5.9 Transportation Diversity

This chapter explores the value of transportation diversity and the costs of reduced transport options. Transportation diversity provides a variety of benefits, including efficiency, equity, option value and resilience. In most developed countries, increased transportation diversity involves increasing alternatives to automobile use.

Definitions

Transportation Diversity (also called *Transport Options*, *Transport Choice* or *Balanced Transportation*) 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). In most developed countries, increased transportation diversity involves increasing alternatives to automobile use, or put another way, in most countries, the opposite of transportation diversity is Automobile Dependency.

Discussion

Society may value transportation diversity for several reasons described below.

- *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. It can help reduce traffic congestion, facility costs, road risk, environmental impacts and consumer expenses in the most cost-effective manner.

- *Consumer Benefits.* A more diverse transportation 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.

- *Equity.* Inadequate transport options often limits 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.

- *Security and Resilience*. Improved transportation options results in a more diverse and flexible transportation system that can accommodate variable and unpredictable conditions. Even people who do not currently use a particular form of transport may value its availability as a form of insurance to accommodate future needs. This benefit is sometimes called *option value*, that is, the value of having a range of options to choose from.

- Economic Development. Transportation diversity tends to provide efficiency gain (including more efficient land use) and reduced dependence on imported goods that support economic development.

Table 5.9-1 summarizes the attributes of various transport modes. Each is most suitable for certain applications. An efficient transportation system uses each mode for what it does best. This requires diversity

Table 5.9-1 **Suitability of Travel Modes**

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	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 physical 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 rentals 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 and skill.	Alternative to some types of trips.

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

People often value a particular transport service even if they do not currently use it. This is called *option value*.[1] This justifies support for facilities and services that carry a relatively small portion of total travel, particularly those that can be used by people who are physically, socially and economically disadvantaged. Since most industrialized countries are relatively Automobile Dependent, transportation diversity is primarily concerned with the availability, convenience and affordability of non-automotive (often called *alternative*) 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.

[1] Johansson, *The Economic Theory and Measurement of Environmental Benefits*, Cambridge Press, 1987.

Quantifying Transportation Diversity Impacts

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

As described above, transportation diversity can provide a variety of social benefits. Such benefits are implicit in current transport policies, such as public resources devoted to pedestrian, transit, rail and airport travel services, even if there is insufficient demand to recover costs from users. Conversely, transport and land use policies that reduce transport diversity can be considered to impose social costs. For example, closing a rural airport may reduce emergency service access, and reducing transit service may deprive transportation disadvantaged people an important mobility option.

TCRP Report 78 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.[2] Current subsidies to maintain transport options indicate society's willingness-to-pay for improved transport diversity. For example, 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 limited, sometimes uncomfortable, and often stigmatized. Thus, transit subsidies do not reflect total transportation option value. Society would assumedly be willing to subsidize transit even more if it provided a higher level of service. Society should similarly value other modes that provide comparable equity and option value benefits, such as walking and cycling facilities, and rideshare programs that improve mobility for non-drivers.

The value of transportation diversity is also indicated by the incremental financial savings from improved transportation options. For example, one study found that households in automobile dependent U.S. urban regions devote more than 20% of household expenditures to surface transportation (over $8,500 annually), while those in communities with more balanced transportation systems spend less than 17% (under $5,500 annually).[3] In addition to these consumer savings, improved transportation diversity can provide significant savings in road and parking facility costs, crash costs and pollution costs.[4] To the degree that improved transportation diversity reduces per capita vehicle ownership and vehicle mileage, it can provide economic savings averaging hundreds or even thousands of dollars in annual per-household.

A third method for quantifying transportation diversity is to compare public expenditures by mode, with the assumption that horizontal equity justifies spending at least as much per capita to subsidize travel by non-drivers as for drivers, and perhaps more if non-drivers have greater needs. For example, if society subsidizes automobile commuters by

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

[3] Barbara McCann, *Driven to Spend; The Impact of Sprawl on Household Transportation Expenses*, STPP (www.transact.org), 2000.

[4] Peter Newman and Jeffrey Kenworthy, *Sustainability and Cities; Overcoming Automobile Dependency*, Island Press (www.islandpress.org), 1998.

$2,000 annually in road and parking costs, it should be willing to spend at least as much to support commuting by walking, cycling, ridesharing, transit and telecommuting, and more (perhaps $4,000 annually) to subsidize commuters with special needs (people with physical disabilities, parents with children that must be delivered to daycare).

A fourth method of quantifying transportation diversity benefits is to survey people concerning their concerns and preferences.[5] For example, an opinion survey of the general public or representative officials might ask the value they place on improving transportation options and insuring basic mobility for people who are transportation disadvantaged, and how such objectives compare with other transportation improvement objectives such as congestion reduction and traffic safety improvements.

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.[6] On the other hand, Transportation Demand Management (TDM) strategies that reduce automobile travel tend to support transportation diversity.[7] Road pricing, parking pricing and vehicle restrictions are examples of strategies that can increase transportation diversity by increasing their market demand and political support.[8]

Comedy Becomes Tragedy
A city slicker driving a fancy car pulls up to an old farmer on a back road. "*How do I get to Muggsville?*" asks the out-of-town driver. The farmer ponders for a moment then answers, " *'Fraid you can't get there from here.*"

A small joke, but consider a minor variation: The same question is asked by a pedestrian or cyclist, and the same answer given. Comedy becomes tragedy because in practice non-drivers frequently cannot get where they want to go, at least with any degree of ease, safety or economy.

Applying Diversity Value to Planning and Policy Decisions

[5] For an example see survey results discussed in Section 4.5.
[6] Terry Moore and Paul Throsnes, *The Transportation/Land Use Connection*, American Planning Association, Report 448/449 (Chicago; www.planning.org), 1994.
[7] VTPI, *Online TDM Encyclopedia*, Victoria Transport Policy Institute (www.vtpi.org), 2002.
[8] John Kain, "Impacts of Congestion Pricing on Transit and Carpool Demand and Supply," in *Curbing Gridlock*, TRB, National Academy Press (www.trb.org), 1994.

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 ways to reduce traffic congestion that are otherwise considered equally cost effective, it makes sense to choose the option that increases transportation diversity, perhaps by improving transit service, over an option that increases automobile dependency, by expanding roadway capacity. In fact, it the community may be justified in choosing the transit option even if it costs somewhat more than highway capacity expansion, if it helps achieve transportation diversity objectives. Based on examples described above, a community may be willing to spend 50¢ per passenger-mile or more to support transportation alternatives that improve mobility for non-drivers or support other transportation diversity objectives.

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.
- 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).

Estimates

Although there are many indications that transportation diversity represents a significant benefit, and reduced transportation diversity imposes significant costs, no quantified estimates have been found. One approach for measuring this impact is based on current transit subsidies, which total approximately $16 billion annually in the U.S. 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 = $16 billion x 1.1 x 0.66 x 2 x 0.5 = $11.6 billion / 2,400 billion annual miles = 0.5¢ / vehicle mile.

Because so little research is available to help quantify this impact, this estimate is extremely uncertain. The high cost per trip of special mobility services that are justified specifically for equity value, and survey results described later in Section 4.5 indicate that this estimate of transportation diversity value may significantly understate the true value.

Variability

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

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.

Consumer choice is a basic requirement for an efficient market, so transportation diversity tends to increase efficiency, and automobile dependency reduces efficiency, particularly if matched with efficient pricing.

Conclusions

Although transportation diversity can be demonstrated both theoretically and empirically to have value, and inadequate transportation options imposes various costs, there are currently no models that measure them or quantify the impacts of automobile use on transportation diversity.

The estimate developed above 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 (1996 U.S. Dollars per Vehicle Mile)**

Vehicle Class	Urban Peak	Urban Off-Peak	Rural	Average
Average Car	0.005	0.005	0.005	0.005
Compact Car	0.005	0.005	0.005	0.005
Electric Vehicles	0.005	0.005	0.005	0.005
Van/Light Truck	0.005	0.005	0.005	0.005
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	0.005	0.005	0.005	0.005
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 of this cost, its 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	$0.05

Information Resources

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

Stephanos Anastasiadis (2002), *Transport And Society: Sustainability's Poor Cousin*, European Federation for Transport and Environment (www.t-e.nu).

BTS (1997), *Mobility and Access; Transportation Statistics Annual Report*, Bureau of Transportation Statistics (www.bts.gov), pp. 173-192.

DFID**,** *Social Benefits in Transport Planning*, UK Department for International Development (www.transport-links.org/transport_links/projects/projects_document_page.asp?projectid=322), includes various resources for more comprehensive transport project evaluation.

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

David J. Forkenbrock and Glen E. Weisbrod (2001), *Guidebook for Assessing the Social and Economic Effects of Transportation Projects*, NCHRP Report 456, TRB, (www.trb.org).

Joel Hirschhorn (200), *In the Fast Lane: Delivering More Transportation Choices to Break Gridlock*, National Governor's Association, (www.nga.org).

Institute for Science and Technology Policy (wwwistp.murdoch.edu.au) explores the impacts of automobile dependency.

Todd Litman (2001), "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.

Peter Newman and Jeffrey Kenworthy (1999), *Sustainability and Cities; Overcoming Automobile Dependency*, Island Press (www.islandpress.org).

Social Exclusion Unit (www.socialexclusionunit.gov.uk), UK DETR.

TransAct (www.transact.org) provides resources related to transportation diversity.

TRL, *Strategic Environmental Assessment Newsletter*, Transportation Research Laboratory (www.trl.co.uk/env_sea_newsletter.htm) investigates integrated transportation planning.

Jeff Turner, *Transport and Social Exclusion Toolkit*, University of Manchester (www.art.man.ac.uk/transres/socexclu0.htm).

VTPI, *Online TDM Encyclopedia*, VTPI, chapters:
"Transport Options" (www.vtpi.org/tdm/tdm65.htm).
"Transport Resilience" (www.vtpi.org/tdm/tdm88.htm).
"Automobile Dependence" (www.vtpi.org/tdm/tdm100.htm).