5.2 Travel Time and Speed

This chapter examines travel time costs, and therefore the value of travel time savings and travel speed. Travel time is one of the largest transportation costs and its valuation significantly affects planning decisions.

5.2.1 Index

5.2.2 Definitions

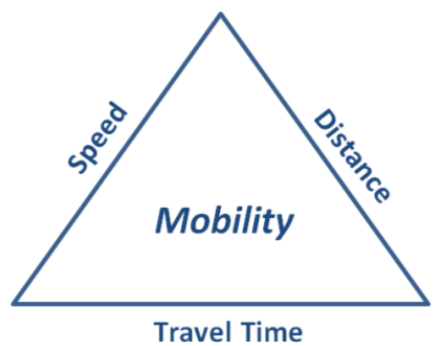
The *Value of Travel Time* (VTT) refers to the cost of marginal changes in time spent travelling. The *Value of Travel Time Savings* (VTTS) refers to the benefits provided by reductions in the amount of time spent on travel.

5.2.3 Discussion

Time is a valuable and scarce resource. Hours are the currency, and minutes are the small change of our lives. The amount of time we spend travelling affects our health and happiness in many ways, and how time and speed are valued in planning affects many costs described in this report.

Time is a unique transportation cost in several ways. It is one of the largest and most variable travel costs. Time savings are often the largest benefit of transportation projects. Unlike other costs, travel time often has positive value: most people enjoy some travel.[1] However, under unpleasant conditions, time spend travelling can have high costs.[2] Because it is both a benefit and a cost, the amount of time people spend travelling tends to maintain equilibrium; too little and people find ways to increase it, too much and they reduce it. Most people devote 60 to 80 minutes per day to personal travel,[3] called *Marchetti's Constant*,[4] and prefer 15-25 minute one-way commute trips and 5-15 minutes errand trips.[5] When travellers choose slower modes, such as walking or bicycling rather than driving, must be better off overall, because their additional travel time is offset by benefits such as increased enjoyment or health benefits.

Travel time, speed and distance are interrelated factors of mobility, as illustrated to the right. For example, faster travel speeds can either save time or increase the distances that people can travel in a given amount of time. Since people tend to maintain fixed travel time budgets, higher speeds generally increase travel distances rather than save time over the long run. Conversely, decisions that reduce travel distances, such as more compact and mixed development, or mobility substitutes such as telecommunications and delivery services, can reduce travel times without increasing speeds.



[1] Yannick Cornet, et al. (2021), "Worthwhile Travel Time: A Conceptual Framework of the Perceived Value of Enjoyment, Productivity and Fitness While Travelling," *Transport Reviews* (DOI: 10.1080/01441647.2021.1983067).

[2] Carolyn O'Fallon and Ian Wallis (2012), *A Wider Look at How Travellers Value the Quality and Quantity of Travel Time*, New Zealand Transport Agency (www.nzta.govt.nz); at https://bit.ly/3NgnPjU.

[3] Asif Ahmed and Peter Stopher (2014), "Seventy Minutes Plus or Minus 10 — A Review of Travel Time Budget Studies," *Transport Reviews*, Vo. 34:5, pp. 607-625 (DOI: 10.1080/01441647.2014.946460).

[4] Cesare Marchetti (1994), "Anthropological Invariants in Travel Behaviour, *Technological Forecasting and Social Change*," p. 75-88; at https://bit.ly/3uOYhl4.

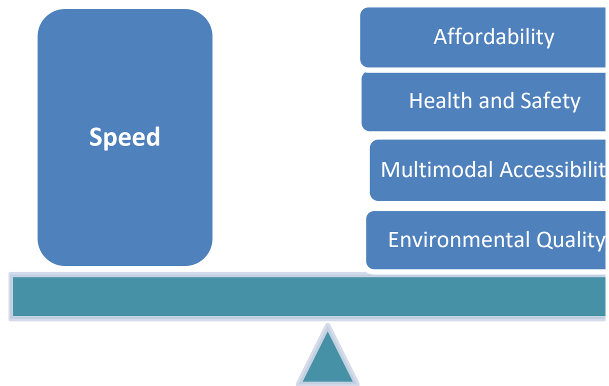
[5] Eric Jaffe (2014), *The Ideal Commute is Not Actually No Commute*, Bloomberg CityLab (www.bloomberg.com); at https://bloom.bg/3LHEdbv.

Certainly, travellers often value speed. Many people enjoy the thrill of speed, at least occasionally, and under some circumstances travellers will pay large premiums for faster travel, such as for urgent errands. Motorists often exceed posted speed limits, and some pay extra for a faster vehicle such as a sport car. However, only a minority of motorists pay are willing to pay optional tolls for faster driving on managed lanes, and far more motorists purchase affordable and luxury vehicles than sports cars, suggesting that financial savings and comfort are often valued more than speed.

The value travellers place on time significantly affects travel decisions. For example, if a mode's time costs decline due to increased speed or comfort, its use is likely to increase, but if it becomes slower or less comfortable, travellers are likely to use it less. Perceived time cost is therefore an important factor in predicting how transport system changes will affect travel behavior.

Planning decisions often involves trade-offs between travel speed and other goals, as illustrated in Figure 3.2.3-1. Several transportation costs tend to increase with speed. Faster modes (automobiles and aviation) and higher traffic speeds tend to increase user costs, require larger and more expensive infrastructure, impose more congestion and crash risk, consume more energy and produce more pollution than slower modes and lower speeds. For example, as traffic speeds increase vehicles require more shy distance (clearance from other objects) and impose more risk, so increasing speeds from 20 to 60 mph require about three times as much road space and increases pedestrian death risks by an order of magnitude.

Figure 3.2.3-1 **Balancing Goals**



Planning decisions often involve trade-offs between speed and other goals, and therefore the value of travel time compared with other impacts.

Higher values of time favor faster modes, higher roadway design speeds and more dispersed development over slower but more affordable, safer, and resource-efficient travel options, and more compact development. For example, a highway expansion might be justified if users' time is valued at 50% of wages but not if valued at 25% of wages. Described more generally, higher travel time valuation tends to favor *mobility* (physical movement) over *accessibility* (the ease of reaching services and activities).

Perspective and Scope

Travel time can be measured using various units summarized in Table 5.2.3-2.

Table 5.2.3-2 **Transport Time Valuation Perspectives**

Name	Description	Implications
Travel time	Any time devoted to travel.	This is the least specific definition.
Clock time	Objectively measured travel time.	This is how time is usually quantified.
Perceived time[6]	Travel time as experienced by users	This reflects traveller comfort.
Work (*commercial* or *on-the-clock*)	Time spent travelling when workers are being paid (deliveries, traveling to worksites etc.).	This tends to have high value.
Personal travel time	Time devoted to personal travel (commuting, errands, etc.).	This is usually the largest category of travel time.
Generalized costs	Combined travel time and financial costs.	How time is considered in traffic models.
Effective speed[7]	Time spent traveling, earning money to pay travel expenses, and performing support services such as vehicle cleaning.	Travel speeds are slower for more expensive modes and lower-wage workers.

This table summarizes various perspectives for valuing travel time and travel time savings.

Conventional planning tends to overlook some travel time factors.

- Trips should be measured door-to-door, taking into account access and waiting time, which typically requires 10-15 minutes for public transit and ridesharing trips.[8] This means that service frequency affects public transit speeds, and response times affect taxi and ridehailing travel speeds since they affect average waiting times.
- Vehicle travel requires time for support activities such as vehicle cleaning, fueling, repositioning, maintenance, and licensing, The *American Time Use Survey*, which classifies these as *auto per se*, estimates that they average 5-10 minutes per day per motorist, adding 16% to total automobile travel time.[9]
- Roadway construction can cause traffic delays that offset a portion of time savings. One study found that typical major highway projects require 3 to 10 years for future time savings to offset their construction delays,[10] and since the additional capacity usually fills with induced traffic within a few years, many never achieve net travel time savings.

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[6] Tim Rowland and Deborah McLeod (2017), *Travel Time Savings and Speed: Actual and Perceived*, Report 568, New Zealand Transport Authority (www.nzta.govt.nz); at https://bit.ly/3DlPXMN.

[7] 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 https://bit.ly/36g5oa9.

[8] Richard H. Pratt (1999), *Traveler Response to Transportation System Changes*, TCRP Web Document 12 DOT-FH-11-9579 (www.trb.org); at http://onlinepubs.trb.org/Onlinepubs/tcrp/tcrp_webdoc_12.pdf

[9] Sherman Lewis, Emilio Grande and Ralph Robinson (2020), *The Mismeasurement of Mobility for Walkable Neighborhoods*, Mineta Transportation Institute (https://transweb.sjsu.edu); at https://bit.ly/38BZEZA.

[10] Barbara McCann, et al. (1999), *Road Work Ahead; Is Construction Worth the Wait*, Surface Transport Policy Project (www.transact.org); at http://transact.org/wp-content/uploads/2014/04/Road_Work_Ahead.pdf.

Criticisms and Challenges

Conventional travel time valuation is criticized for several reasons.[11, 12, 13, 14, 15]

Planning often uses time values that are higher than most travellers are willing to pay for marginal time savings. Transportation agencies typically value personal travel time at 35% to 80% of average wages, but when tested with optional tolls that allow motorists to avoid congestion delay, average willingness to pay is generally much less, indicating that travellers often prefer to save money rather than time. Highway improvement projects that are justified by excessive time values are economically inefficient; their benefits are less than their costs.

Conventional planning is also criticized for failing to recognize the diversity of travel time values, and for failing to account for qualitative factors such as travel comfort and convenience. Accounting for these factors can justify more investments to improve convenience and comfort, particularly for active and public transport. Accounting for the diversity of time values would justify more traffic prioritization that favors higher time value trips, such as freight and HOV lanes that favor high time value vehicles, and road tolls that allow travellers to avoid congestion when making urgent trips.

Conventional planning is criticized for assuming that increased travel speeds provides travel time savings. This fails to account for fixed travel time budgets, and therefore the tendency of higher travel speeds to result in more travel distances rather than actually saving travel time. In fact, roadway expansions that are justified based on the assumption that they will provide travel time savings often result in more households locating in sprawled areas where residents spend *more* time travelling, as described in the box titled, *The Travel Time Paradox*.

Planning generally fails to account for the increased external costs (traffic and parking congestion, barrier effect, road and parking facility costs, traffic risk, and pollution emissions) that result from master travel that induces additional vehicle travel and increases sprawl. Accessibility-based analysis recognizes non-auto travel demands, and

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[11] David Hensher (2019), "Using the Average Wage Rate to Assess the Merit of Value of Travel Time Savings: A Concern and Clarification," *Findings*, February (https://doi.org/10.32866/5772).

[12] Todd Litman (2021), *Not So Fast: Better Speed Valuation for Transport Planning*, Victoria Transport Policy Institute (www.vtpi.org); at www.vtpi.org/nsf.pdf.

[13] Cornelis Dirk van Goeverden (2022), "The Value of Travel Speed," *Transportation Research Interdisciplinary Perspectives*, Vo. 13 (https://doi.org/10.1016/j.trip.2021.100530).

[14] Robert Cervero (2011), *Going Beyond Travel-Time Savings*, World Bank (www.worldbank.org); at https://bit.ly/378st04.

[15] David Metz (2008), "The Myth of Travel Time Saving," *Transport Reviews*, Vol. 28/3, pp. 321- 336 (doi/abs/10.1080/01441640701642348).

ways that higher traffic speeds tend to reduce other accessibility factors such as non-auto travel conditions, transportation affordability, and geographic proximity.[16]

For example, conventional planning considers the time savings provided by wider roads with higher design speeds, but generally ignores the barrier effect delay that those decisions impose on active modes (chapter 5.13), or the reduction in proximity caused by sprawled development. Planning that favors traffic speeds over other accessibility factors is unfair and harmful to people who for any reason cannot drive, should not drive, or prefer not to drive for most trips. More comprehensive travel time valuation tends to give more priority to slower modes, lower traffic speeds, and more compact development, and therefore tends to help disadvantaged groups.

Conventional planning is criticized for overstating the productivity gains from faster traffic. Once a region has a basic highway network and a moderate level of vehicle travel (typically 4,000 to 8,000 annual vehicle-miles per capita), additional roadway expansions and vehicle travel provide negative productivity gains, apparently because their total benefits are less than their total costs, including indirect and external costs.[17]

Equity-based planning recognizes the diminishing marginal benefits provided by mobility, which means that improved mobility for mobility constrained people (people with disabilities, now incomes, and non-drivers in general) provide greater total benefits than the same mobility gains by people who are already highly mobile.

The table below summarizes effects of higher travel time values.

Table 5.2.3-1 **Effects of Higher Travel Time Values**[18]

Impacts	Better	Worse
Modes and facilities.	Favors faster modes such as automobile and aviation, and higher roadway design speeds.	Reduces investments in slower modes, such has walking, bicycling and public transit.
Travellers	Favors high-mobility travelers (people who drive and fly a lot)	Reduces services and safety for people who cannot, should not, or prefer not to drive for most trips.
Land use patterns	Favors lower-density, automobile-oriented urban fringe development.	Justifies more urban highways and parking supply that discourage compact infill.
Impacts	Increases vehicle travel speeds, and opportunity for motorists.	Reduces affordability, safety, non-drivers' accessibility, resource consumption, and environmental quality.

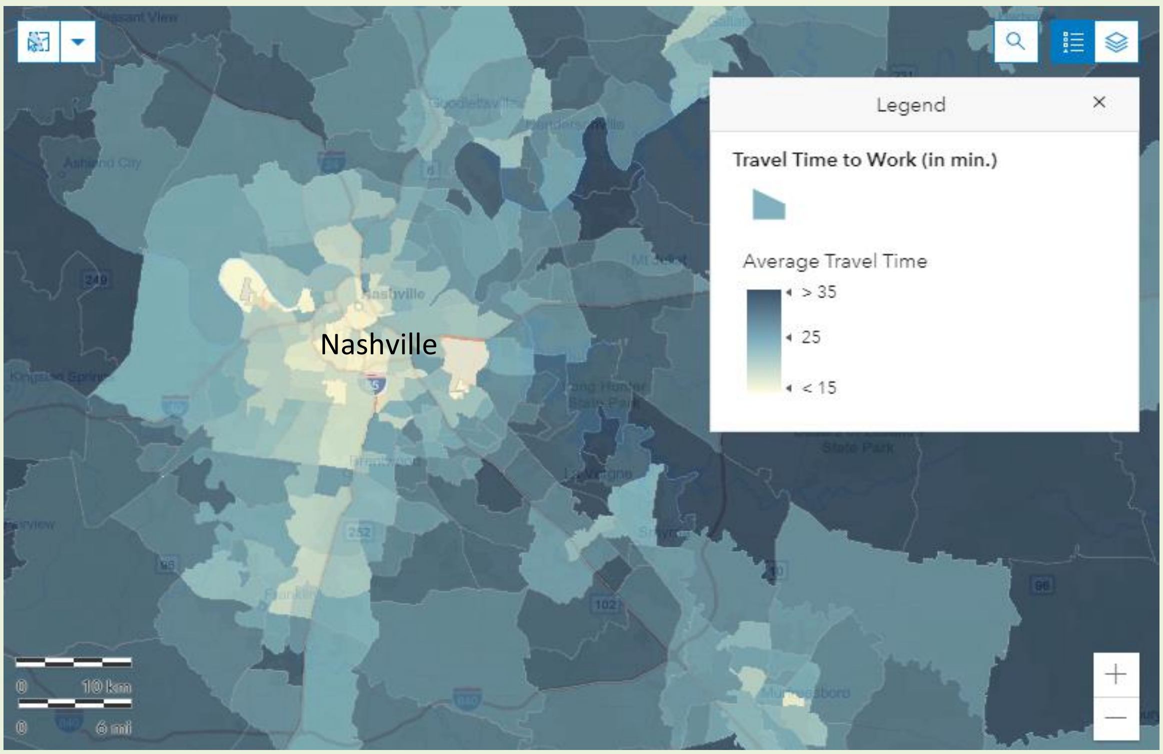
Higher travel time values favor faster modes, higher roadway design speeds and dispersed development.

[16] David Levinson and David King (2020), *Transport Access Manual: A Guide for Measuring Connection between People and Places*, University of Sydney (https://ses.library.usyd.edu.au); at https://hdl.handle.net/2123/23733.
[17] Todd Litman (2014), *The Mobility-Productivity Paradox: Exploring the Negative Relationships Between Mobility and Economic Productivity*, ITED Conference; at www.vtpi.org/mob_paradox.pdf.
[18] Litman (2021).

The Travel Time Paradox

Highway expansion projects are often justified based on the assumption that they will reduce traffic congestion and increase traffic speeds, but they often do the opposite. Over the long run highway expansions often increase total amount of time that residents spend travelling because they create more dispersed development patterns where travel distances are longer and there are fewer non-auto travel options.

A good way to illustrate this is to examine *Commute Duration Dashboard* (https://bit.ly/3Pv3zfr) heatmaps, such as the one below for the Nashville, Tennessee, a typical U.S. urban region. It shows that residents of central urban neighborhoods spend about half as long commuting to work as residents in urban-fringe areas, despite the fact that roads in outlying areas have higher traffic speeds and less congestion.



Central area residents have much shorter-duration average commute that at the urban fringe.

This indicates that, by encouraging residents to move to more sprawled, automobile-dependent areas, urban fringe highway expansions tend to increase the total amount of time residents spend travelling. Those highway expansions may allow some households to purchase homes on larger parcels of land, but it is inaccurate to claim that they provide time savings.

To minimize travel time costs, transportation agencies should ensure that any household that wants can find suitable homes in central areas.

Costs of Speed

Faster modes and higher operating speeds tend to require more expensive vehicles and infrastructure, impose more congestion, cause more crash risk, require more energy and produce more pollution than slower modes and speeds. The table below summarizes these impacts.

Table 5.2.3-2 **Costs of Increased Travel Speeds**[19]

Impact Category	Effects of Higher Speeds
Traveler stress and comfort	Higher traffic speeds tend to increase driver stress and reduce passenger comfort.
Vehicle costs	Faster modes have higher costs. A motorcycle or automobile costs an order of magnitude more than a bicycle.
Infrastructure costs	Roads designed for low speed traffic cost much less than high-speed highways that have wider lanes and grade-separated intersections. Automobiles also require costly parking facilities at each destination.
Congestion	As speeds increase vehicles require more shy distance (clearance from other objects). An increase from 20 to 60 mph approximately triples a vehicle's space requirements. This increases congestion imposed on other road users and infrastructure costs.
Crash costs	Increases crash frequency and severity. The chance of a pedestrian or bicyclists death increases from about 10% at 16 mph up to 90% at 58 mph.
Energy consumption and pollution emissions	Beyond optimal speeds (30 to 50 mph on highways and less on surface streets) increased speed increases energy consumption, noise and pollution emissions.
Barrier effect	Wider roads and higher traffic speeds create barriers to walking and bicycling.
Community livability	Faster traffic tends to degrade the public realm and reduce community livability.
Social equity	Tends to be unfair and regressive (favors wealthier people who use faster modes).
Total vehicle travel	Faster travel tends to increase total vehicle travel. A 10% increase in speed generally increases affected vehicle travel by 10%, due to fixed travel time budgets.

Higher speeds have various impacts on travellers and communities.

Conventional planning tends to overlook or undervalue many of these impacts. For example, the *Manual on Uniform Traffic Control Devices* applies the "85th Percentile Rule," which means that speed limits are often set by the 15% of drivers who exceed posted limits, with little consideration to other impacts.[20] The Transportation Research Board's *Development of a Posted Speed Limit Setting Procedure and Tool*, considers trade-offs between travel time and crash risk, but overlooks other impacts, including induced vehicle travel and the resulting increases in external costs.[21]

[19] Litman (2021).

[20] Sara C. Bronin and Gregory H. Shill (2021), "Rewriting Our Nation's Deadly Traffic Manual," *Harvard Law Review F*, Vo. 135, p. 1; at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3946749.

[21] Eric Sundquist (2020), *California Highway Projects Face Review for Induced Travel*, State Smart Transportation Initiative (www.ssti.us); at https://bit.ly/2VW5pev.

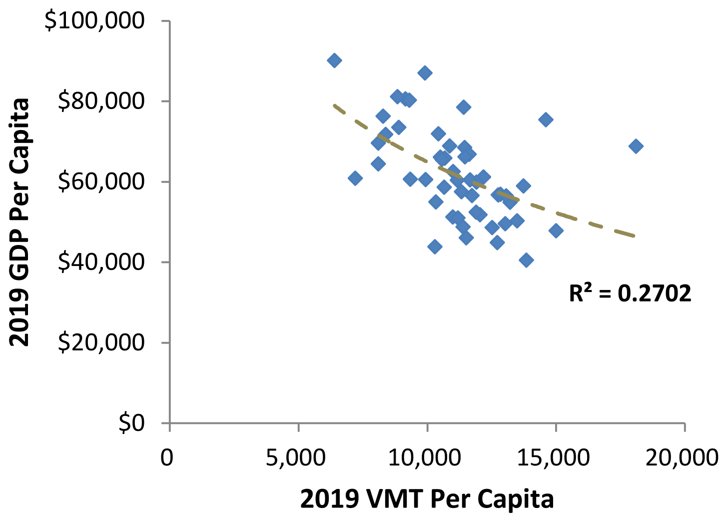
Quantification Methods

The following methods are used to monetize (measured in monetary units) travel time costs.[22]

Economic Productivity

This method, called the cost savings approach (CSA), assumes that travel time savings increase economic productivity by allowing employees to work more hours, and by expanding the pools of jobs available to workers and workers available to employers. However, although there is evidence that productivity increases with city size and density,[23] and therefore accessibility, there is little evidence that it increases with marginal increases in traffic speeds.[24] Once a region has a basic roadway network, productivity tends to *decline* with increased road supply and vehicle travel, as illustrated below, suggesting that any benefits of faster modes are offset by increased costs.[25]

Figure 5.2.3-3 **Per Capita GDP and VMT For U.S. States** (FHWA 2020)



Per capita economic productivity increases as vehicle travel declines. (Each dot is a U.S. state.)

This and other research indicate that beyond an optimal level, increases in per capita vehicle travel reduce productivity because their marginal costs exceed their marginal benefits.

Revealed Preference

This approach infers the value that travellers place on time by their responses to trade-offs, for example, when motorists can choose to pay a toll for a faster trip, or a transit passenger can pay a premium for an express fare. Many of the values described in this report are based on revealed preference studies.

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22 Kenneth Small (2012), "Valuation of Travel Time," *Economics of Transportation*, (DOI 10.1016/j.ecotra.2012.09.002); at www.socsci.uci.edu/~ksmall/VOT%20review.pdf.

23 Rüdiger Ahrend, Alexander C. Lembcke and Abel Schumann (2017), "The Role of Urban Agglomerations for Economic and Productivity Growth," *International Productivity Monitor*, No. 32 (www.csls.ca); at www.csls.ca/ipm/32/Ahrend_Lembcke_Shumann.pdf.

24 Marlon G. Boarnet, et al. (2017), *The Economic Benefits of Vehicle Miles Traveled (VMT)-Reducing Placemaking: Synthesizing a New View*, National Center for Sustainable Transportation (https://ncst.ucdavis.edu); at https://escholarship.org/uc/item/5gx55278.

25 Litman (2014).

Stated Preference

This investigates the value people place on travel time using surveys that typically involve scenarios requiring trade-offs between time, money and comfort, for example, the amount they would pay for faster travel, or whether they would choose a slower but more comfort option.[26, 27] This is considered less reliable than revealed preference studies but allows researchers to consider currently non-existent options.

Travel Impact Modelling

Some studies analyze how changes in users' travel time affect travel activity, and therefore the elasticity (or coefficient) values that should be used in transportation models.[28] These generally indicate that elasticities of vehicle travel with respect to time range from -0.5 to -1.0, meaning that a 10% reduction in travel time increases travel distances by 5% to 10%.

Special consideration is needed to account for variations in travellers' needs and abilities when valuing their travel time costs. For example, a lower-income working single parent may be both time and money poor, and so could benefit significantly from accessibility improvements such as faster public transit, occasional car travel, or an affordable home in a high access neighborhood. Conventional travel time valuation methods, which focus on vehicle traffic time costs, give little consideration to these factors, as summarized below.

Table 5.2.3-3 **Variations in Travellers Needs and Abilities**[29]

	Time Poor	Time Rich
Money Poor	*Example: A low-income working single parent with little time or money.* Has little ability to pay, but benefits significantly from faster travel.	*Example: Retiree with a modest pension who has plenty of time but little money.* May value convenience and comfort more than speed.
Money Rich	*Example: High income professional with many work and family obligations.* High ability to pay. Their needs are well recognized in conventional time valuation.	*Example Affluent retiree with plenty of time and money.* Has high ability to pay. Their needs are well recognized in conventional time valuation.

People's mobility needs and abilities vary. Conventional travel time valuation methods often give little consideration to factors such as the needs of low-income workers or the importance of comfort.

26 Neil Douglas (2021), *Australian Transport Assessment and Planning Guidelines M1 Public Transport*, Australian Transport Assessment and Planning (www.atap.gov.au); at https://bit.ly/3tAZn4R.
27 Richard Batley, et al. (2019), "New Appraisal Values of Travel Time Saving & Reliability in Great Britain," *Journal of Transportation* (DOI 10.1007/s11116-017-9798-7); at https://bit.ly/3JpBNwK.
28 Mark R. Wardman (2022), "Meta-Analysis of British Travel-Related Demand Elasticity Evidence: an Update," *Transportation Research Part A*, Vol. 157, pp. 198-214 (https://doi.org/10.1016/j.tra.2022.02.001).
29 ITF (2019), *What is the Value of Saving Travel Time?*, ITF Roundtable Reports, No. 176, (www.itf-oecd.org); at www.itf-oecd.org/what-value-saving-travel-time.

Cost Variables

Below are factors that can affect travel time cost valuation.[30,31]

- *Travel purpose.* Work (also called *paid*, *commercial* or *on-the-clock*) travel time costs include driver wages and benefits, plus the value of vehicle and cargo time. This assumes that savings of this travel time can increase economic productivity, for example, by allowing vehicles and employees to make more trips and accomplish more work per day.

  Commute travel has high value and tends to be constrained in destination and time, and so tends to have high time costs, particularly for unexpected delays. Most errand trips have moderate value and flexibility, but a small portion is urgent with high time values. Social and recreational travel tends to have low time costs, and includes some travel with zero or negative marginal time costs (travellers enjoy the activity).

- *Traveller income.* Most experts assume that personal travel time unit costs increase with income, based on the assumptions that higher-income travellers have higher opportunity costs (the time they save could provide greater productivity gains) and they have greater willingness-to-pay (lower-income travellers are more likely to choose to save money rather than time). Personal travel time is usually estimated at 25% to 70% of prevailing wages, but varies by factors such as type of trip, traveler preferences and conditions.

  However, many transportation agencies apply the same values of time to lower- and higher-income groups (such as motorists and transit passengers) for equity sake, assuming that lower-income groups deserve an equal share of public investments.

- Personal time costs tends to increase with passenger discomfort, stress and insecurity.[32]
  - For pedestrians and bicyclists, travel time unit costs increase with proximity to traffic noise and risk, perceived crime risks, and declines with comfort factors such as shade.
  - For public transit users time costs increase with crowding and seating comfort, uncomfortable heat or cold, exposure to perceived crime risk, and inconvenience that adds stress.
  - For motorists, travel time unit costs tend to increase with congestion and arrival uncertainly, and are particularly high for unexpected delays.[33] A U.S. FHWA study identified various indicators of travel reliability, such as the *90th or 95th percentile travel times*, which reflects the longest travel time during a ten or twenty day period, and the *buffer index*, which reflects the extra time travelers must add to their average travel time to ensure on-time arrival. Those extra minutes are called the *buffer time*.

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[30] Ian Wallis, K. Rupp and R. Alban (2015), *Travel Time Saving Assessment*, The New Zealand Transport Agency (www.nzta.govt.nz); at https://bit.ly/2yJryEp.

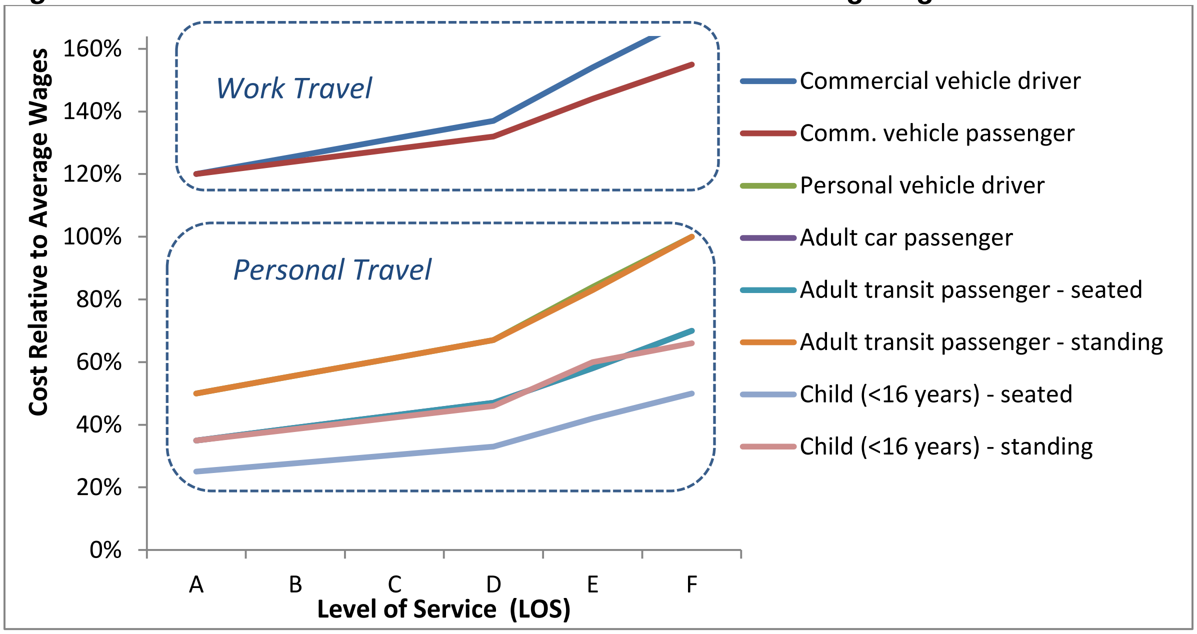
[31] Small (2012).

[32] 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.

[33] SSHRP (2014), *Estimation and Use of Value of Travel Time Reliability for Multi-Modal Corridor Analysis*, L35A, Second Strategic Highway Research Program (SHRP 2); at http://tinyurl.com/lza3jdm.

These factors can be quantified using level-of-service (LOS) rating systems. The figure below illustrates how estimated travel time unit costs increase with roadway LOS ratings.

Figure 3.2.3-3 **Travel Time Values Relative to Prevailing Wages**[34]



This illustrates how estimated time values are affected by travel conditions, measured using level-of-service ratings. Work time (when travellers are being paid) has higher value than personal travel.

- Some travel time has low costs or positive value because users enjoy the experience,[35, 36] or value active travel (walking and bicycling) health benefits.[37] Time costs tend to be low for the first 60 daily minutes of travel and increase significantly beyond about 90 minutes.[38] Ideal travel times are longer for active, leisure, sociable, productive and restful travel.[39]
- Under favorable conditions, public transit travel time can be enjoyable and productive,[40] but are very high when transit vehicles are uncomfortable or crowded.[41]

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[34] Todd Litman (2008), "Valuing Transit Service Quality Improvements," *Journal of Public Transportation*, Vol. 11, No. 2, Spring 2008, pp. 43-64; at www.vtpi.org/quality.pdf.
[35] OECD (2019), *Zero Value of Time Roundtable*, International Transport Forum (www.itf-oecd.org); at www.itf-oecd.org/zero-value-time-roundtable.
[36] Yannick Cornet, et al. (2021), "Worthwhile Travel Time: A Conceptual Framework of the Perceived Value of Enjoyment, Productivity and Fitness While Travelling," *Transport Reviews* (10.1080/01441647.2021.1983067).
[37] Christopher Standen (2018), *The Value of Slow Travel: An Econometric Method for Valuing the User Benefits of Active Transport*, Dissertation, University of Sydney (https://ses.library.usyd.edu.au); at https://bit.ly/2EkA0Ym.
[38] Jonas De Vos, Huyen T.K. Le and Maarten Kroesen (2022), "Does Commute Duration Attenuate the Effect of Travel Mode Choice on Commute Satisfaction?," *Travel Behaviour and Society* (doi.org/10.1016/j.tbs.2022.02.004).
[39] T.K. Le Huyen, et al. (2020), "Expanding the Positive Utility of Travel Through Weeklong Tracking," *Journal of Transport Geography*, Vol. 84 (doi.org/10.1016/j.jtrangeo.2020.102679).
[40] OECD (2019).
[41] Marco Batarce, Juan Carlos Muñoz and Juan de Dios Ortúzar (2016), "Valuing Crowding in Public Transport," *Transportation Research A*, Vo. 91, pp. 358–378 (dx.doi.org/10.1016/j.tra.2016.06.025).

5.2.6 Reviews and Meta Analyses

This section describes some major travel time cost review studies.

- *Australian Transport Assessment and Planning Guidelines M1 Public Transport: Parameter Values Technical Report* is a comprehensive (137 page) review of travel time valuation theory and practice for planning analysis, with emphasis on Australian and New Zealand evidence.[42] It summarizes and compares results from previous studies and official guidelines, and provides recommendations for values of time for various trip purposes (work, commuting and other), modes, travel conditions (congested and uncongested), and transit service conditions that affect passenger convenience and comfort. It found that 2019 travel time values are $14.20/hr for Australia and $NZ 9.90/hr for NZ; peak travel values are a fifth higher than for off-peak travel, and commuting values are 15% higher than overall averages; and for Australia the value of time was $16.00/hr for rail, $14.50/hr for tram/LRT, $12.30/hr for bus, and $20.80/hr for ferry.

- The *Synthesis of Research on Value of Time and Value of Reliability* compiled and synthesize research on the value of time (VOT) and the value of reliability.[43] Based on this information the researchers recommend valuing work travel at 100% of the driver's wages plus benefits, personal travel time (including commuting) at 50% of prevailing wage rate, and transit travel at 25-35% of wages under comfortable conditions (when sitting), but significantly higher in crowded transit vehicles (100% of wage rate) or for waiting under unpleasant conditions (up to 175% of wage rate).

- The British Department for Transport (DfT) sponsors extensive research on travel valuation and modelling, including travel time costs.[44] A comprehensive 2015 study recommended new travel time cost analysis methods and values to use in the UK's Transport Analysis Guidance (TAG), which specifies how transportation projects should be evaluated.[45]

- A meta-analysis estimated UK travel time elasticities which indicate how changes in travel speed affect the amount that people will travel by various modes.[46] It found long run elasticities of -0.47 for car travel, -0.53 for bus, and -0.71 for train travel. Long-run effects are typically 2.3 times short-run effects.

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[42] Neil Douglas (2021), *Australian Transport Assessment and Planning Guidelines M1 Public Transport: Parameter Values Technical Report*, ATAP (www.atap.gov.au); at https://bit.ly/3tAZn4R.

[43] Sisinnio Concas and Alexander Kolpakov (2009), *Synthesis of Research on Value of Time and Value of Reliability*, National Center for Urban Transportation (www.cutr.usf.edu); at https://bit.ly/3LVsO8p.

[44] *Transport Appraisal and Strategic Modelling (TASM) Research* (https://bit.ly/3unBLBi).

[45] DfT (2015), *Understanding and Valuing Impacts of Transport Investments: Values of Travel Time Savings*, UK Department for Transport (www.gov.uk); at http://bit.ly/1StAmO8.

[46] Wardman (2022).

- Abrantes and Wardman performed a detailed review of UK time valuation studies.[47] It concludes that the GDP elasticity is 0.9 (a 10% increase in productivity increased time values 9%), which justifies increasing time cost values with income. They find that time spent in congested traffic conditions is valued 34% more than in free flow traffic, walk and wait time are valued at somewhat less than twice in-vehicle time, and all else being equal, bus travel time costs are slightly higher than other modes.

- Waka Kotahi, New Zealand's Transport Agency, has sponsored extensive research on how travellers value time.[48] Their *Monetised Benefits and Costs Manual*, includes travel time values for vehicle occupants and vehicle and freight-time costs, that vary by road type (urban arterial, urban other, rural strategic and rural other roads) and travel condition (uncongested and congested), and other factors. [49]

- "Advances in the Valuation of Travel Time Savings," was a special issue of the journal *Transportation Research Part E*, published in 2001.[50] It contained articles by leading researchers concerning emerging research methods and results, trends in travel time valuation, and the transferability of travel time values by time and location.

- Dam, et al (2022), found that commute travel time savings that result when people work at home was devoted to a combination of additional time working, sleeping and leisure, including increases in out-of-home leisure activities that often increase travel.[51]

- A meta-analysis of 90 Value of Travel Time Savings (VTTS) studies performed in Europe, North-America and Australia found 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.[52]

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[47] Pedro A.L. Abrantes and Mark R. Wardman (2011), "Meta-analysis of UK values of travel time: An update," *Transportation Research Part A*, Vol. 45, pp. 1–17.

[48] *Waka Kotahi Reports* (www.nzta.govt.nz/resources/research/reports).

[49] Waka Kotahi (2021), *Monetised Benefits and Costs Manual*, New Zealand Transport Agency (www.nzta.govt.nz); at www.nzta.govt.nz/resources/monetised-benefits-and-costs-manual.

[50] Mark Wardman and William G. Waters II (2001), "Advances in the Valuation of Travel Time Savings," *Transportation Research Part E*, Volume 37, Issues 2-3, Pages 85-251 (April – July); at https://bit.ly/3v2AqPp.

[51] David Dam, et al. (2022), "What Have Workers Done with the Time Freed up by Commuting Less?," *Liberty Street Economics*, Federal Reserve Bank of New York (https://libertystreeteconomics.newyorkfed.org); at https://nyfed.org/3eUSXcF.

[52] Luca Zamparini and Aura Reggiani (2007), "Meta-Analysis and the Value of Travel Time Savings," *Networks and Spatial Economics* (DOI: 10.1007/s11067-007-9028-5).

5.2.7 Monetary Estimates

- *Australian Transport Assessment and Planning Guidelines* incorporates detailed analysis of travel time values based on extensive original research.[53] It values private travel time at 40%, and business travel at 130% of seasonally adjusted average wages, with various adjustments based on travel convenience and comfort factors. The table below summarizes some of its travel time values.

Table 5.2.7-1 **Australian Travel Time Values** (2013 Aus. Dollars)[54]

	Non-urban		Urban		Freight Travel Time	
	Occupancy rate	Value per occupant	Occupancy rate	Value per occupant	Non urban	Urban
Vehicle type	persons/veh	$/person-hour	persons/veh	$/person-hour	$/vehicle-hour	
Cars (all types)						
Private	1.7	$14.99	1.6	$14.99	na	na
Business	1.3	$48.63	1.4	$48.63	na	na
Utility vehicles						
Courier Van-Utility	1	$25.41	1	$25.41	na	na
4WD Mid Size Petrol	1.5	$25.41	1.5	$25.41	na	na
Rigid trucks						
Light Rigid	1.3	$25.41	1.3	$25.41	$0.78	$1.53
Medium Rigid	1.2	$25.72	1.3	$25.72	$2.11	$4.15
Heavy Rigid	1	$26.19	1	$26.19	$7.22	$14.20
Buses						
Heavy Bus (driver)	1	$25.72	1	$25.72	$0.00	na
Heavy Bus (passenger)	20	$14.99	20	$14.99	$0.00	na
Articulated trucks						
Artic 4 Axle	1	$26.81	1	$26.81	$15.53	$30.59
Artic 5 Axle	1	$26.81	1	$26.81	$19.80	$39.01
Artic 6 Axle	1	$26.81	1	$26.81	$21.36	$42.06
Combination vehicles						
Rigid + 5 Axle Dog	1	$27.20	1	$27.20	$30.53	$62.99
B-Double	1	$27.20	1	$27.20	$31.46	$64.91
Twin steer + 5 Axle	1	$27.20	1	$27.20	$29.50	$60.89
A-Double	1	$27.98	1	$27.98	$41.31	$85.25
B Triple	1	$27.98	1	$27.98	$42.17	$87.01
A B Combination	1	$27.98	1	$27.98	$50.79	$104.80
A-Triple	1	$28.45	1	$28.45	$60.89	$125.64
Double B-Double	1	$28.45	1	$28.45	$61.59	$127.09

The Australian Transport Assessment and Planning Guidelines includes detailed travel time savings values.

[53] Neil Douglas (2021), *Australian Transport Assessment and Planning Guidelines M1 Public Transport: Parameter Values Technical Report*, ATAP (www.atap.gov.au); at https://bit.ly/3tAZn4R.

[54] ATAP (2013), *Value of Travel Time for Vehicle Occupants*, Australian Transport Assessment and Planning (www.atap.gov.au); at www.atap.gov.au/parameter-values/road-transport/3-travel-time.

- The UK Department for Transport (DfT) commissioned extensive research concerning travel time valuation.[55] It found that in 2010, travellers valued commute time at about £10 per hour, and non-commute time at £4.57, with higher rates for longer journeys. Much of this information is incorporated into the *Transport Analysis Guidance* (TAG) linked spreadsheets that automate project evaluation calculations. The table below summarizes a small portion of its travel time values.

Table 5.2.7-2 **British Travel Time Values** (2010 £ per hour)[56]

Mode	Cost Factor
Work Travel	
Car driver	£14.86
Car passenger	£14.86
LGV (driver or passenger)	£10.52
OGV (driver or passenger)	£12.13
PSV driver	£11.94
PSV passenger	£8.42
Taxi driver	£11.50
Taxi / Minicab passenger	£14.86
Rail passenger	£24.52
Underground passenger	£8.42
Walker	£8.42
Cyclist	£8.42
Motorcyclist	£14.86
Average of all working persons	£16.19
Non-Work Travel	
Commuting	£8.36
Other	£3.82

- A team of UK researchers used various surveys to measure travellers' willingness-to-pay (WTP) for travel time savings.[57] Compared with previous studies they found higher values for commute time costs but lower values for other personal travel. The WTP for business travel time savings show marked variation by distance; for trips of less than 20 miles, values are around 75% lower than previous values; for trips of around 100 miles, WTP-based values are comparable to previous values; and for longer trips still, WTP-based values exceed previous estimates.

[55] DfT (2015), *Understanding and Valuing Impacts of Transport Investments: Values of Travel Time Savings*, UK Department for Transport (www.gov.uk); at http://bit.ly/1StAmO8.
[56] DfT (2006-2020), "Spreadsheet Tab A.1.3.1," *Transport Analysis Guidance*, UK Department for Transport (www.dft.gov.uk); at www.gov.uk/guidance/transport-analysis-guidance-webtag.
[57] Richard Batley, et al. (2019), "New Appraisal Values of Travel Time Saving & Reliability in Great Britain," *Journal of Transportation* (DOI 10.1007/s11116-017-9798-7); at https://bit.ly/3JpBNwK.

- The New Zealand Transport Agency's *Monetised Benefits and Costs Manual*, includes detailed guidance on how to value travel time savings.[58] The table below summarizes some of their default values.

Table 5.2.7-3 **Values of Time for Transport Modelling Purposes** (2002 NZ$/h)[59]

Mode	Work Travel	Commute Trips	Other Trips
Car, motorcycle driver	$23.85	$7.80	$6.90
Car, motorcycle passenger	$21.70	$5.85	$5.20
Light commercial driver	$23.45	$7.80	$6.90
Light commercial passenger	$21.70	$5.85	$5.20
Medium/heavy commercial driver	$20.10	$7.80	$6.90
Medium/heavy commercial passenger	$20.10	$5.85	$5.20
Seated bus and train passenger	$21.70	$4.70	$3.05
Standing bus and train passenger	$21.70	$6.60	$4.25
Pedestrian and cyclist	$21.70	$6.60	$4.25

This table summarizes travel time values used by New Zealand transport agencies.

- Swedish researchers investigated travel time costs for walking, bicycling and riding transit under various conditions.[60] Median walking values ranged from 79 SEK/h (US$12/h) on a separated path with good visibility up to 239 SEK/h (US$37/h), for walking to access another mode along a high-speed roadway. Median bicycling values ranged from 241 SEK/h (US$37/h) in mixed traffic, 249 SEK/h (US$38/h) on a bicycle lane in the road way, 178 SEK/h (US$27/h) on a bicycle path next to the road, and 167 SEK/h (US$26/h) on a bicycle path far from the road. Public transit passengers are willing to pay SEK 12—32 ($1.30-3.50) per hour to change from 8 standing passengers per square meter to being seated, depending on conditions.[61]

- The USDOT's *Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis,* describes how U.S. transportation agencies should value travel time. It reviews travel time valuation literature (although it only considers pre-2010 studies, including an older version of this report) and concludes that travel time values are affected by trip purpose, traveller characteristics (including income), mode, trip distance and comfort. The table below summarizes recommended value ranges. It recommends that walking and waiting be valued at 100% of wages.

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[58] Waka Kotahi (2021), *Monetised Benefits and Costs Manual*, New Zealand Transport Agency (www.nzta.govt.nz); at www.nzta.govt.nz/resources/monetised-benefits-and-costs-manual.
[59] Waka Kotahi (2021), p. 66.
[60] Gunilla Björklund (2014), *Valuation of Travel Time Savings in Pedestrian and Bicycle Trips*, Swedish National Road and Transport Research Institute (VTI); at http://tinyurl.com/q3mvzcc.
[61] Gunilla Björklund and Jan-Erik Swärdh (2015), *Valuing In-vehicle Comfort and Crowding Reduction in Public Transport*, Paper 2015:12, Swedish National Transport Research Institute (VTI); at https://bit.ly/3ujjZPL.

Table 5.2.7-4 **USDOT Travel Time Savings Values** (2015)[62]

Category	Ranges	Recommended	
	Percent of Wages		2015 Dollars
Local Travel			
Personal	35-60%	50%	$13.60
Business	80-120%	100%	$25.40
Intercity Travel			
Personal – Surface modes	60-90%	70%	$19.00
Business – Surface modes	80-120%	100%	$25.00
Personal – Air & High Speed Rail	60-90%	70%	$36.10
Business – Surface modes	80-120%	100%	$63.20
Truck drivers	80-120%	100%	$27.20
Bus drivers	80-120%	100%	$28.30
Transit rail operators	80-120%	100%	$46.10
Locomotive engineers	80-120%	100%	$41.60
Airplane pilots and engineers	80-120%	100%	$86.70

This table summarizes USDOT travel time cost values.

Revealed Willingness to Pay

Some studies evaluate motorists' willingness to pay to avoid congestion delays. They indicate that a minority of motorists will pay significant tolls to save travel time, but average values are relatively low.[63] For example, on Houston's Katy Freeway toll lanes, 11% of motorists pay optional tolls worth approximately $40 per travel-hour saved, but the average for all motorists on the highway ranged from $1.96 to $8.06 per hour.[64] Similarly, about less than a third of motorists on Miami's I95 pay optional tolls worth approximately $32 per hour saved, or 50% of drivers' wage rates.[65]

Some studies find higher willingness to pay for time savings, but these generally effect higher-income travellers or higher-value trips. For example, *The Value of Time in The United States: Estimates From Nationwide Natural Field Experiments*, used variations in the price and wait time by Lyft ridehailing passengers to estimate that passengers value marginal delay at $19.38 per hour on average in 2015 dollars.[66] Although the study authors define this as "the" value of time, it actually reflects a more specific and limited scope: the value of time by ridehailing customers (who tend to have relatively high incomes) making relatively high value trips (trips for which they are already committing

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[62] USDOT (2016), *Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis,* U.S. Department of Transportation (www.usdot.gov); at https://bit.ly/3Jfm57p.
[63] David Brownstone and Kenneth 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.
[64] Mark Burris, et al. (2016), *Travelers' Value of Time and Reliability as Measured on Katy Freeway*, Texas A&M Transportation Institute PRC 15-37F; at www.trb.org/Main/Blurbs/174885.aspx.
[65] Virginia Perk, et al. (2012), *Improving Value of Travel Time Savings Estimation for More Effective Transportation Project Evaluation*, Center for Urban Transportation Research; at https://bit.ly/3KADCIs.
[66] Ariel Goldszmidt, et al. (2020), *The Value of Time in the United States: Estimates from Nationwide Natural Field Experiments*, National Bureau of Economic Research (www.nber.org); at www.nber.org/papers/w28208.

to pay many dollars). A study found that ridehailing (Uber and Lyft) users pay more than $50 per hour saved compared with public transit travel, with higher utilization when public transit conditions are poor (difficult to access, crowded, etc.), indicating that travel conditions affect travellers willingness to pay for time savings.[67]

Developing Country Conditions

- A recent study analyzed the valuation of travel time in developing countries for unpaid activities such as collecting water or traveling to health clinics.[68] It examined various methods including contingent valuation (asking travellers what they would choose given various trade-offs between travel time and money) and revealed preference (such as the amount that households pay for water deliveries). It concluded that the common practice of valuing personal travel time at approximately 50% of the household's after-tax wage rates seems to be applicable in low- and middle-income countries.

- Based on an extensive review of international studies, World Bank economist Kenneth Gwilliam recommends the following travel time values for evaluating transportation improvements in developing countries.

Table 5.2.6-3 **Recommended Travel Time Cost Values**[69]

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

This table summarizes recommended travel time values for international development projects.

- I.T. Transport investigated developing country travel time values, based on surveys of travellers' willingness-to-pay for time savings under various conditions.[70, 71] They

[67] Joseph Schwieterman and Mallory Livingston (2018), *Uber Economics: Evaluating the Monetary and Nonmonetary Trade-offs of TNC and Transit Service in Chicago, Illinois*, Chaddick Institute for Metropolitan Development, DePaul University (https://las.depaul.edu); at https://bit.ly/2KpCITA.
[68] Dale Whittington and Joseph Cook (2019), "Valuing Changes in Time Use in Low- and Middle-Income Countries," *Journal of Benefit-Cost Analysis*, Vo. 10/S1, pp. 51 - 72 (DOI: https://doi.org/10.1017/bca.2018.21)
[69] Kenneth Gwilliam (1997), *The Value of Time in Economic Evaluation of Transport Projects; Lessons from Recent Research*, World Bank (www.worldbank.org).
[70] 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 https://bit.ly/3xbSfOR.

find that travel time values vary by gender (men are able to pay more, although women tend to be more time constrained, so equal valuation may be justified for equity sake) and conditions (many travellers are willing to pay more to reduce discomfort). It argues that many personal trips, such as carrying goods to market, are productive actives that should be valued based on wage rates. It concludes that the World Bank's guides for valuing for non-work journeys at 33% of the hourly household income appear to be reasonable.

- Brazilian researchers found the following effective social speeds of local travel modes, which accounts for user money and time costs, plus external costs.

***Table 5.3.7-5* Effective Speed**[72]

Mode	Kms./day	Work hrs/day	Commute hrs./day	Effective Speed (km/hr)	Rank
Private Car	20.084	1.93	1.24	6.34	5th
Motorcycle	22.198	1.44	1.06	8.88	3rd
Public Transport	13.226	0.62	1.91	5.23	6th
Taxi	22.248	1.63	1.00	8.46	4th
Bicycle	15.064	0.06	0.84	16.74	1st
Pedestrians	11.350	0.00	1.04	10.91	2nd

Effective speeds (distance divided by time spent travelling and earning money to pay travel expenses) tend to be higher for walking and bicycling than auto travel, particularly for lower-wage workers.

Effects of New Technologies

Several studies examine how new technologies affect travel time values due if passengers can rest or work in ridehailing, transit autonomous vehicles.

- The International Transport Forum's *What is the Value of Saving Travel Time?* concluded that people often obtain positive utility from work, leisure and resting during travel which reduces a portion of travel time costs.[73] The study estimates that under favorable conditions, such as a comfortable bus, train, or self-driving car, the ability to use travel time productivity can reduce travel time unit costs 20-25%, and autonomous vehicles are likely to increase vehicle travel.
- One study found that motorists tend to be more sensitive to time costs than fuel costs, and so conclude that households that own autonomous vehicles are likely to increase their vehicle travel by 2% to 47% due to travel time cost savings.[74]

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[71] I. T. Transport Ltd. (2005), *The Value of Time in Least Developed Countries: The African Studies*, UK Department for International Development (www.dfid.gov.uk); at https://bit.ly/35ZwYwt.

[72] Leonardo Herszon Meira, et al. (2020), "Measuring social effective speed to improve sustainable mobility policies in developing countries," *Transportation Research D*, Vo. 78 (https://doi.org/10.1016/j.trd.2019.12.002).

[73] Based on ITF (2019).

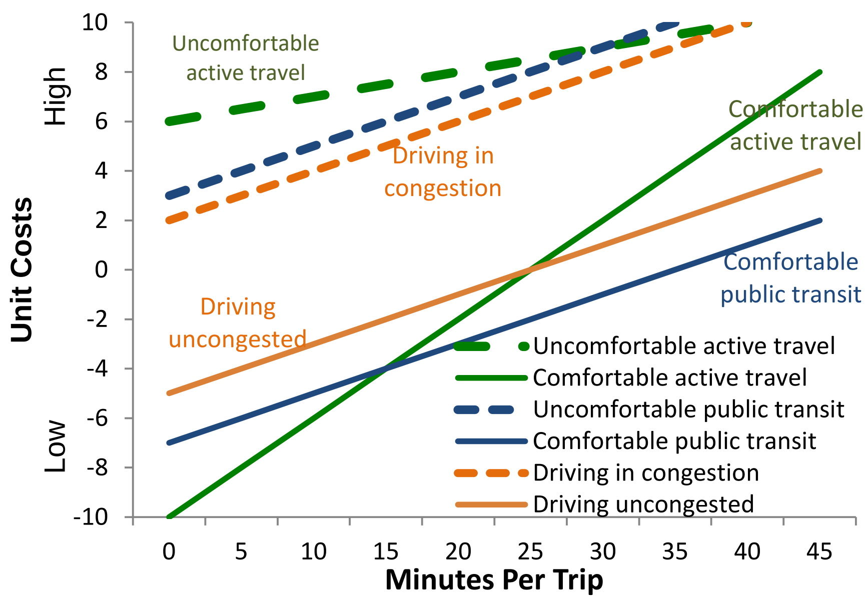
[74] Morteza Taiebat, Samuel Stolper, and Ming Xu (2019), "Forecasting the Impact of Connected and Automated Vehicles on Energy Use: A Microeconomic Study of Induced Travel and Energy Rebound," *Applied Energy*, Vo. 247, pp. 297-308 (https://doi.org/10.1016/j.apenergy.2019.03.174).

- 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 of the time), and place positive utility on such time.[75] 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." Productive activities are higher for business than for commuting or leisure travel, and increases with journey duration.

5.2.9 Variability

Travel time costs vary depending on many factors including trip purpose, travellers' demographics and incomes, and conditions. The figure below illustrates the effects of these factors. Under comfortable conditions most people enjoy short duration trips, particularly active travel (due to enjoyment and exercise) and public transport (because they can rest or work while travelling), resulting in negative cost values (i.e., people want to spend time engaged in that activity). However, under uncomfortable conditions travel has high costs, particularly for longer trips. Of course, these factors vary depending on individual needs and preferences. For example, some days a person may enjoy a slower mode, such as walking or bicycling, but other days prefer a faster mode, such as driving.

Figure 5.2.3-4 **Transport Time Unit Costs Per Trip**



Travel time unit costs (per minute or hour) vary by mode, conditions and trip duration. Under comfortable conditions short trips (typically less than 15 minutes) tend to have negative costs (positive value), particularly for active travel. Costs increase under uncomfortable conditions, particularly for active and public transport trips if travellers experience physical discomfort or stress.

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[75] 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.

5.2.10 Equity and Efficiency Issues

How travel time is valued can have many equity and efficiency impacts. How travel time costs and savings are evaluated in planning significantly affects the allocation of public resources. For example, if planning places a higher value on delays to motor vehicles than to pedestrians and bicyclists, transportation agencies will invest more in automobile facilities and higher speed roadways than if non-auto travel time is given higher values.

Because physically, economically and socially disadvantaged groups tend to rely more than average on slower modes, vertical equity can justify placing higher travel time values on these modes. For example, people with disabilities rely significantly on pedestrian travel, so equity goals can justify placing high value on pedestrian travel time that would justify better sidewalks and crosswalks, traffic signal timing that favors slower-moving pedestrians, and pedestrian shortcuts. Similarly, since many lower-income travellers rely on public transit, vertical equity can justify public transit service improvements, including changes that increase transit travel speeds, and comfort improvements that reduce transit travel unit costs.

More comprehensive travel time analysis evaluates transportation based on accessibility rather than mobility, which and recognizes the door-to-door travel time savings provided by more integrated transportation systems (such as better pedestrian and bicycle access to public transit) and more compact development. This can benefit all travellers, but is particularly beneficial to people who cannot, should not, or prefer not to rely on automobile transportation.

Because faster modes and higher traffic speeds increase external costs, including congestion delay, risk and pollution costs imposed on other people, overvaluing travel time relative to other impacts can have significant equity impacts. These include:[76]

- Higher speed modes require more expensive infrastructure, such as roads and parking facilities, resulting in greater public subsidies to users.
- Higher roadway design speeds benefit motorists but increase delay, risk, noise and pollution imposed on pedestrians and bicyclists.
- Urban highway projects provide time savings to suburban motorists, but displace urban neighborhoods, increasing travel time and transportation costs to former residents.

[76] Todd Litman (2022), "Evaluating Transportation Equity: Guidance for Incorporating Distributional Impacts in Transport Planning," *ITE Journal*, Vo. 92/4, April 2022; comprehensive report at www.vtpi.org/equity.pdf.

5.2.11 Conclusions

Travel time costs are highly variable, including a significant portion of travel with low or negative costs since travelers enjoy the experience, a moderate portion with moderate costs, and a small portion with very high cost values. High-time-value travel includes:

- Paid travel.
- Urgent personal trips.
- Travel under congested or uncomfortable conditions.
- Unexpected delays.
- Longer trips with high daily mileage (more than 90 daily minutes).

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
Work (paid)	Travel by employees when 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).	5-10% (commercial travel)
Personal, high value	Travel that is urgent or causes significant discomfort or stress.	50% wage rates for drivers, 35% of wages for passengers.	10-20%. Some commutes and errands, and some walking, biking and transit travel.
Personal, medium value	Personal travel during which travelers experience no discomfort.	25% wage rates for adults.	40-60%. Typical of errand trips under uncongested conditions.
Low or aero-cost	Travel that users enjoy and so would pay little to reduce their travel time.	No cost.	10-20%. Typical for recreational and some 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)[77] 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 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. In the future, autonomous vehicles may reduce some travelers' time costs from driver (50% of wage rates) to passenger (25% of wage rates).

[77] 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.

Transit and Rideshare Values

A typical transit trip is assumed to require 10-15 minutes for access and waiting. Collecting rideshare passengers is assumed to increase trip duration by 10%. 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, and travel time unit costs can increase as much as 2.5 times in very crowded vehicle (6 standing-passengers/m2) compared with uncrowded vehicles with available seats.

Walking and Cycling Values

Time devoted to walking and bicycling is charged at $3.75 per hour,[78] 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

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

5.2.12 Information Resources

Richard Batley, et al. (2019), "New Appraisal Values of Travel Time Saving & Reliability in Great Britain," *Journal of Transportation* (DOI 10.1007/s11116-017-9798-7); at https://bit.ly/3JpBNwK.

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