*, Vol. 31, No. 3, Sept., pp. 231-254.

[10] Harry Cohan and Frank Southworth (1999), "On the Measurement and Valuation of Travel Time Variability Due to Incidents on Freeways," *Journal of Transportation and Statistics*, Bureau of Transportation Statistics (www.bts.gov), Dec., pp. 123-131; at www.gcu.pdx.edu/download/2cohen.pdf

[11] Yaron Hollander (2006), "Direct Versus Indirect Models For The Effects Of Unreliability," *Transportation Research A*, Vol. 40, Issue 9 (www.elsevier.com), November, pp. 699-711.

[12] Kenneth Small, et al. (1999), *Valuation of Travel-Time Savings and Predictability in Congested Conditions for Highway User-Cost Estimation*, NCHRP 431, TRB (www.trb.org); Lisa A. Schweitzer, et al. (1998), *Highway Performance and Time-Sensitive Industries*, University of Iowa (www.ppc.uiowa.edu); Henry Liu, Will Recker and Anthony Chen (2004), "Uncovering the Contribution of Travel Time Reliability to Dynamic Route Choice," *Transportation Research*, Vol. 38A, No. 6, July, pp. 435-453.

[13] Patricia L. Mokhtarian (Editor) (2005), *Transportation Research – Special Issue: The Positive Utility of Travel*, Vol. 39A, Issues 2-3 (www.elsevier.com/locate/tra), February/March.

[14] Rachel Goodman (2001), "A Traveller In Time: Understanding Deterrents to Walking to Work," *World Transport Policy and Practice*, Vol. 7, No. 4 (www.eco-logica.co.uk/worldtransport.html),pp. 50-54.

- Travel needs and preferences vary. For example, some people place a higher cost on time spent driving while others place a higher cost on transit travel.[15]

Evaluating Travel Time Costs

Travel time costs are a large component of transport economic impacts, so how they are evaluated significantly affects planning decisions. Travel time is often worth more than monetary costs. For example, a 30 mph car trip has about 15¢ per mile operating costs compared with 25¢ per mile time costs (valued at $6.00 per hour with 1.2 passengers).

Travel time costs are highly variable: a small portion of trips have high time values, a large number of trips have moderate to low time values, and some travel has zero or negative time cost (travel is a desired activity). For example, congested roadway and crowded transit travel tend to have high time value since people making lower-value trips will avoid such conditions. On the other hand, travelers who voluntarily choose a slower mode (such as walking or public transit) in response to positive incentives must be better off overall or they would not make that change; their increased minutes of travel are offset by lower per minute costs or other savings.[16]

Conventional transport evaluation often undervalues qualitative travel time cost factors, which skews planning decisions to favor increased travel speed at the expense of other improvements.[17] For example, conventional evaluation accounts for roadway widening travel time savings but not the additional delay it causes for walking and cycling (called the Barrier Effect described in chapter 5.13). Similarly, reduced unit cost from improved walking conditions and more comfortable transit vehicles are seldom quantified and so are undervaluted compared with projects that increase vehicle travel speeds.

The true value of changes in travel speed can be difficult to determine because people tend to have *fixed travel time budgets*, typically devoting about 70 daily minutes or 8 weekly hours to personal travel. As a result, incrased travel speeds tend to increased travel rather than save time.[18] For example, if a highway or transit improvement increases travel speeds, commuters often accept longer distance commutes. As a result, the true benefits are increased mobility and improved location options, not travel time savings.[19] Much of the benefit is often capitalized in land values, the more dispersed land use reduces accessibility,[20] and the induced vehicle travel impose additional costs.[21]

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[15] Raymond Novaco and Cheryl Collier (1994), *Commuting Stress, Ridesharing, and Gender: Analysis from the 1993 State of the Commute Study in Southern California*, UCTC 208 (www.uctc.net).
[16] Kenneth Small (1998), "Project Evaluation," *Transportation Policy and Economics*, Brookings Institution (www.brookings.edu); at www.uctc.net/papers/379.pdf.
[17] Todd Litman (2007), *Build for Comfort, Not Just Speed: Valuing Service Quality Impacts In Transport Planning*, Victoria Transport Policy Institute (www.vtpi.org); at www.vtpi.org/quality.pdf.
[18] Glenn Lyons (2003), *Future Mobility – It's About Time*, University of the West of England (www.uwe.ac.uk); at www.transport.uwe.ac.uk/research/projects/travel-time-use/Lyons-UTSG-2003.pdf.
[19] David M. Newbery (2002), "Spatial General Equilibrium and Cost-Benefit Analysis," *Cost-Benefit Analysis: Environmental and Ecological Perspectives*, Transaction Pub. (www.transactionpub.com), pp. 1-18.
[20] Todd Litman (2001), "Generated Traffic; Implications for Transport Planning," *ITE Journal*, Vol. 71, No. 4, Institute of Transportation Engineers (www.ite.org), April, pp. 38-47; at www.vtpi.org/gentraf.pdf.

5.2.5 Travel Speeds by Mode

Tables 5.2.5-1 and 5.2.5-2 indicate average travel speed by mode. Bus travel, including passenger stops, is estimated to average 5.2 mph in central business districts, 10 mph in cities, and 14.3 mph in suburban areas.[22] Delucchi estimates that carpools increase average trip distances by 10%, vanpools by 15%, buses add 4% for walking and 15% for auto access, and rail 5% for walking and 20% for auto access.[23] John Kain estimates that carpoolers incur an additional time cost of 8 minutes per trip for two riders, 10 minutes for three riders, and 12 minutes for four riders, plus one additional mile per passenger.[24]

Table 5.2.5-1 **Average Travel Speeds by Mode**[25]

Mode	Minutes Per Mile	Miles Per Hour
Automobile	1.9	32
Line Haul Rail	2.0	30
Light Rail & BRT[26]	2.5	24
Auto Access	3.0	20
Line Haul Bus	4.0	15
Bicycle	5.0	12
Feeder Bus	6.0	10
Walk	20	3

Table 5.2.5-6 **Average Public Transit Trip Characteristics**[27]

	Bus	Commuter Train	Streetcar/ Trolley	Subway/ Elevated	All Transit
Trip Distance (miles)	11.7	24.3	3.6	10.0	12.4
Travel Time (minutes)	37.5	50.0	26.2	38.6	38.8
Travel Speed (mph)	18.7	29.2	8.3	15.5	19.2
Waiting Time (minutes)	10.8	9.1	6.3	7.4	9.8
Total Time (minutes)	48.3	59.1	32.4	46.0	48.7
Overall Speed (mph)	14.6	24.7	6.7	13.0	15.3

This table illustrates typical travel times and speeds.

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[21] John Whitelegg (1993), "Time Pollution," *The Ecologist* (www.theecologist.org), Vo. 23, No. 4 pp. 131-134

[22] Herbert Levinson (1983), "Analyzing Transit Time Performance," cited in *Characteristics of Urban Transportation Systems*, Federal Transit Administration (www.fta.dot.gov), September 1992, Table 3-1.

[23] Mark Delucchi (1998), *Emissions of Criteria Pollutants, Toxic Air Pollutants, and Greenhouse Gases, from the Use of Alternative Transportation Modes and Fuels*, UC Transport. Center (Berkeley), No. 344, Table 42.

[24] John Kain (1994), "Impacts of Congestion Pricing on Transit and Carpool Demand and Supply," in *Curbing Gridlock*, TRB, (www.trb.org), p. 516.

[25] NHI (1995), *Estimating the Impacts of Urban Transportation Alternatives, Participant's Notebook*, National Highway Institute, Federal Highway Admin. (www.fhwa.dot.gov), Course #15257, p VI-16.

[26] Bus Rapid Transit (BRT) was not included in the original study, but has similar travel speeds to light rail. See VTPI (2007) *Bus Rapid Transit: Bus System Design Features That Significantly Improve Service Quality And Cost Efficiency*. VTPI (www.vtpi.org); at www.vtpi.org/tdm/tdm120.htm

[27] CUTR (1998), *Public Transit in America: Findings from the 1995 Nationwide Personal Transportation Survey*, Center For Urban Transportation Research (www.cutr.usf.edu/), Table 4-13.

Estimates and Studies

This section describes factors that affect travel cost values and summarizes various travel cost studies. Note: all monetary units are in U.S. dollars unless indicated otherwise.

5.2.6 Factor Adjustments

- Table 5.2.6-1 indicates how travel time values can be adjusted to reflect qualitative factors such as comfort, convenience and reliability using Level-of-Service ratings for various modes. These can be considered default values that should be calibrated and adjusted to reflect specific conditions and the preferences of affected groups.

Table 5.2.6-1 **Recommended Travel Time Values** (Relative to Prevailing Wages)[28]

Category	LOS A-C	LOS D	LOS E	LOS F	Waiting		
					Good	Average	Poor
Commercial vehicle driver	120%	137%	154%	170%		170%	
Comm. vehicle passenger	120%	132%	144%	155%		155%	
City bus driver	156%	156%	156%	156%		156%	
Personal vehicle driver	50%	67%	84%	100%		100%	
Adult car passenger	35%	47%	58%	70%		70%	
Adult transit passenger – seated	35%	47%	58%	70%	35%	50%	125%
Adult transit passenger – standing	50%	67%	83%	100%	50%	70%	175%
Child (<16 years) – seated	25%	33%	42%	50%	25%	50%	125%
Child (<16 years) – standing	35%	46%	60%	66%	50%	70%	175%
Pedestrians and cyclists	50%	67%	84%	100%	50%	100%	200%
Transit Transfer Premium					5-min.	10-min.	15-min.

This summarizes recommended travel time values, based on Waters (1992) with adjustments to reflect the quality of transit passenger waiting, walking and transfer conditions. These are default values that should be calibrated and adjusted to reflect specific conditions and the preferences of affected groups.

- The table below summarizes travel time values developed for economic evaluation in British Columbia. Commercial (paid) travel time costs should reflect workers' wages and benefits, plus vehicle and cargo time values. Unit costs increase with congestion, measured using roadway Level of Service (LOS) ratings.

Table 5.2.6-2 **Travel Time Values Developed for British Columbia**[29]

Category	LOS A-C	LOS D	LOS E	LOS F	Waiting
Commercial vehicle driver	120%	137%	154%	170%	170%
Commercial vehicle passenger	120%	132%	144%	155%	155%
City bus driver	156%	156%	156%	156%	156%
Personal vehicle driver	50%	67%	84%	100%	100%
Adult car or bus passenger	35%	47%	58%	70%	70%
Child passenger under 16 years	25%	33%	42%	50%	50%
Pedestrians and cyclists	50%	67%	84%	100%	100%

This summarizes recommended travel time values, calculated relative to average wages.

[28] Todd Litman (2007), *Build for Comfort, Not Just Speed: Valuing Service Quality Impacts In Transport Planning*, Victoria Transport Policy Institute (www.vtpi.org); at www.vtpi.org/quality.pdf.
[29] William Waters (1992), *The Value of Time Savings for The Economic Evaluation of Highway Investments in British Columbia*, BC Ministry of Transportation and Highways (www.gov.bc.ca/tran).

- Based on an extensive review of international studies, World Bank economist Kenneth Gwilliam recommends that, when evaluating transportation improvements for international development, work travel time should be valued at wages and benefits, and that a default value for adult personal travel (including commuting) travel time should be 30% of household income per hour unless better local data are available, as summarized in the table below[30]

Table 5.2.6-3 **Recommended Travel Time Cost Values**

Purpose	Rule	Recommended Value
Work (paid) travel	Cost to employer	133% wages
Commute and other personal (unpaid) travel	Empirically observed values	Adult: 30% household hourly income Child: 15% household hourly income
Walking/waiting	Empirically observed values	150% value for trip purpose
Freight and public transport	Resource cost approach	Vehicle time cost + driver wages + occupants' time costs

5.2.7 Monetary Estimates

North America

- Apogee Research estimated travel time costs per passenger mile for urban peak and urban off-peak travel at high, medium and low densities in two cities.[31] Time values were based on 50% of average local wages for commuting and 25% for other travel.

Table 5.2.7-1 **Travel Time Costs in Two Cities** (¢ per passenger mile)

	Express-way		Non-Expwy		Comm. Rail		Rail Transit		Bus		Bicycle		Walk	
Boston, MA	*Peak*	*Off-P*	*Peak*	*Off-P*	*Peak*	*Off-P*	*Peak*	*Off-P*	*Peak*	*Off-P*	*Peak*	*Off-P*	*Peak*	*Off-P*
High	24.3	9.6	40.4	23.9	28.9	22.7	40.1	28.6	50.5	39.8	60.6	47.8	243	159
Medium	15.2	8.0	24.3	15.9	19.8	14.0	28.1	25.3	50.5	39.8	60.6	47.8	202	159
Low	11.0	8.0	20.2	13.6	19.0	13.3	n/a	n/a	50.5	39.8	60.6	47.8	202	159
Portland, MA														
High	11.1	7.8	19.9	13.1	n/a	n/a	n/a	n/a	42.6	33.5	49.8	39.2	166	131
Medium	10.0	7.1	16.6	11.2	n/a	n/a	n/a	n/a	42.6	33.5	49.8	39.2	166	131
Low	7.7	6.0	12.4	9.8	n/a	n/a	n/a	n/a	30.2	23.8	49.8	39.2	166	131

[30] Kenneth Gwilliam (1997), *The Value of Time in Economic Evaluation of Transport Projects; Lessons from Recent Research*, World Bank (www.worldbank.org).

[31] CLF (1994), *The Costs of Transportation*, Conservation Law Foundation (www.clf.org), p. 119-120.

- Brownstone and Small analyze motorists' willingness to pay road tolls for reduced travel time and travel time variability.[32] They find that morning commute travel time savings average $10-40 per hour, and reliability is also valued. Other researchers find similar travel time savings values on the New Jersey Turnpike.[33] These relatively high values are considered typical in large urban areas where income levels are relatively high, user flexibility is low, and possibilities to shift other modes/routes are limited.

- The U.S. DOT uses the following travel time values for evaluating transportation projects (1997 U.S. dollars): in-vehicle time, $8.90/person-hour; out-of-vehicle time (e.g. waiting for a bus), $17.00/person-hour; commercial truck, $16.50/person-hour.[34] Table 5.2.7-2 indicates US DOT recommended travel time factors.

Table 5.2.7-2 **Recommended Value of Travel Time**[35]

Time Component	Reference	Value
In-Vehicle Personal (local)	Of wages	50%
In-Vehicle Personal (intercity)	Of wages	70%
In-Vehicle Business	Of total compensation	100%
Excess (waiting, walking, or transfer time) Personal	Of wages	100%
Excess (waiting, walking, or transfer time) Business	Of total compensation	100%

This table summarizes USDOT recommended travel time values. For business travel costs are estimated to average 120% of wages to reflect total compensation, including non-wage benefits.

Australia and New Zealand

- Booz Allen Hamilton used stated preference survey data to estimate own and cross-elasticities for various costs (fares, travel time, waiting time, transit service frequency, parking fees) modes (automobile, transit, taxi) and trip types (peak, off-peak, work, education, other) in the Canberra, Australia region.[36] They developed generalized costs and travel time cost values, including estimates of the relative cost of walking and waiting time for transit users. The travel time cost values from a similar study in Brisbane, Australia are summarized in Table 5.2.7-3.

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[32] David Brownstone and Kenneth A. Small (2005), "Valuing Time And Reliability: Assessing The Evidence From Road Pricing Demonstrations," *Transport. Research A*, Vol. 39 (www.elsevier.com/locate/tra), pp. 279-293.

[33] Kaan Ozbay, Ozlem Yanmaz-Tuzel and José Holguín-Veras (2006), *Theoretical Derivation of Value of Travel Time and Demand Elasticity: Evidence from NJ Turnpike Toll Road*, Transportation Research Board 85th Annual Meeting, TRB (www.trb.org).

[34] USDOT (1997), *Departmental Guidance on the Evaluation of Travel Time in Economic Analysis*, memo, USDOT (www.fhwa.dot.gov); used in STEAM software (www.ota.fhwa.dot.gov/steam).

[35] ECONorthwest and PBQD (2002), *Estimating the Benefits and Costs of Public Transit Projects*, TCRP Report 78, TRB (www.trb.org); at http://gulliver.trb.org/publications/tcrp/tcrp78/index.htm .

[36] Booz Allen Hamilton (2003), *ACT Transport Demand Elasticities Study*, Department of Urban Services: Canberra (www.tams.act.gov.au) at www.tams.act.gov.au/__data/assets/pdf_file/0011/14024/acttransportdemandelasticitiesstudy.pdf

Table 5.2.7-3 **Travel Time Costs in Brisbane, Australia** (2003 Aus. Dollars)[37]

Mode	Short (Under 30 Minutes)				Medium (30 – 45 Minutes)			
	Peak		Off-Peak		Peak		Off-Peak	
	CBD	Non CBD	CBD	Non CBD	CBD	Non CBD	CBD	Non CBD
Bus	9.20	7.70	7.50	5.90	9.20	8.70	7.60	7.50
Rail	9.30	6.90	6.90	6.00	8.80	7.70	7.90	6.70
Ferry	10.70	-	8.30	-	-	-	-	-
Car	10.60	9.00	8.30	7.10	10.10	8.00	9.00	6.40

- TransFund New Zealand uses standard travel time values summarized in the table below. Their project evaluation manual has detailed instructions for applying these values.

Table 5.2.7-4 **Base Values for Vehicle Occupant Time** (1998 NZ Dollars Per Hour)[38]

Mode	Work Travel	Non-Work Travel	Congestion Premium
Car, Motorcycle Driver	$21.30	$7.00	$3.50
Car, Motorcycle Passenger	$21.30	$5.25	$2.60
Light Commercial Driver	$19.25	$7.00	$3.50
Light Commercial Passenger	$19.25	$5.25	$2.60
Medium Commercial Driver	$15.80	$7.00	$3.50
Medium Commercial Passenger	$15.80	$5.25	$2.60
Heavy Commercial Driver	$15.80	$7.00	$3.50
Heavy Commercial Passenger	$15.80	$5.25	$2.60
Seated Bus Passenger	$21.30	$5.25	$2.60
Standing Bus Passenger	$21.30	$10.55	$2.60
Pedestrian and Cyclist	$21.30	$10.55	NA

"Work" travel involves travel while paid. "Non-work" travel is all personal travel, including commuting. "Congestion Premium" is an additional cost for travel in congested conditions.

Europe / UK

- Cirillo and Axhausen use travel surveys to determine the value of travel time for residents of German cities.[39] They found that travel time has an overall average value of about $10/hour, but that for a portion of trips (estimated at 10-15% overall and up to 24% during non-working days), travel time has positive rather than negative value.

- The table below summarizes typical values of time used for transport project evaluation in Europe.

[37] N.J. Douglas, L.J. Franzmann, and T. W. Frost (2003), *Estimation of Demand Parameters for Primary Public Transport Service*, Australian Transport Research Forum (www.Douglaseconomics.co.nz).

[38] TransFund (1998), *Project Evaluation Manual*, TransFund New Zealand (www.transfund.govt.nz).

[39] C. Cirillo and K.W. Ashausen (2006), "Evidence On The Distribution Of Values Of Travel Time Savings From A Six-Week Diary," *Transportation Research A*, Vol. 40, No. 5 (www.elsevier.com), June, pp. 444-457.

***Table 5.2.7-5* Illustrative Values of Time**[40]

	Passenger Transport	Freight Transport
Interurban Rail	Business: € 21.00 per person hour Commuting / Private: € 6.40 per person hour Leisure / Holiday: € 3.20 per person hour	Full trainload (950 tonnes): € 725.00 per tonne-hour Wagon load (40 tonnes): € 30.00 per tonne-hour Average per tonne: € 0.76 per tonne-hour
Road	Business: € 21.00 per person hour Commuting / Private: € 6.00 per person hour Leisure / Holiday: € 4.00 per person hour	Light Goods Vehicle: € 40.00 per vehicle-hour Heavy Goods Vehicle: € 43.00 vehicle-hour

- The COBA model (the standard Cost Benefit Analysis framework for evaluating transport improvements in the UK) uses the travel time values in Table 5.2-15.

***Table 5.2.7-6* Travel Time Values Used by U.K. COBA Model**[41]

Vehicle	Occupancy	Time Mode	Per Occupant*	Per Vehicle*
Car (working)	1.00 driver	Working	1,289.8	1,407.6
	0.11 passenger	Working	1,070.6	
Car (non-working)	1.00 driver	Non-Working	315.0	548.1
	0.74 passenger	Non-Working		
Average Car	1.00 driver	14.6% work		673.6
	0.65 passenger			
Light Goods Vehicle (working)	1.00 driver	Working	1,003.1	1,424.4
	0.42 passenger	Working	1,003.1	
Light Goods Vehicle (non-work)	1.00 driver	Non-Working	315.0	504.0
	0.60 passenger	Non-Working	315.0	
Average Light Goods Vehicle	1.00 driver	72% work		1,166.7
	0.47 passenger			
Other Goods Vehicle (truck)	1.00 driver	Working	945.0	945.0
Public Service Vehicle (bus)	1.00 driver	Working	983.1	
	12.1 passenger	Non-Working	315.0	
	0.1 passenger	Working	1,064.4	4,901.0
Average Vehicle				784.4

* 1994 U.K. Pence per hour.

- Travel time value research for the U.K. Department of Transport estimates that personal (excluding business travel) travel time savings average 6.6 pence per minute for commuting and 5.9 pence per minute for other trips, with variations depending on travel conditions and user types.[42] This is equivalent to about £5.00 per hour for commuting time and £4.37 per hour for other travel. The researchers recommend that walking and waiting time be valued at 200% to 250% of in-vehicle travel time.

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[40] van Essen, et al (2004), *Marginal Costs of Infrastructure Use – Towards a Simplified Approach*, CE Delft; results published in Vermeulen, et al (2004), *The Price of Transport: Overview of the Social Costs of Transport*, CE Delft (www.ce.nl).

[41] R. Vickerman (2000), "Evaluation Methodologies for Transport Projects in the United Kingdom," *Transport Policy*, Vol. 7, No. 1(www.elsevier.com/locate/tranpol), January 2000, pp. 7-12.

[42] P. Mackie, et al. (2003), *Values of Travel Time Savings in the UK*, Institute for Transport Studies, University of Leeds (www.its.leeds.ac.uk/); at http://eprints.whiterose.ac.uk/2079/ .

Other Regions

- I.T. Transport investigated developing countries/ travel time values, based on surveys of residents' willingness to pay for travel time savings under various conditions.[43] It found the average base travel time saving values for rural travelers in three countries were: Taka 3.50 per hour (US$ 0.06) for Bangladesh, Cedi 1,627 per hour (US$ 0.18) for Ghana and TZS 195 per hour (US$ 0.18) for Tanzania, representing 51%, 64% and 49% area wage rates. Travel time values are affected by factors such as traveler gender, age, travel activity, load, comfort, road condition, and whether the traveler is being paid for their time. Table 5.2.7-7 summarizes rural Bangladesh cost values.

Table 5.2.7-7 **Travel Time Costs in Rural Bangladesh** (Taka per hour)[44]

	Average	Men	Women
In-vehicle Time	3.50	4.75	2.25
Walking Time	3.91	5.16	2.66
Additional Values			
Uncomfortable travel conditions (add)	2.29		
Market day (add)	1.47		
Salaried or trader (add)	14.72		
Travelling with a load (add)	0.48		
Poor traveler (total travel time value)	0.31		

5.2.8 Other Topics

Reliability

- Travel time costs tend to be significantly higher under congested and unpredictable travel conditions. The tables below summarize the implied cost values. The researchers suggest that travel time costs under congested conditions be calculated at 2.5 times that of overall travel time savings.

Table 5.2.8-2 **Cost of Shifting from Uncongested to Congested Travel**[45]

Total Travel Time (Minutes)	Cost Increment ($/Min.)
10	$0.79
15	0.52
26	0.30
30	0.26
45	0.17
60	0.13

This table shows willingness to pay for reduced congestion delay for various trip lengths.

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[43] I. T. Transport Ltd. (2005), *Valuation Of Travel Time Savings: Empirical Studies In Bangladesh, Ghana And Tanzania And A Practical Model For Developing Countries*, UK Department for International Development (www.dfid.gov.uk/); at www.ittransport.co.uk/documents/R8307%20Final%20Report%20VoTA%20July%202005%20Final.pdf .

[44] I.T. Transport (2002), *The Value of Time in Least Developed Countries*, Department for International Development, UK under its Knowledge and Research Programme (www.transport-links.org/transport_links).

[45] Kenneth Small, et al (1999), *Valuation of Travel-Time Savings and Predictability in Congested Conditions for Highway User-Cost Estimation*, NCHRP 431, TRB (www.trb.org).

Table 5.2.8-3 **Estimated Values of Reliability**

Trip Type and Income	$/Min. of Standard Deviation
Work trip, higher income (>$45k/yr)	$0.26
Work trip, lower income (<$45k/yr)	0.22
Non-work trip, higher income (>$45k/yr)	0.21
Non-work trip, lower income (<$45k/yr)	0.17

This table shows average willingness to pay for more reliable arrival time.

- A study for the U.S. Federal Highway Administration publication identifies various travel reliability indicators:[46]
    - The *90th or 95th percentile travel times*, which reflects the longest travel time during a ten or twenty day period. This is reported in minutes and seconds
    - The *buffer index* reflects the extra time travelers must add to their average travel time to ensure on-time arrival, computed as the difference between the 95th percentile and average travel times, divided by the average travel time. It is expressed as a percentage. For example, a 40% buffer index means that, for a trip that averages 20 minutes travelers should budget an additional 8 minutes (20 minutes × 40% = 8 minutes) to ensure on-time arrival. The extra minutes are called the *buffer time*.
    - The *planning time index* reflects the total travel time required to provide an adequate buffer time, including both typical and unexpected delay. The planning time index compares near-worst case travel time to a travel time in light or free-flow traffic. For example, a planning time index of 1.60 means that a 20-minute trip in light traffic requires 32 minutes of total time planned (20 minutes × 1.60 = 32 minutes).
    - The *frequency that congestion exceeds some threshold* reflects the degree to which congestion exceeds a performance standard. It is typically expressed as the percent of days or time that travel times exceed X minutes or travel speeds fall below Y mph. This is relatively easy to compute if continuous traffic data is available, and it is typically reported for weekdays during peak traffic periods.

- Highway construction traffic delays can impose significant travel time costs and spillover effects on other roadways.[47] For some projects, such delays can offset a significant portion of projected travel time savings.

Use of Travel Time

- A survey of U.K. rail passengers found that many use their time productively by working or studying (30% some of the time and 13% most of the time), reading (54% some of the time and 34% most of the time), resting (16% some of the time and 4% most of the time) and talking to other passengers (15% some of the time and 5% most

[46] FHWA (2006), *Travel Time Reliability: Making It There On Time, All The Time*, Federal Highway Administration (http://ops.fhwa.dot.gov/publications/tt_reliability/index.htm).
[47] Barbara McCann, et al. (1999), *Road Work Ahead; Is Construction Worth the Wait*, Surface Transport Policy Project (www.transact.org).

of the time), and so place positive utility on such time.[48] When asked to rate their travel time utility, 23% indicated that "I made very worthwhile use of my time on this train today," 55% indicated that "I made some use of my time on this train today," and 18% indicated that "My time spent on this train today is wasted time." The potion of travel time devoted to productive activity is higher for business travel than for commuting or leisure travel, and increases with journey duration.

Car and Van Pools

- Pratt estimates that ridesharing (car- and vanpooling) typically adds 10-12 minutes per trip compared with driving alone (page 5-5).[49] He summarizes information from various studies on transit user time costs for riding, walking and waiting (report Table 10-12).

Meta Analysis

- Zamparini and Reggiani perform a meta-analysis of 90 Value of Travel Time Savings (VTTS) studies performed in Europe, North-America and Australia.[50] They find the mean VTTS value to be about 83% of wage rates, with higher values in Europe than North America, and lower values for public transit than for driving or air travel.

- Wardman summarized public transit users travel time values, with separate values for bus and rail, walking and waiting time, based on meta-analysis of previous studies.[51]

5.2.9 Variability

Travel time costs vary depending on user, trip purpose and travel conditions.

5.2.10 Equity and Efficiency Issues

Travel time is an internal cost. The main equity issue occurs if people who are transportation disadvantaged bear excessive travel time costs compared with those who are more advantaged. Travel time costs can be considered inefficient if users impose delay on other travelers (see Congestion Costs). Transportation project evaluation practices that value certain travel time savings (such as reduced motorist congestion delays) but not others (such as delays to pedestrians, or comfort and convenience to transit passengers) can result in inequitable planning decisions.

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[48] Glenn Lyons, Juliet Jain and David Holley (2007), "The Use Of Travel Time By Rail Passengers In Great Britain," *Transportation Research A*, Vol. 41, No. 1 (www.elsevier.com/locate/tra), Jan. 2007, pp. 107-120.
[49] Richard H. Pratt (1999), *Traveler Response to Transportation System Changes, Interim Handbook*, TCRP Web Document 12 DOT-FH-11-9579. (www.trb.org) at http://onlinepubs.trb.org/Onlinepubs/tcrp/tcrp_webdoc_12.pdf
[50] Luca Zamparini and Aura Reggiani (2007), "Meta-Analysis and the Value of Travel Time Savings: A Transatlantic Perspective in Passenger Transport," *Networks and Spatial Economics* (www.springerlink.com); at www.springerlink.com/content/h663q51u448078x1/fulltext.pdf
[51] Mark Wardman (2004), "Public Transport Values of Time," *Transport Policy*, Vol. 11, No. 4 (www.elsevier.com), Oct. 2004, pp. 363-377.

5.2.11 Conclusions

Travel time costs are highly variable, including a small portion of travel with very high time values, to a significant portion of travel with little or no *cost*, since travelers enjoy the experience and would pay nothing to reduce it. High-time-value travel includes:

- Paid travel.
- Urgent personal trips.
- Travel under congested or uncomfortable conditions.
- Unexpected delays.
- Relatively long trips (more than about 20 minutes) or high daily mileage (more than about 90 minutes a day).

For this evaluation, travel is divided into four categories, with different cost values, as summarized in the table below.

Table 5.2.11-1 **Travel Time Cost Categories**

Category	Description	Cost Value	Portion of Total Travel
Paid	Travel by employees when they are being paid, including freight vehicle drivers, business people traveling to meetings, and workers traveling between job sites.	150% wage rates (to account for wages, benefits, vehicle and freight time values).	5% (commercial travel)
Personal, high cost	Personal travel during which travelers experience significant discomfort or frustration, such as driving in congestion or being a pedestrian or transit passenger in uncomfortable conditions.	50% wage rates for drivers, 35% of wages for passengers.	20%. Typical for urban-peak commute and errand travel that occurs under congested or unpleasant conditions.
Personal, medium cost	Personal travel during which travelers experience no discomfort.	25% wage rates for adults.	50%. Typical of errand trips under uncongested conditions.
Zero-cost travel time.	Travel that users enjoy and so would pay nothing to reduce their travel time.	No cost.	25%. Typical for recreational travel and a portion of other personal travel.

This table summarizes categories of travel used in this analysis.

Automobile Values

Under urban-peak conditions, drivers' time is valued at $7.50 per hour (50% of $15 US median wage in 2007)[52] and passengers' at $3.75 per hour (25% of $15). Under urban off-peak and rural conditions, drivers' and passengers' time is valued at $2.50 per hour (25% of average wages, times 2/3, to account for the 1/3 of this travel with zero time

[52] BLS (2007), *May 2007 National Occupational Employment and Wage Estimates United States*, Bureau of Labour Statistics (www.bls.gov); at www.bls.gov/oes/current/oes_nat.htm#b00-0000 The median value of $15.10 was rounded down to $15. Note that the average wage of $19.56 might be a more appropriate value in large cities with higher than average incomes.

cost). These values are used for automobile modes and motorcycles. Urban Peak speeds are estimated to average 30 mph with a 16.5% congestion cost premium (assuming that half of these trips experience LOS D). Urban Off-Peak and Rural travel costs assume speeds averaging 35 and 40 mph respectively and no congestion premium.

Transit and Rideshare Values

Rideshare passengers are assumed to increase trip times by 20%. Diesel Bus and Electric Bus/Trolley costs are estimated to average 12 mph under Urban Peak, 15 mph under Urban Off-Peak, and 18 mph under rural travel conditions, based on average bus speeds. A travel time rate of 35% of wages ($5.25 per hour) is used for transit passengers under urban-peak conditions, to account for crowding, and 25% of wages ($3.75 per hour) for off-peak and rural transit travel.

Walking and Cycling Values

Time devoted to walking and bicycling is charged at $3.75 per hour,[53] which is half of the standard rate for SOV drivers, due to enjoyment, although this costs is sensitive to conditions and personal preference, and so may be zero value in some situations (when people walk or bicycle for enjoyment), and higher than average wages in others (walking and cycling in uncomfortable or dangerous conditions). Walking is assumed to average 3 mph. Bicycling is assumed to average 10 mph, and incurs the 16.5% premium for Urban Peak travel. Telework incurs no time cost.

Estimate **User Travel Time Costs** (2007 U.S. Dollars per Passenger Mile)

Vehicle Class	Urban Peak	Urban Off-Peak	Rural	Average
Average Car	0.288	0.075	0.063	0.113
Compact Car	0.288	0.075	0.063	0.113
Electric Car	0.288	0.075	0.063	0.113
Van/Light Truck	0.288	0.075	0.063	0.113
Rideshare Passenger	0.225	0.075	0.063	0.100
Diesel Bus	0.438	0.238	0.200	0.263
Electric Bus/Trolley	0.438	0.238	0.200	0.263
Motorcycle	0.288	0.075	0.063	0.113
Bicycle	0.438	0.375	0.375	0.388
Walk	1.250	1.250	1.250	1.250
Telework	0.000	0.000	0.000	0.000

Automobile Cost Range

The per mile travel time cost range used in this analysis is:

Minimum	Maximum
$0.07	$0.34

[53] This implies that a typical person traveling for commuting or errands might be willing to pay for a transit or taxi ride up to $1.25 to avoid walking one mile and up to $2.50 to avoid walking two miles.

5.2.12 Information Resources

Information sources on travel time costing are described below.

ASCE (2001), *Guide to Transportation Benefit-Cost Analysis*, American Society of Civil Engineers (www.asce.org); at http://ceenve.calpoly.edu/sullivan/cutep/cutep_bc_outline_main.htm.

Cambridge Systematics (2005), *Traffic Congestion and Reliability: Trends and Advanced Strategies for Congestion Mitigation*, FHWA (www.fhwa.dot.gov); at www.ops.fhwa.dot.gov/congestion_report/index.htm.

EDRG (2007), *Monetary Valuation of Hard-to-Quantify Transportation Impacts: Valuing Environmental, Health/Safety & Economic Development Impacts*, NCHRP 8-36-61, National Cooperative Highway Research Program (www.trb.org/nchrp); at www.statewideplanning.org/_resources/63_NCHRP8-36-61.pdf.

FHWA (1998), *Surface Transportation Efficiency Analysis Model (STEAM)*, Federal Highway Administration (www.fhwa.dot.gov).

FHWA (1998), *Travel Time Data Collection Handbook*, Federal Highway Administration (www.fhwa.dot.gov); at www.fhwa.dot.gov/ohim/start.pdf.

FHWA (2006), *Travel Time Reliability: Making It There On Time, All The Time*, Federal Highway Administration (http://ops.fhwa.dot.gov); at http://ops.fhwa.dot.gov/publications/tt_reliability/index.htm.

I. T. Transport (2005), *Valuation Of Travel Time Savings: Empirical Studies In Bangladesh, Ghana And Tanzania And A Practical Model For Developing Countries*, UK Dept. for International Development (www.ittransport.co.uk); at www.ittransport.co.uk/documents/R8307%20VoT%20Brief%20Final%20July%202005.pdf.

Todd Litman (2007), *Build for Comfort, Not Just Speed: Valuing Service Quality Impacts In Transport Planning*, Victoria Transport Policy Institute (www.vtpi.org); at www.vtpi.org/quality.pdf.

David Luskin (1999), *Facts and Furphies in Benefit-Cost Analysis: Transport*, Report 100, Bureau of Transport Economics (www.btre.gov.au); at www.btre.gov.au/info.aspx?ResourceId=24&NodeId=22.

P. Mackie, et al. (2003), *Values of Travel Time Savings in the UK*, UK Dept. for Transport (www.dft.gov.uk); at www.dft.gov.uk/pgr/economics/rdg/valueoftraveltimesavingsinth3130

Patricia L. Mokhtarian (2005), *Transportation Research – Special Issue: The Positive Utility of Travel*, Vol. 39A, Issues 2-3 (www.elsevier.com/locate/tra), February/March 2005.

Kenneth Small (1999), "Project Evaluation," in *Transportation Policy and Economics*, Brookings (www.brookings.edu); at www.uctc.net/papers/379.pdf.

Statistics Canada (2008) *Average hourly wages of employees by selected characteristics and profession.* (www.statcan.ca); at www40.statcan.ca/l01/cst01/labr69a.htm.

TAC (1994), *A Primer on Investment and Economic Development*, Transportation Association of Canada (www.tac-atc.ca).

TRACE (1999), *Costs Of Private Road Travel And Their Effects On Demand*, CORDIS - Community Research & Development Service (www.cordis.lu/transport/src/trace.htm).

Paul J. Tranter (2004), *Effective Speeds: Car Costs are Slowing Us Down*, University of New South Wales, for the Australian Greenhouse Office (www.climatechange.gov.au); at www.environment.gov.au/settlements/transport/publications/effectivespeeds.html.

Travel Time Use In The Information Age (www.transport.uwe.ac.uk/research/projects/travel-time-use/index.htm) investigates how new communications technologies affect travel time.

TRL (2004), *The Demand for Public Transit: A Practical Guide*, Transportation Research Laboratory, Report TRL 593 (www.trl.co.uk); at www.demandforpublictransport.co.uk. Includes analysis of travel time values and the impact of travel speed on transport behavior.

van Essen, et al (2004), *Marginal Costs of Infrastructure Use – Towards a Simplified Approach*, CE Delft (www.ce.nl).

Vermeulen, et al (2004), *The Price of Transport: Overview of the Social Costs of Transport*, CE Delft (www.ce.nl).

William Waters (1992), *The Value of Time Savings for The Economic Evaluation of Highway Investments in British Columbia*, BC Ministry of Transportation and Highways (www.gov.bc.ca/tran).

Luca Zamparini and Aura Reggiani (2007), "Meta-Analysis and the Value of Travel Time Savings: A Transatlantic Perspective in Passenger Transport," *Networks and Spatial Economics* (www.springerlink.com); at www.springerlink.com/content/h663q51u448078x1/

Anming Zhang, Anthony E. Boardman, David Gillen and W.G. Waters II (2005), *Towards Estimating the Social and Environmental Costs of Transportation in Canada*, Centre for Transportation Studies, University of British Columbia (www.sauder.ubc.ca/cts), for Transport Canada; at www.sauder.ubc.ca/cts/docs/Full-TC-report-Updated-November05.pdf.