5.9 Transportation Diversity

This chapter describes transportation diversity and describes it impacts. Increasing transport diversity can provide various benefits that should be considered in transport planning.

5.9.1 Chapter Index

5.9.2 Definitions

Transportation Diversity (also called *Option Value*[1] or *Transport Choice*) refers to the quantity and quality of transport services available in a particular situation (i.e., at a particular location and time, taking into account a users' needs and abilities).[2] It can include diversity of *modes* (particularly modes suitable for use by people who are physically, economically or socially disadvantaged), *prices* (such as various vehicle and vehicle rental prices), *services* (such as public transit, taxi, and delivery services), and *location options* (such as affordable housing located in accessible locations, and a diverse range of shops near residential and employment areas).

It can be argued that diversity is an neutral attribute that cannot be considered a transportation cost. However, transport diversity affects various costs for individuals and society, or described more positively, improving transport diversity can provide significant benefits that should be considered when evaluating policies and planning options. To the degree that planning decisions involve mutually-exclusive trade-offs between modes (such as in the allocation of road space) it is important to consider the resulting transport diversity impacts.

Many communities are relatively *automobile dependent* (transport systems are optimized for automobile travel to the detriment of other modes) so increasing transport diversity primarily involves improving non-auto travel.

---

[1] DfT (2014), *Social Impact Appraisal, TAG UNIT A4.1*, *Transport Analysis Guidance*, Department for Transport (www.dft.gov.uk); at http://bit.ly/20eDG1M.

[2] Todd Litman (2007), "You Can Get There From Here: Evaluating Transportation Choice," *Transportation Research Record 1756*, TRB (www.trb.org), pp. 32-41; at www.vtpi.org/choice.pdf.

5.9.3 Discussion

Inadequate diversity reduces transportation system efficiency, forcing people to use modes that are not optimal for a particular trip. For example, in automobile dependent communities people must drive even when they would prefer to use alternatives, and drivers are forced to chauffeur non-drivers. This increases economic, social and environmental costs and is particularly harmful to people who are physically, economically and socially disadvantaged, and so are unable to drive. Increasing transportation diversity can provide various benefits:

- *Consumer Benefits.* A more diverse transportation system is able to accommodate a wide ranger of needs and preferences. It provides travel options that allow consumers to save money, reduce stress, and avoid the need to chauffeur non-drivers. Improving walking and cycling conditions allows people to use these modes for utilitarian and recreation trips, providing user enjoyment, financial savings and health benefits.
- *Efficiency.* Increasing transportation diversity tends to create a more efficient transportation system because it allows each mode to be used for what it does best. This helps reduce traffic congestion, facility costs, road risk, environmental impacts and consumer expenses in the most cost-effective manner.
- *Equity*. Inadequate transport options often limit the personal and economic opportunities available to people who are physically, economically or socially disadvantaged. Increasing transportation options can help achieve equity objectives, by helping to provide *basic mobility* and *transportation affordability*.
- *Livability.* Many people value living in or visiting a community where walking and cycling are safe, pleasant and common. There are also public health benefits from increased walking and cycling. As a result, transportation options can help communities become more "livable," resulting in increased property values and commercial activity.
- *Resilience and Security*. Improved transportation options results in a more diverse and flexible transport system that can accommodate variable and unexpected changes such as energy supply disruptions and fuel price increases, poverty, and transport system stresses such as disasters, major sport and cultural events, and infrastructure construction projects. Even people who do not currently use a particular mode may value its availability as a form of insurance, called *option value*, the value of having a range of options available.
- *Economic Development*. Transportation diversity tends to support economic development by reducing transport problems and costs (traffic congestion, road and parking facility costs, accident damages, energy consumption) and by improving empoloyee access to jobs.

Not all these benefits apply in every situation, but planning decisions that improve non-auto modes often help provide many of these benefits. Conversely, planning decisions that reduce transport diversity tend to impose varius economic and social costs.

Table 5.9.3-1 summarizes attributes of various transport modes. Each is most suitable for certain applications. An efficient transportation system requires enough diversity so each mode can be used for what it does best.

Table 5.9.3-1 **Suitability of Travel Modes[3]**

Mode	Non-Drivers	Poor	Handi-capped	Limitations	Most Appropriate Uses
Walking	Yes	Yes	Varies	Requires physical ability. Limited distance and carrying capacity. Difficult or unsafe in some areas.	Short trips by physically able people.
Wheelchair / mobility scooter	Yes	Yes	Yes	Requires sidewalk or path. Limited distance and carrying capacity.	Short urban trips by people with physical disabilities.
Bicycle	Yes	Yes	Varies	Requires bicycle and ability. Limited distance and carrying capacity.	Short to medium length trips by physically able people on suitable routes.
Taxi	Yes	Limited	Yes	Relatively high cost per mile.	Infrequent trips, short and medium distance trips.
Fixed Route Transit	Yes	Yes	Yes	Destinations and times limited.	Short to medium distance trips along busy corridors.
Paratransit	Yes	Yes	Yes	High cost and limited service.	Travel for disabled people.
Auto driver	No	Limited	Varies	Requires driving ability and automobile. High fixed costs.	Travel by people who can drive and afford an automobile.
Ridesharing (auto passenger)	Yes	Yes	Yes	Requires cooperative driver. Consumes driver's time if a special trip (chauffeuring).	Trips that the driver would take anyway (ridesharing). Occasional special trips (chauffeuring).
Carsharing (Vehicle Rentals)	No	Limited	Varies	Requires convenient and affordable vehicle rental services.	Occasional use by drivers who don't own an automobile.
Motorcycle	No	Limited	No	Requires riding ability and motorcycle. High fixed costs.	Travel by people who can ride and afford a motorcycle.
Telework	Yes	Varies	Varies	Requires equipment.	Substitutes for some mobility.

Each mode is most suitable for certain applications. A diverse transport system more efficiently meets particular needs and conditions.

People often value travel option they do not currently use. This is called *option value*.[4] This justifies support for facilities and services that carry a relatively small portion of total travel, particularly those that can be used by physically, socially and economically disadvantaged groups. Since most industrialized countries are relatively automobile dependent, transportation diversity is primarily concerned with the availability, convenience and affordability of non-auto travel options, including the quality of connections between these modes. Most people can expect to rely on non-automotive modes at certain periods of their life, when their ability to drive is limited by physical disability, vehicle failures, financial constraints or disasters.

[3] Todd Litman (2007), "You Can Get There From Here: Evaluating Transportation Choice," *Transportation Research Record 1756*, TRB (www.trb.org), pp. 32-41; at www.vtpi.org/choice.pdf.

[4] Johansson (1987), *The Economic Theory and Measurement of Environmental Benefits*, Cambridge Press (www.cambridge.org).

Quantifying Transportation Diversity Impacts

This section describes how this impact can be applied in transportation decision making.

Two general perspectives can be used for transportation diversity evaluation. A *planning perspective* evaluates specific benefits provided by increased transport diversity. For example, improving alternative modes helps reduce traffic congestion, consumer costs, parking costs, energy consumption and pollution emissions, and helps improve mobility options for non-drivers and public fitness. Some of these impacts can be quantified, and others can be evaluated qualitatively.[5] For example, households in communities with more diverse transport systems save about $3,000 annually in transportation costs,[6] and benefit from reduced need to chauffeur family members and friends who cannot drive. Surveys can be used to identify and estimate residents willingness to pay for improved transport options.[7]

The International Transport Forum report, *Economic Benefits of Improving Transport Accessibility*, examines ways to evaluate the benefits of improving mobility options for non-drivers.[8] Bailey (2004) uses the portion of residents who do not travel on a given day as reported in travel surveys as an indication of the number of people who are significantly transport disadvantaged in a community. He found that the portion of residents age 65+ who do not travel on an average day ranges from 44% up to 69%, and is affected by their ability to own an automobile, ability to drive, quality of walking conditions and transit services, and community design factors.

An *economic perspective* evaluates the degree that current policies and planning practices are distorted in ways that reduce transportation diversity. For example, to the degree that current planning is biased in favor of motor vehicle travel over non-motorized modes, private automobile travel over public transport, and spawl over compact development, the transportation system will be excessively automobile oriented and less diverse than optimal.[9] Until such biases are fully corrected, policies that increase transport diversity, such as subsidies for alterantive modes, can be justified on second-best grounds.

---

[5] Todd Litman (2007), *Guide to Calculating Mobility Management Benefits*, Victoria Transport Policy Institute (www.vtpi.org); at www.vtpi.org/tdmben.pdf.

[6] Barbara McCann (2000), *Driven to Spend; the Impact of Sprawl on Household Transportation Expenses*, STPP (www.transact.org); Todd Litman (2021), *Transportation Affordability: Evaluation and Improvement Strategies*, VTPI (www.vtpi.org); at www.vtpi.org/affordability.pdf.

[7] AARP (2009), *The Road Ahead: AARP Survey on Transportation in Vermont*, American Assocation for Retired Persons (www.aarp.org); at http://assets.aarp.org/rgcenter/il/vt_transport_09.pdf.

[8] ITF (2017), *Economic Benefits of Improving Transport Accessibility*, The International Transport Forum (www.itf-oecd.org); at https://bit.ly/3ixjyOl.

[9] Todd Litman (2006), "Transportation Market Distortions," *Berkeley Planning Journal* (https://berkeleyplanningjournal.com), Vo. 19, pp. 19-36; at www.vtpi.org/distortions_BPJ.pdf.

Another method of quantifying transportation diversity benefits is to survey people concerning the value they place on improving transportation options and providing basic mobility for disadvantaged groups, and how those compare with other planning objectives such as congestion reduction and traffic safety improvements.

The report, *Estimating the Benefits and Costs of Public Transit Projects*, provides an analysis methodology for quantifying the value consumers place on transportation option value, taking into account their expected cost savings and frequency of use.[10] Current subsidies to maintain transport options indicate society's willingness-to-pay for improved transport diversity. For example, US transit subsidies average about 50¢ per passenger-mile, and higher in lower-density, suburban areas where such subsidies are justified almost entirely for equity and option value (in urban areas transit services also provide congestion, parking and emissions reduction benefits). Even with subsidies, transit services are often limited and so do not reflect their total potential option value (society would assumedly be willing to pay even more for higher quality service). This value should apply to other modes that provide comparable equity and option value benefits, such as walking and cycling improvements, and rideshare programs.

Transportation diversity improvements can often be justified on horizontal equity principles, in order to ensure that all travellers receive comparable share of transportation infrastructure investments.[11]

Because different modes often compete for users and resources (funding and road space), policies and programs that encourage increased automobile use tend to reduce transportation diversity. For example, tax policies and zoning codes that favor automobile travel use tend to increase automobile dependency and reduce transportation diversity. It is difficult to maintain a balanced transportation system in a community where most residents never use alternative modes. Automobile dependency results from a self-reinforcing cycle of increased automobile use, reduced transportation options, and more automobile-oriented land use patterns.[12] On the other hand, Transportation Demand Management (TDM) strategies that reduce automobile travel tend to support transportation diversity.[13] Road pricing, parking pricing and vehicle restrictions are examples of strategies that can increase transportation diversity by increasing their market demand and political support.[14]

---

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

[11] Todd Litman (2022), *Fair Share Transportation Planning: Estimating Non-Auto Travel Demands and Optimal Infrastructure Investments*, Victoria Transport Policy Institute (www.vtpi.org); at www.vtpi.org/fstp.pdf.

[12] Terry Moore and Paul Throsnes (1994), *The Transportation/Land Use Connection*, American Planning Association, Report 448/449 (www.planning.org).

[13] VTPI (2008), *Online TDM Encyclopedia*, VTPI (www.vtpi.org/tdm).

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

Applying Diversity Value to Planning and Policy Decisions

As described above, planning and policy analysis can place a positive value on transportation diversity, particularly options that help achieve objectives such as improved access for emergency services and basic mobility for people who are transportation disadvantaged. Conversely, a negative value can be applied to policies and programs that are likely to increase automobile dependency and therefore reduce transportation diversity.

For example, if a community is considering two possible congestion reduction strategies that are otherwise equally cost effective, such as widening roadways or improving public transit services, it makes sense to choose the transit improvement option because it increases transportation diversity. In fact, the community may be justified in choosing the transit option even if it costs somewhat more than highway capacity expansion in order to improve mobility options for non-drivers and therefore help achieve social equity objectives. Based on examples described above, a community may be willing to spend 50¢ per passenger-mile or more to support an option that improves transport diversity.

On the other hand, policies and programs that increase automobile use may be considered to impose costs of several cents per additional vehicle mile to the degree that they reduce the viability of alternative modes and so reduce transportation diversity.

To incorporate diversity into transportation planning, it is helpful to identify specific transportation diversity benefits, objectives and evaluation criteria. These can be used to evaluate the transportation diversity impacts of a particular policy or program. Some examples are listed below. These can be modified, expanded and prioritized according to the preferences of community members and officials.

Transportation Diversity Benefits

- Provides access for emergency services or urgent medical treatment.
- Improves access for people who are economically, physically or socially disadvantaged.
- Increases transportation affordability.
- Provides consumer cost savings.
- Provides public cost savings.
- Reduces the need for drivers to chauffeur non-drivers.
- Helps address transport problems such as traffic and parking congestion, and pollution.
- Can provide mobility if another component of the transportation system fails, or during a major disaster or energy crisis.
- Supports healthy physical activity (e.g., increases walking and cycling).
- Supports economic development (e.g., attracts tourists).
- Increases community livability (improved walkability, reduced neighborhood traffic).

5.9.4 Estimates

Although there are many indications that transportation diversity represents a significant benefit, no quantified estimates have been found. One approach for measuring this impact is based on current transit subsidies, which total approximately $30 billion annually in the U.S. [15] Assuming:

1. Indirect subsidies including tax exemptions, special facilities such as bus pullouts, and road wear equal 10% of financial subsidies.
2. Two thirds of transit subsidies are justified on the basis of transportation equity and option value (to put this another way, society would maintain 2/3 of current subsidies if equity and option value where the only benefits transit provided.)
3. Transit only captures 1/2 of all transportation equity and option value demand (in other words, society would be willing to double existing subsidies if transit provided the same quality of service as personal automobiles).
4. Driving is 50% responsible for the current lack of transport equity and option value.

Results: Automobiles' share of reduced transport equity and option value = $30 billion x 1.1 x 0.66 x 2 x 0.5 = $22 billion / 3,000 billion annual miles[16] = 0.7¢ / vehicle mile.

Because so little research is available to help quantify this impact, this estimate is extremely uncertain. Given the he high cost per trip of special mobility services that are justified specifically for equity value, and large potential energy security benefits, this estimate of transportation diversity value may significantly understate the true value.

5.9.5 Variability

The value of improved transportation diversity is likely to be greatest in more automobile dependent communities.

5.9.6 Equity and Efficiency Issues

Transportation diversity raises several equity issues:

- The relative mobility of drivers and non-drivers.
- The definitions of *Basic Access* and *Transportation Disadvantaged*.
- The economic and social burden that inadequate transportation diversity (i.e., automobile dependency) imposes on people who are transportation disadvantaged.
- The fairness of current transportation planning and funding practices.
- The fairness of non-users subsidizing transportation services that they do not currently use.

---

[15] 2004 data adjusted for inflation to 2007 dollars by CPI. FHWA (2006), *2006 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance*, (www.fhwa.dot.gov), Exhibit 6-16 Revenue Sources for Transit Financing, 2004; at wwwcf.fhwa.dot.gov/policy/2006cpr/chap6.htm#transit

[16] FHWA (2008), *April 2008 Traffic Volume Trends*, (www.fhwa.dot.gov); at www.fhwa.dot.gov/ohim/tvtw/tvtpage.htm

5.9.7 Conclusions

Although transportation diversity can be demonstrated both theoretically and empirically to have value, and inadequate transport options imposes various costs, there are currently no standard models that measure them. The estimate developed above in section 5.9.4 based on transit subsidies is probably low but will be used until better methods are developed. It is applied to private vehicles, but not to van pools, bus, trolley, bicycle, walk or telework, which are viable alternatives for non-drivers. Transit services oriented toward upper-income commuters may provide little equity value. Telework can provide transport equity and option benefits if implemented as a worker option.

Estimate **Transportation Diversity Costs (2007 U.S. Dollars per Vehicle Mile)**

Vehicle Class	Urban Peak	Urban Off-Peak	Rural	Average
Average Car	0.007	0.007	0.007	0.007
Compact Car	0.007	0.007	0.007	0.007
Electric Vehicles	0.007	0.007	0.007	0.007
Van/Light Truck	0.007	0.007	0.007	0.007
Rideshare Passenger	0.000	0.000	0.000	0.000
Diesel Bus	0.000	0.000	0.000	0.000
Electric Bus/Trolley	0.000	0.000	0.000	0.000
Motorcycle	0.007	0.007	0.007	0.007
Bicycle	0.000	0.000	0.000	0.000
Walk	0.000	0.000	0.000	0.000
Telework	0.000	0.000	0.000	0.000

Automobile Cost Range

Due to the uncertainty, the minimal value is zero and the maximum is somewhat arbitrarily set at an order of magnitude larger than the estimate developed above.

Minimum	Maximum
$0.00	$0.07

5.9.8 Information Resources

Information on transportation diversity evaluation is available from the following sources.

Bruce Appleyard and William Riggs (2021), "Human Rights to the Street: Ethical Frameworks to Guide Planning, Design, and Engineering Decisions Toward Livability, Equity and Justice," *Journal of Transport and Land Use*, Vo. 14/1, pp. 911-931 (http://dx.doi.org/10.5198/jtlu.2021.1918).

Ralph Buehler and Andrea Hamre (2015), "The Multimodal Majority? Driving, Walking, Cycling, and Public Transportation Use Among American Adults," *Transportation* 42, 1081–1101 (doi.org/10.1007/s11116-014-9556-z).

CTE (2008), "*Improved Methods For Assessing Social, Cultural, and Economic Effects of Transportation Projects*," NCHRP Project 08-36, TRB (www.trb.org), Center for Transportation and the Environment, American Association of State Highway and Transportation Officials (AASHTO); at http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP08-36(66)_FR.pdf.

DFID (2013), *Social Dimensions of Transport –A Resource for Social Impact Appraisals*, UK Department for International Develoment; at https://bit.ly/3VoZpIR.

DfT (2014), *Social Impact Appraisal, TAG UNIT A4.1*, *Transport Analysis Guidance*, Department for Transport (www.dft.gov.uk); at https://www.gov.uk/government/publications/tag-unit-a4-1-social-impact-appraisal.

Karst Geurs, Rinus Haaijer and Bert Van Wee (2006), "Option Value of Public Transport: Methodology for Measurement and Case Study for Regional Rail Links in the Netherlands," *Transport Reviews*, Vol. 26/5 (https://doi.org/10.1080/01441640600655763).

ITF (2017), *Economic Benefits of Improving Transport Accessibility*, The International Transport Forum (www.itf-oecd.org); at https://bit.ly/3VHV1UN.

Anna Krameer and Alexandra Goldstein (2015), "Meeting the Public's Need for Transit Options: Characteristics of Socially Equitable Transit Networks," *ITE Journal* (www.ite.org), Vol. 85, No. 9, pp. 23-29; summary at http://trid.trb.org/view.aspx?id=1371713.

John LaPlante (2010), "The Challenge of Multimodalism; Theodore M. Matson Memorial Award," *ITE Journal* (www.ite.org), Vol. 80, No. 10, October, pp. 20-23.

Todd Litman (2007), "You Can Get There From Here: Evaluating Transportation Choice," *Transportation Research Record 1756*, TRB (www.trb.org), pp. 32-41; at www.vtpi.org/choice.pdf.

Todd Litman (2021), *Evaluating Accessibility for Transportation Planning*, Victoria Transport Policy Institute (www.vtpi.org); at www.vtpi.org/access.pdf .

Todd Litman (2022), "Evaluating Transportation Equity: Guidance for Incorporating Distributional Impacts in Transport Planning," *ITE Journal* (www.ite.org), Vo. 92/4, April; at https://vtpi.org/Litman_ITEJ_Equity_Apr2022.pdf.

Todd Litman (2022), *Fair Share Transportation Planning: Estimating Non-Auto Travel Demands and Optimal Infrastructure Investments*, Victoria Transport Policy Institute (www.vtpi.org); at www.vtpi.org/fstp.pdf.

NZTA (2010), *Economic Evaluation Manual (EEM)*, New Zealand Transport Agency (www.nzta.govt.nz); at www.nzta.govt.nz/resources/results.html?catid=401.

Christopher Porter, Jonathan Lee, Taylor Dennerlein and Paula Dowell (2015), *Selected Indirect Benefits of State Investment in Public Transportation*, Research Results Digest 393, NCHRP Project 20-65, Task 52, National Cooperative Highway Research Program (www.trb.org/NCHRP); at http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rrd_393.pdf.

Marie Thynell (2009), *Social Change and Urban Transport*, Sustainable Urban Transit Technical Document #2, Sustainable Urban Transport Asia (www.sutp.org); at www.globalstudies.gu.se/digitalAssets/1299/1299523_TD02_SocialChange_Final.pdf.

Ian Wallis and Don Wignall (2012), *The Benefits of Public Transport: Option Values and Non-Use Values*, NZ Transport Agency Report 471 (www.nzta.govt.nz); at www.nzta.govt.nz/assets/resources/research/reports/471/docs/471.pdf.

Fang Zhao, et al. (2013), *Transportation Needs of Disadvantaged Populations: Where, When, and How?*, Federal Transit Administration (www.transit.dot.gov); at https://bit.ly/3QS7Ut1.

VTPI, *Online TDM Encyclopedia*, VTPI, chapters:
"Transport Options" (www.vtpi.org/tdm/tdm65.htm).
"Transport Resilience" (www.vtpi.org/tdm/tdm88.htm).
"Basic Mobility and Accessibility" (www.vtpi.org/tdm/tdm103.htm)