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"Efficiency - Equity - Clarity"

You Can Get There From Here

Evaluating Transportation System Diversity

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Abstract

Transportation diversity (also called *options* and *choice*) refers to the quantity and quality of transportation options available to an individual or group, taking into account their specific needs and abilities. It includes different modes, services and prices. Increased transportation diversity can provide numerous benefits, including increased transport system efficiency, consumer cost savings, and support for equity objectives. Many of these benefits are overlooked or undervalued in conventional transport planning. This paper describes transportation diversity benefits, objectives and solutions. It discusses methods for evaluating transportation diversity. Twenty-five specific transport options are considered, including various travel modes, substitutes for physical travel, and land use strategies that improve access.

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Introduction

Diversity is often a valued attribute. Investors want diversified portfolios. Communities want diversified economies. Most people want diverse activities in their lives. Engineers recognize that diversity helps increase system resilaince, allowing variable and diverse demands to be accommodated. Similarly, there are benefits to transportation diversity.

Transportation diversity (also called *options* or *choice)* refers to the quantity and quality of transport options available to an individual or group, taking into account their needs and abilities. It can include different modes, services, prices and even destinations. Increased diversity can make a transport system more efficient, equitable and robust.

Definitions
There can be confusion over terms used to describe transport diversity. We sometimes describe it as the value of *travel choice*, but the word *choice* is both a noun (as in "having *options*") and a verb (as in "making a *decision*"). To avoid this confusion I generally use the terms *options* for specific options, and *diversity* for having a variety of options from which to choose.

Conventional planning tends to assume that progress is linear, with newer, faster modes replacing older, slower modes. This *series model* assumes that the older modes are unimportant, and so, for example, there is no harm if walking conditions and transit service quality decline provided that automobile ownership and travel speeds increase. A more diverse transportation system requires a *parallel model*, which recognizes that each mode can be useful, so progress can involve improving various modes, not just the newest one. For example, in many situations the best transport improvements may be improve walking and cycling conditions or prioritize travel to favor higher-value trips over lower-value trips. Even if they don't increase speed, these strategies can improve travel convenience, comfort and affordability.

Transportation diversity includes not only different modes and vehicles, but also different service and price options. For example, transit options can include having lower-priced, basic service and more expensive, premium quality service with greater comfort or speed. Similarly, motorist options can involve different vehicle ownership and rental options, or the ability to use an uncongested lane or a more convenient parking space for an additional fee. Transportation options also includes management options such as Parking Cash Out, which allows commuters to choose between receiving a free parking space or alternative benefit, and land use options, such as being able to choose a suitable home in a more accessible, less automobile-dependent neighborhood.

Transportation diveristy is affected by individual abilities and needs. People who cannot drive, have limited wealth or physical disabilities can only use a subset of the full range of transportation options. Transportation needs tend to be greater for people who work, attend school or have family responsibilities. Transportation diversity must therefore be evaluated from these various perspectives.

A motorist driving on a rural road stops to ask an old farmer for directions to a nearby town. The farmer ponders the question and replies, "I'm afraid you can't get there from here."

This old joke is amusing because it contradicts what we know of transportation. Given accurate directions and sufficient fuel a motorist can reach nearly any location on a public road. But if the visitor were walking, the situation might not be so funny. Rather than suggesting that the destination is generally inaccessible, it could mean, "*You* can't get there, at least not the way you are traveling." It is tragic rather than comic if some groups of people have inferior transportation options.

Transportation diversity improvements can help solve many transportation problems. For example, traffic congestion can often be reduced by improving transportation options, including transit, ridesharing, cycling, walking, delivery services, telecommuting, flextime and HOT lanes (STPP, 2001). These give travelers more alternatives to driving in congestion, and those who continue to drive benefit to the degree that these alternatives reduce peak-period vehicle traffic. Similarly, other transportation problems can be addressed by improving transportation options.

Many people intuitively appreciate the value of transportation diversity. If you know somebody with a physical disability you probably appreciate the importance of transport facilities and services that meet their needs. If you have experienced poverty you probably place a high value on affordable transportation options. If you enjoy walking, running or cycling you probably value having facilities that accommodate these activities.

Yet, these are often treated as special services rather than as a basic planning goals. Planning intended to address specific parking or traffic problems often gives little consideration to transportation diversity objectives. Transportation options that are less common, used primarily by lower-income people or that are difficult to measure are often given little consideration in transport planning. This can result in a self-fulfilling prophecy, in which dominant transport options receive most resources while alternatives that could improve transportation diversity receive little support.

This is not to suggest that public officials are unaware of these problems. To their credit, many transportation professionals support transportation options that are considered of little significance by conventional planning practices. Public resources are devoted to provide transit, special mobility services, and nonmotorized transportation facilities, despite, rather than because of, sophisticated transportation demand models.

This paper explores the value of having diverse transportation options that meet a wide range of needs and preferences. It describes practical ways to evaluate transportation diversity and incorporate it as an objective in transport planning.

Benefits of Transportation Diversity

This section describes specific benefits that can be provided by transportation system diversity.

Transportation diversity can provide various benefits:

- *Efficiency.* Improved transportation options can reduce traffic congestion, facility cost savings, increased road safety, environmental improvement and consumer cost savings by allowing travelers to chose the most cost-effective option for each trip.
- *Consumer benefits and savings.* Consumers benefit from alternatives that allow them to save money, avoid stress, enjoy additional benefits (such as recreation and exercise), and reduce their 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.
- *Option value.* People who do not currently use an alternative mode may value its availability for possible future use when they are unable to drive. This is called "option value." Over the course of their lives most people can expect to rely on alternative modes, due to physical disability, financial constraints, vehicle failures, major disasters or other limitations.
- *Livability.* Many people value travel options such as walking and cycling, and being in a community where these activities are safe, pleasant and common. Improved transport diversity can result in increased property values and commercial activity.

Many specific problems can be addressed by improving transport system diversity. For example, traffic congestion can be reduced by improving alternative modes on major corridors, and inadequate mobility for non-drivers can be addressed by improving the mobility options that serve economically and physically disadvantaged people in an area.

Although some of these benefits are difficult to measure, they can be important, comparable in magnitude to more commonly recognized transport planning goals. For example, U.S. motor vehicle expenditures total about $650 billion annually, about six times estimated traffic congestion and air pollution costs (Litman, 2005). This suggests that mobility option improvements that reduce consumer transport costs by 10% are worth about six times as much as roadway improvements that reduce congestion by 10%.

The value of transportation diversity becomes clearer if, instead of dividing travelers into a large group of motorists and a small group of non-motorists, we divide them into a small group who expect to always travel by automobile, and a larger group who expect to rely on other modes sometime during their life. Travelers who don't use alternative modes may also benefit from reduced traffic and parking congestion, facility cost savings, reduced crash risk, and reduced pollution.

Not all mobility options support all of these goals. For example, some public transit service is justified primarily for equity objectives, and others primarily for efficiency objectives ("Transit Evaluation," VTPI, 2000). However, in general, a more diversified transportation system tends to provide these benefits.

Each transport mode has a unique performance profile, that is, a combination of abilities and constraints that determine the role it can play in an efficient transportation system. For example, walking is affordable and does not require special skill or a license, but it does require physical ability and is limited in speed, distance and carrying capacity. Automobile travel is more costly and requires a driver's license, but it can travel faster, farther and can carry a relatively heavy load. Table 1 summarizes these factors.

Table 1 Travel Modes Performance Profiles

Mode	Disadvantaged Users			Limitations	Most Appropriate Uses
	Non-Drivers	Poor	Disability		
Walking	Yes	Yes	Varies	Requires physical ability. Limited distance and carrying capacity. Difficult or unsafe in some areas.	Shorter trips by physically able people. Access trips to motorized mode Recreational trips.
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 automobile 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.
Telecommute	Yes	Varies	Varies	Requires equipment and skill.	Alternative to some types of trips.

Each mode has a unique performance profile making it suitable for certain users and uses.

Network Analysis

Transportation is part of an integrated system, so transportation diversity should be evaluated at a network level. Current transport and land use systems generally serve motorists well. Motorists can drive to most destinations with modest cost, discomfort or risk. It is the non-automotive transportation system (i.e., the transport network that serves nondrivers) that tends to have the greatest weaknesses.

Automobile-oriented transportation systems tend to reduce non-automotive transport options (Newman and Kenworthy, 1999; Litman, 1999). Policies that favor driving (e.g., generous road and parking capacity, increased traffic speeds) can lead to land use patterns that are unsuitable for alternative modes, create physical barriers to nonmotorized travel, and reduce public support for alternative modes. Conversely, efforts to improve one type of transportation can have positive spillover effects on other modes. For example, improving pedestrian conditions can improve access to transit. Where transportation options are good households tend to own fewer cars, but in more automobile dependent communities, each driver needs a personal automobile. This tends to create a cycle of increasing automobile dependency as middle-class residents rely increasingly less on alternative modes, and so are less likely to support them economically and politically.

Only if consumers have viable mobility options does travel behavior necessarily reflect their true preferences. Current levels of automobile dependency result, in part, from market distortions that underprice automobile use, encourage urban sprawl, and reduce transportation diversity (VTPI, 2000, “Market Principles”). Given better options and less distorted markets, consumers would probably drive significantly less, rely more on transportation alternatives, and be better off overall as a result (Litman, 2006).

It is important to evaluate transportation diversity in terms of *accessibility* (the ability to reach desired goods, activities and destinations) rather than just *mobility* (physical movement). Accessibility is affected by mobility, affordability, land use patterns, and mobility substitutes (such as telecommunications and delivery services). For example, from this perspective, accessibility can be improved by locating common destinations closer together, as well as improving mobility between destinations (Litman, 2003).

A more diverse transportation system can provide significant economic benefits. Households in communities with good transport options spend thousands of dollars a year less on transportation than households in automobile dependent communities (McCann, 2000). This tends to increase regional economic development since motor vehicles and fuel expenditures tend to provide less employment and business activity than other types of consumer expenditures (VTPI, 2000, “TDM and Economic Development).

Increasing transportation system diversity can have important positive effects on the prestige of alternative modes. For example, when walking, cycling and public transit transport is only used by a small number of economically, socially and physically disadvantaged people, they tend to be sitgmatized, further reducing their use. When they have a wider range of users, they receive more respect and public support.

Barriers to Transportation Diversity

There are many barriers to improved transportation diversity. Existing planning practices and regulations discourage specialization and innovation in transportation markets. Motor carrier and taxi regulations tend to prohibit or severely limit development of new transportation services, often due to outdated objectives or entrenched interests. In many jurisdictions they prohibit virtually any form of transit service competition, and are often applied so broadly that an entirely new service and route is illegal, even if would not directly compete with existing transit (Klein, Moore and Reja, 1997). For example, it is illegal for private companies to offer jitney or paratransit services even in areas or at times that conventional transit service is poor. Similarly, taxi regulations often discourage competition and innovations (Moore and Rose, 1998).

Land use regulations and development practices in most communities (such as minimum parking requirements and prohibitions on mixed land use) tend to favor automobile transport to the detriment of other forms of access. In many communities households searching for a home to rent or purchase must choose between living in an automobile-dependent suburb with good schools and public services, or neighborhood with better transportation options but inferior schools and services. They often lack the option of having goods community services with good transportation diversity.

Conventional transportation planning tends to undervalue many benefits of transportation diversity because they are difficult to measure or accrue to less powerful members of society. Planning that focuses on specific transportation problems, such as traffic and parking congestion, pollution or crashes, tends to give little weight to other benefits associated with improved transportation options. Most public officials are physically-able, middle-income motorists who may have little personal experience with the problems facing people who are transportation disadvantaged. Planning and funding practices often give little attention to transportation options that are considered minor.

For example, in most communities, integrating cycling and transit transport by installing bikeracks on buses and providing bike storage and rental services at transit stations would only serve a tiny portion of total personal travel needs, and only directly benefit a small portion of the population, mostly young and lower-income people. It might therefore be given little consideration in conventional planning, particularly by officials who don't expect to depend on these services themselves. Yet, these may be important transportation options for some people, improving their potential to access schools and jobs, or providing an opportunity to save money. They can have significant benefits if they help some household reduce their automobile ownership, providing substantial financial savings and leveraging a greater reduction in vehicle travel. It could be an important part of a comprehensive program that improves transit service and cycling conditions, and encourages use of alternative modes. In some regions of the world, a significant portion of commute and visitor transportation relies on such services.

Pricing and management strategies that would improve transportation diversity are often politically difficult to implement. For example HOT lanes offer travelers new options: they can continue driving free in congestion, travel without congestion by using transit or

ridesharing, or travel without congestion by paying an extra fee ("Road Pricing," VTPI, 2000). Parking pricing allows motorists to pay for a more convenient parking space, or to use a cheaper or free space that is less conveniently located. Similarly, premium-priced, express commuter bus service can be faster and more comfortable than standard transit service. All of these directly benefits users, and indirectly benefit society if they reduce total vehicle travel. However, transportation and the general public are reticent to implement these pricing and management options. Some people feel that they contradict the egalitarian tradition of transportation service (all users should bear congestion and poor transit service discomfort equally).

However, in practice, a single quality of service probably does little to achieve equity objectives. Higher income people can avoid much of the discomfort of congestion with flexible schedules, luxury cars and cellular telephones. They will simply drive rather than using inferior transit service. Even lower-income people may value having premium road, parking and transit options for occasional use. For example, low-income motorist may pay to use an HOT lane in an emergency. Similarly, a lower-income employee may be willing to pay extra for express bus service if they are feeling ill, or if the alternative is the even higher cost of driving an automobile.

Basic Access and Basic Mobility

Basic Access refers to people's ability to access goods, activities and destinations that are considered important to society, such as medical care and other essential services, schooling and employment, and a certain amount of social activities ("Basic Access," VTPI, 2005). *Basic Mobility* refers to mobility that provides basic access. A transport option is particularly valuable if it provides basic access to people who have significant unmet accessibility needs.

In general, people who can drive and afforda an automobile have relatively good mobility, except under urban peak conditions, or other situations where driving is constained. The greatest unmet mobility needs are for people who for any reason are unable to drive or afford an automobile, and this is compounded for people with mobility disabilities.

	Serves Non-drivers	**Requires Driving Ability**
High Cost	Air travel Paid Chauffeur	Private Airplane Automobile Motorcycle
Low Cost	Occasional taxi travel Public Transit Walking	Carsharing

Described differntly, most motorists are easily able to meet their basic access needs. Their marginal travel consists of relatively low-value mobility. But people who are economically, physically or socially disadvantaged often have significant unmet travel demand, so an increase in their mobility can provide significant benefits to those individucals and society, for example, allowing them to access medical services, school and employment opportunities.

Conventional transportation planning focuses primarily on vehicle or personal mobility as an indicator of access, but physical movement is seldom an end in itself (except for the recreational travel that has no destination). Evaluating transport in terms of access allows the widest range of solutions to be considered for addressing transportation problems (BTS, 1997; VTPI, 2000, "Measuring Transportation").

Basic access (or *basic mobility*) means that people can obtain goods, services and activities that society considers important, such as emergency services, medical care, education, employment, and essential goods.

Transportation disadvantaged refers to people who have significant unmet transportation needs. The six attributes listed in the table below may contribute to a person being transportation disadvantaged. Somebody with just one or two of these attributes is not

necessarily transportation disadvantaged. For example, a non-driver may have adequate transportation options if they are physically able, live in a community with good walking and transit services, and can afford taxi and delivery services when necessary. Similarly, a wheelchair user may have adequate transportation options if they can drive or afford a chauffeur, and live in a community that accommodates wheelchairs. However, adding one or two more attributes (for example, if the non-driver goes to an automobile-dependent community, or if the wheelchair user cannot drive) can make them significantly transportation disadvantaged.

Table 2 **Attributes That Contribute to Transportation Disadvantage**

Transportation Ability	Transportation Need
▪ Non-drivers. People who cannot drive or do not have access to a motor vehicle.	▪ Commuter. People who must make daily trips to work or school.
▪ Low Income. Drivers and non-drivers whose basic transportation needs are significantly constrained by financial limitations.	▪ Caregiving Responsibilities. Primary caregiver to non-driving dependents (children, elderly relatives, etc.).
▪ Disabled. People who have physical disabilities that limit their ability to travel independently.	▪ Automobile Dependency. Lives in a community with automobile-dependent transportation and land use patterns.

Below are types of people that tend to be transportation disadvantage, and so should be given particular consideration in planning.

- Households that do not own an automobile.
- People with significant physical disabilities.
- Low-income households.
- Low-income single parents.
- People who are too young or old to drive.
- Recent immigrants from developing countries.

Optimal Level of Transportation Diversity

Although there are clearly benefits to increased transportation options, it can be difficult to determine what level of diversity is optimal. It requires answering questions such as the level of subsidy that is justified for supporting alternative modes, the allocation of such subsidies between different modes, and the degree that use of one mode may be constrained in order to improve other modes.

Below are three general conceptual approaches that can be used to determine the optimal level of transportation diversity.

1. Basic Access/Mobility

This approach involves defining a basic level of access/mobility that all community residents should enjoy, and improve transprt options until it is provided.

2. Premium or Budget

This approach involves defining a reference premium or total budget that society should be willing to pay to improve transportation diversity. For example, when evaluating solutions to a transportation problem such as traffic congestion, decision-makers may favor those that increase transportation options, and be willing to pay up to a certain amount extra for diversity-improving options.

3. Optimal Transportation Market

This approach involves estimating the level of transportation diversity that would occur in an undistorted market, which includes full cost pricing of transport unless a subsidy is specifically justified, economically neutral public policies, and least-cost planning.

Evaluation Methods

This section describes six practical methods of evaluating transportation diversity.

Transportation diversity is a complex issue, involving a variety of impacts, many of which are difficult to measure. There is no single best method for evaluating transportation diversity. Six possible methods are described below. They can be incorporated individually or in combination into a particular planning process.

Method 1 Transportation Diversity Indicators

Indicators are a conceptual tool that measures progress towards (or away from) a measurable objective. A set of indicators, such as the five defined in the box below, can be used to evaluate transportation diversity. Policies, projects or options can be rated according to how well they help achieve these objectives. These indicators can be modified as appropriate to meet the needs of a particular planning process.

Transportation Diversity Indicators

Equity Objectives

- *Non-drivers.* Does it improve access or otherwise benefit non-drivers?
- *Low-incomes.* Does it improve access or otherwise benefit people with lower incomes?
- *Physical disabilities.* Does it improve access or otherwise benefit people with disabilities?

TDM Objectives

- *Commuting.* Does it improve access or support other TDM objectives (road safety, reduced environmental impacts) for commute trips.
- *Non-Work Travel.* Does it improve access or support other TDM objectives for non-work trips, including shopping, medical visits, recreation trip, and tourist travel.

Method 2: Solving Specific Problems from Inadequate Transportation Options

This method involves identifying and addressing specific problems associated with inadequate transportation options. Examples include:

- Insuring that transportation disadvantaged patients can access medical services.
- Insuring that elderly residents can access shops and personal services.
- Insuring that low-income youths can access education and employment opportunities.
- Insuring that developmentally disadvantaged people can participate in social and recreational activities.

Planners can identify individual solutions to these transportation problems, such as establishing a special mobility service, contracting with existing mobility service providers to provide additional trips, changing scheduled transit service to accommodate such needs, or subsidizing taxi service.

This is a common approach to addressing such problems. However, it may not be the best approach because it defines problems and solutions narrowly. For example, providing weekday paratransit service intended to help elderly residents access medical services and stores may leave them unable to participate in evening and weekend social activities that users consider equally important. Some elderly non-drivers may sometimes prefer walking to stores, rather than being chauffeured for all trips.

As much as possible, problems should be defined broadly and a wide range of solutions should be considered. For example, rather than defining a problem as a lack of bus service for elderly shoppers, it is better to define the problem as a lack of access for moderate-income non-drivers with limited physical ability. This broader problem definition allows a wider range of solutions to be considered. Users should be involved in defining the problem, identifying potential solutions, and establishing priorities, prices and rules.

Method 3: Strategic Planning For Transportation Options

This approach involves categorizing policies and projects according to whether they tend to increase or reduce transport diversity. It recognizes that transportation and land use decisions have cumulative and synergetic effects (Louis Berger & Associate, 1998). Although the impacts of an individual decision may appear modest and difficult to measure, their general direction is usually predictable. Rather than modeling individual impacts, it may be best to simply categorize decisions according to whether they support or contradict strategic goals regarding transport diversity.

For example, if a number of solutions are being considered to help solve a problem such as traffic congestion, possible solutions can be rated according to whether they increase or reduce transportation options. The table below categorizes the transportation diversity impacts of various polices and programs. This method can be modified to reflect the needs of a particular situation.

Table 3 **Policy and Planning Impacts on Transportation Diversity**

Tends to Increase Transport Options	Tends to Reduce Transport Options
▪ Additional modes, such as new transit or carsharing services. ▪ Pedestrian and cycling improvements. ▪ Traffic calming. ▪ Public transit improvements. ▪ HOV priority measures. ▪ Transportation Demand Management programs. ▪ Pricing reforms that reduce automobile use (i.e., parking pricing, congestion pricing, distance-based insurance pricing). ▪ Land use policies favorable to transit and non-motorized transport, including higher densities, increased mix, and transit-oriented development.	▪ Wider roads and new highways, particularly if they bisect communities. ▪ Increased motor vehicle traffic volumes and speeds. ▪ Generous parking requirements and buildings designed for automobile access with poor pedestrian access. ▪ Low-density, homogeneous land use and urban fringe development. ▪ Pricing that encourages driving (e.g., free parking, low fuel taxes, fixed insurance) or increase the price of alternatives (transit fare increases). ▪ Anything that degrades pedestrian and cycling conditions.

Method 4: Evaluating Individual Transportation Options

This method involves evaluating individual transport options in terms of various objectives. The following information is provided for 25 transport options:

- A description of the option.
- A discussion of demand for the option, including information on how to measure demand.
- Performance indicators, including Level of Service (LOS) standards if available.
- A table indicating how well that option helps achieve various transport diversity objectives.

The *Online TDM Encyclopedia* (VTPI, 2000) provides additional information. This framework can be modified as appropriate to include different options and objectives.

Walkability

Walkability refers to the overall quality of the pedestrian environment. Pedestrian travel is slow, averaging about 3 mph, and walking trip distances tend to be short, typically ¼ to ½ mile. As a result, even small changes in the pedestrian network can have a large effect on walkability. For example, reducing walking distance by a few hundred feet can significantly increase the feasibility of walking, particularly for people with disabilities or loads such as shopping or laundry.

Demand

Nearly everybody walks, but some people are particularly dependent on walking, including non-drivers, children, transit users, and tourists. Pedestrian travel tends to be more common in areas with suitable facilities, traffic conditions and land use patterns. Models are available for predicting pedestrian demand ("Evaluating Nonmotorized Transport," VTPI, 2000).

Performance Indicators

Various standards and indicators can be used for evaluating walkability (Dixon, 1996; VTPI, 2000, "Evaluating Nonmotorized Transport). Performance indicators include:

- The number of barriers identified by pedestrians in surveys.
- Portion of streets with continuous and connected sidewalks, paths and crosswalks.
- Quality of pedestrian facilities, including functional width, surface condition, etc.
- Width and traffic volumes on roads to be crossed, and average crossing wait.
- Pedestrian security, including risk of falls and assaults.

Support for Transportation Objectives

Pedestrian improvements benefit people who are transportation disadvantaged, and support TDM objectives, both directly, and by improving access to transit.

Support for Transportation Objectives

	Transportation Disadvantaged			TDM	
	Non-Drivers	Low-Income	Physically Disabled	Commuting	Non-Work Travel
Pedestrian	3	3	3	3	3

Rating from 0 (no benefit) to 3 (very beneficial).

Universal Design

Universal Design or *barrier-free design* refers to facilities that accommodate people with diverse abilities and needs, including wheelchairs users, people who walk with difficulty or have visual disabilities, and pedestrians pushing strollers or handcarts. The term *Universal Design* is preferred to *handicapped access* because these design requirements can benefit many users, not just those with disabilities.

Demand

Demand for Universal Design requirements can be estimated based on the number of people in an area with physical disabilities (people using wheelchairs and walker, and who have severe visual disabilities), plus pedestrians with strollers and handcarts.

Performance Indicators

Several planning and professional organizations publish Universal Design guidelines and standards (Access Board, 1998; Litman, et al, 1999). Performance indicators include:

- The number of mobility barriers identified by people with physical disabilities.
- The portion of the pedestrian network that meets barrier-free design standards.
- Availability of information on barrier-free facilities in an area.
- How well other modes (transit, taxies, long-distance travel services) accommodate people with special needs.

Support for Transportation Objectives

Universal Design benefits people who are physically disabled or using strollers and handcarts.

Support for Transportation Objectives

	Transportation Disadvantaged			TDM	
	Non-Drivers	Low-Income	Physically Disabled	Commuting	Non-Work Travel
Universal Design	1	1	3	1	1

Rating from 0 (no benefit) to 3 (very beneficial).

Cycling

Cycling is an important transportation option in some situations. Cyclists' needs and preferences vary considerably. Some cyclists are comfortable riding on roads with heavy traffic, while others consider even moderate traffic a significant deterrent, and have a strong preference for separated facilities.

Demand

Cycling demand tends to be highest among certain demographic groups (children, young adults, some elderly), for local trips, in communities with suitable facilities. Models are available to predict cycling demand taking into account demographic, geographic and facility design factors (VTPI, 2000, "Evaluating Nonmotorized Transport").

Performance Indicators

Dixon (1996) provides a relatively easy-to-use method for evaluating cycling Level of Service. VTPI, 2000, "Evaluating Nonmotorized Transport, summarizes other evaluation models. Performance indicators include:

- Barriers identified by cyclists.
- Roadway cycling conditions, including traffic volumes and speeds, lane widths, surface conditions, and presence of hazards such as potholes and railroad track crossings.
- Existence and quality of special cycling facilities, including separated paths, bike lanes and paved shoulder on highways and arterials.
- Quality of bicycle parking and changing facilities.

Support for Transportation Objectives

Cycling provides basic mobility for some transportation disadvantaged people, is inexpensive, and supports TDM objectives.

Support for Transportation Objectives

	Transportation Disadvantaged			TDM	
	Non-Drivers	Low-Income	Physically Disabled	Commuting	Non-Work Travel
Cycling	3	3	1	3	3

Rating from 0 (no benefit) to 3 (very beneficial).

Moped

Mopeds are small, low-powered motorcycles. They provide an inexpensive form of transportation that reduces parking and some environmental impacts. Mopeds travel at moderate speeds (averaging about 30 km/hr), with medium trip lengths, that are suitable for local roads but not major highways.

Demand

Moped travel demand varies significantly, depending on geographic, demographic, social and roadway condition factors.

Performance Indicators

Performance indicators include:

- Roadway cycling conditions, including traffic volumes and speeds, lane widths, surface conditions, and presence of special hazards to moped travel.
- Caution and respect for mopeds exhibited by motor vehicle drivers.
- Moped crash and injury rates.
- Affordability of mopeds and fuel relative to average incomes.
- Existence and quality of moped parking facilities.

Support for Transportation Objectives

Mopeds benefit some transportation disadvantaged people, including some with low incomes and physical disabilities. Some jurisdictions allow people too young to drive an automobile to drive a moped. Mopeds support some TDM objectives, including parking cost savings and fuel conservation.

Support for Transportation Objectives

	Transportation Disadvantaged			**TDM**	
	Non-Drivers	Low-Income	Physically Disabled	Commuting	Non-Work Travel
Moped	1	2	1	1	1

Rating from 0 (no benefit) to 3 (very beneficial).

Taxi

Taxis are an important mode in some situations (Trudel, 1999; Taxi-L):

- Non-drivers often rely on taxis for basic mobility, including emergencies, errands, shopping, and even commuting.
- Visitors who do not have an automobile (i.e., business travelers and tourists who arrive by airplane, ship or train).
- As a backup option to motorists (i.e., when a vehicle fails, drivers have drunk alcohol, etc.).

Taxi service is often regulated, with restrictions on market entry and pricing, although many communities are shifting to more competitive markets (Moore and Rose, 1998). Informal taxi service often develops in rural communities where certain motorists will drive their neighbors for a fee.

Demand

Taxi demand is affected by the size of transportation disadvantaged population in an area, the portion of trips by transportation disadvantaged people that cannot be met by other modes, and the number of visitors who arrive in an areas without a car. Potential users can be surveyed and taxi commissions or companies in similar communities can be consulted to develop demand estimates.

Performance Indicators

Performance indicators include:

- Average response time for various conditions and locations.
- Number of taxis per capita, or per non-driver in an area.
- Price for an average trip relative to users' income.
- Comfort, safety, reliability, and courtesy of service.
- Number of taxis able to carry people with disabilities (i.e., wheelchair users).
- Number of problems reported by users.

Support for Transportation Objectives

Taxi service is an important transportation option for many people who are transportation disadvantaged. Conventional taxi travel does not reduce motor vehicle travel, and so does not support TDM objectives.

Support for Transportation Objectives

	Transportation Disadvantaged			**TDM**	
	Non-Drivers	Low-Income	Physically Disabled	Commuting	Non-Work Travel
Taxi	3	2	3	0	0

Rating from 0 (no benefit) to 3 (very beneficial).

Transit

Public transit includes various types of services, including:

- Fixed route bus.
- Express commuter bus.
- Light rail (smaller, lower-speed trams, in urban areas, with frequent stops).
- Heavy rail (larger, higher-speed trains, in suburban areas, with infrequent stops).

Demand Models

Most transportation models can provide information on public transit demand. More detailed studies are usually needed to determine how transit demand is affected by specific design or service changes.

Performance Indicators

Recent publications provide guidelines for evaluating public transit service quality (Kittelson & Associates, 1999). The Local Index of Transit Availability (LITA) rates transit service availability within urban areas, taking into account demographic and geographic factors (Rood, 1999). Transit service can be assessed with respect to specific mobility needs, such as welfare-to-work. Performance indicators include:

- Service coverage (transit routes within walking distance of residential, commercial and employment destinations) and frequency (number of transit vehicles per hour).
- Quality of pedestrian access to transit stops and stations.
- Service reliability, average wait time, and comfort (e.g., shelters at bus stops).
- Personal security while walking, waiting and riding on transit.
- Comfort (e.g., crowding and cleanliness of shelters and vehicles).
- Fares relative to users income.
- Average trip time costs, and how those compare with other modes (particularly driving).
- Number of problems reported by users.

Support for Transportation Objectives

Transit provides mobility to transportation-disadvantaged groups and helps achieve TDM objectives (VTPI, 2000, "Social Benefits of Public Transit). Commuter bus and heavy rail services generally provide relatively little benefit to transportation disadvantaged groups and for non-work travel, although there may be exceptions.

Support for Transportation Objectives

	Transportation Disadvantaged			TDM	
	Non-Drivers	Low-Income	Physically Disabled	Commuting	Non-Work Travel
Fixed Route Bus	3	3	3	3	3
Commuter Bus	1	1	1	3	1
Light Rail	2	2	2	3	2
Heavy Rail	1	1	1	3	1

Rating from 0 (no benefit) to 3 (very beneficial).

Paratransit

Paratransit uses small buses or vans to provide various types of transportation services (VTPI, 2000, "Shuttle Services"). Specific examples include:

- "Community Transportation" programs that provide special mobility services for disadvantaged groups.
- Flexible route, door-to-door transit service provided to the general public. This can be more efficient and attractive than fixed-route bus service in lower-density areas.
- Mobility-to-work programs that involve reverse-commute shuttle services between low-income neighborhoods and suburban employment centers (Multisystems, et al., 2000).
- Private "jitney" mini-bus services.

Demand

Demand can be evaluated based on the size of the group that would use such services.

Performance Indicators

Paratransit can be evaluated with the same level-of-service factors used for public transit, modified to reflect targeted users. For example, special mobility services can be evaluated based on the quantity of trips provided per potential user. Performance indicators include:

- Number of trips provided per potential user (i.e., people who qualify for the service).
- Portion of trips requested that are served.
- Average response time.
- Price for an average trip relative to users' income.
- Comfort, safety, reliability, and courtesy of service.
- Number of problems reported by users.

Support for Transportation Objectives

Paratransit provides mobility to transportation disadvantaged groups and helps achieve TDM objectives. These impacts depend on type of service.

Support for Transportation Objectives

	Transportation Disadvantaged			TDM	
	Non-Drivers	Low-Income	Physically Disabled	Commuting	Non-Work Travel
Community Transportation	2	2	3	1	1
Flexible-Route Transit	3	3	2	2	1
Mobility to Work	3	3	1	3	0
Private Jitney	3	3	1	3	2

Rating from 0 (no benefit) to 3 (very beneficial).

Interregional Bus and Rail

Interregional bus and rail services (e.g. Greyhound, Amtrak, Via Rail) provide mobility between cities and regions. Although most North American regions have rail or bus service, quality is often poor and prices are relatively high, making it unattractive and unaffordable to many users.

In many communities, long-haul bus service is infrequent, connections are difficult, terminals are inconveniently located and unattractive, support services are minimal, buses are sometimes unpleasant, and costs are far greater than what motorists would pay to drive the same distance (the poor quality of interregional bus service is striking compared with the service quality, amenities and support provided to interregional air service). As a result of poor quality and high costs, in many areas interregional bus service is stigmatized and used only by people who have no practical alternative (low-income, non-drivers).

Demand

Interregional travel models and studies may provide information for predicting demand for interregional bus and rail. On some corridors, a portion of medium-distance (100-500 mile) journeys could use interregional bus and rail service, rather than personal automobile or air travel, if service quality improved.

Performance Indicators

Interregional bus and rail can be evaluated with similar level-of-service factors used for public transit, modified as needed to reflect the special needs of longer-distance trips. For example, interregional bus and rail must accommodate baggage, and may have seasonal peaks that should be considered. Performance indicators include:

- Existence and frequency of interregional bus or train service to a community.
- Price of interregional bus or train service relative to user incomes and other travel modes.
- Average trip speeds.
- Convenience of connections with other routes and transportation services.
- Comfort, safety, reliability, and courtesy of service.
- Comfort and convenience of terminals, including connections with local transportation.
- Number of problems reported by users.

Support for Transportation Objectives

Interregional bus and train service is an important transportation options for non-drivers, particularly for short- and medium-distance trips, and to destinations not served by commercial air service. It is not usually used for commuting.

Support for Transportation Objectives

	Transportation Disadvantaged			TDM	
	Non-Drivers	Low-Income	Physically Disabled	Commuting	Non-Work Travel
Intercity Bus and Rail Services	3	3	3	1	1

Rating from 0 (no benefit) to 3 (very beneficial).

Commercial Air Travel

Commercial air services provide mobility between cities and regions. Commercial air service requires a suitable airport. Due to economies of scale, commercial air travel is often more expensive in smaller communities than in major cities.

Demand

Interregional travel models and studies may provide information that may be useful in predicting demand for commercial air travel.

Performance Indicators

Performance indicators include:

- Existence and frequency of commercial air service in a community.
- Price of air travel relative to user incomes and other travel modes.
- Comfort, safety, reliability, and courtesy of service.
- Number of problems reported by users.

Support for Transportation Objectives

A portion of commercial air travel serves basic mobility, including access to special medical services and family emergencies, particularly in isolated communities. Air service does not usually support TDM objectives (i.e., reductions in traffic congestion, facility costs, risk, pollution or consumer costs).

Support for Transportation Objectives

	Transportation Disadvantaged			**TDM**	
	Non-Drivers	Low-Income	Physically Disabled	Commuting	Non-Work Travel
Commercial Air Service	2	1	2	0	0

Rating from 0 (no benefit) to 3 (very beneficial).

Automobile

This refers to *motorists*, which includes people who can drive a personal automobile or are chauffeured (a driver makes a special trip). For this analysis, "automobile" includes cars, light trucks, vans and motorcycles. Many transportation disadvantaged people are motorists, including people with physical disabilities and low incomes, although age restrictions, the physical requirements of driving, and the financial costs of owning and operating an automobile limits many people's ability to drive.

Various management and pricing options, such as those listed below, can improve transportation options for motorists (VTPI, 2000):

- Distance-based Insurance makes insuring a low-annual-mileage vehicle more affordable, which can allow lower-income drivers to own a car, and other drivers to own an extra vehicle for special uses, such as an old truck for errands or a recreational vehicle.
- Some Parking Management strategies, such as improved user information, shared parking arrangement and overflow parking plans, give motorists better parking options.
- Parking Pricing can insure that motorists have a convenient parking space, provided that they are willing to pay for it.
- Road Pricing such as Value Pricing and HOT lanes, allow motorists to avoid congestion provided that they are willing to pay for it.

Demand Models

Conventional transportation demand models used in most communities provide information on automobile travel demand.

Performance Indicators

Level of Service standards exist for motor vehicle traffic flows (TRB, 1994). Performance indicators with respect to transportation options are described below.

- Portion of population licensed to drive.
- Portion of people with disabilities and low income licensed to drive.
- Portion of population that owns a personal automobile.
- Portion of people with disabilities and low income that own a personal automobile.
- Ability of drivers with disabilities to find convenient parking spaces.

Support for Transportation Objectives

Non-drivers are often chauffeured by automobile, and may lower-income and physically disadvantaged people drive automobiles. SOV travel does not support TDM objectives (which are often defined as reducing SOV travel).

Support for Transportation Objectives

	Transportation Disadvantaged			TDM	
	Non-Drivers	Low-Income	Physically Disabled	Commuting	Non-Work Travel
Automobile Travel	1	2	2	0	0

Rating from 0 (no benefit) to 3 (very beneficial).

Ridesharing

Ridesharing (carpooling and vanpooling) refers to a passenger using an otherwise empty automobile seat (ridesharing does not include chauffeured passengers, i.e., when drivers make a special trip). Rideshare matching services exist in many communities, and informal ridesharing is common among families, friends and neighbors.

Demand Models

No standard demand models currently exist for ridesharing.

Performance Indicators

Performance indicators include:

- Existence and quality of rideshare matching services in a community.
- Number of potential users registered by rideshare matching service.
- Number of successful rideshare matches and trips.
- Employee benefits offered rideshare users (such as Parking Cash Out).

Support for Transportation Objectives

Ridesharing benefits all categories of transportation-disadvantaged people, and supports TDM objectives.

Support for Transportation Objectives

	Transportation Disadvantaged			**TDM**	
	Non-Drivers	Low-Income	Physically Disabled	Commuting	Non-Work Travel
Ridesharing	3	3	3	3	3

Rating from 0 (no benefit) to 3 (very beneficial).

Vehicle Rentals and Carsharing

Vehicle rentals are common but mostly oriented toward particular markets, such as visitors to an area or people who need a van or truck to move a large load. Carsharing is an automobile rental service designed to substitute for private vehicle ownership (VTPI, 2000, "Carsharing"). Vehicles are rented by the hour, located near residences, and require minimal effort to check in and out.

Demand Models

Vehicle rentals are used by lower-income drivers who don't own an automobile, whose vehicle is temporarily not operating, who need a particular type of vehicle (such as a truck or van), or who are visiting another community. Carsharing tends to be most attractive to low- and middle-income residents of higher-density urban neighborhoods with good travel alternatives (i.e., good walking, cycling and public transit). It is considered a cost-effective alternative to owning an automobile that is driven less than 6,000 miles (10,000 kilometers) annually. Experience in Europe indicates considerable demand in some communities.

Performance Indicators

Performance indicators include:

- Number of rental and carshare vehicles per capita.
- Portion of residents living within a 10-minute walk of a carsharing station.
- Portion of population that regularly uses carsharing services.
- Vehicle rental and carshare rates relative to user income.

Support for Transportation Objectives

Vehicle rentals and carsharing benefits people who are low income. Because carsharing tends to reduce total per capita driving, it supports TDM objectives compared with car ownership.

Support for Transportation Objectives

	Transportation Disadvantaged			TDM	
	Non-Drivers	Low-Income	Physically Disabled	Commuting	Non-Work Travel
Vehicle Rentals and Carsharing	0	3	1	2	2

Rating from 0 (no benefit) to 3 (very beneficial).

Telecommunications

Electronic communications (telephones, Internet, and other communications services) can substitute for some physical trips, including work or school commutes, shopping, banking, government transactions, and research (Plaut, 1997; VTPI, 2000, "Tele-work).

Demand Models

Demand for telephones is nearly universal, and demand for Internet access is increasing as people become more familiar with the technology, and its practical uses. Organizations such as the International Telework Association and the Canadian Telework Association have developed guidelines indicating which employment categories, tasks and employees are most suitable for telecommuting.

Performance Indicators

Performance indicators include:

- Portion of households with telephone and Internet access.
- Portion of transportation-disadvantaged people telephone and Internet access.
- Portion of employers who allow telework.
- Portion of public services (banks, government agencies, libraries, etc.) that can be performed by telephone or Internet.

Support for Transportation Objectives

Telecommunications can benefit most transportation-disadvantaged people, and it can support TDM objectives, although how much this reduces automobile travel is uncertain.

Support for Transportation Objectives

	Transportation Disadvantaged			**TDM**	
	Non-Drivers	Low-Income	Physically Disabled	Commuting	Non-Work Travel
Telecommunications	3	3	3	3	3

Rating from 0 (no benefit) to 3 (very beneficial).

Delivery Services

Delivery services include postal systems, private couriers, and local delivery services for goods such as groceries. Such services can provide basic access for transportation-disadvantaged people and substitute for some car trips.

Demand Models

Various types of deliveries have different types of demand. There is no demand model for all types of delivery.

Performance Indicators

Various types of delivery services have different performance standards related to what can be carried, delivery speed, cost, etc.

- Range and quality of package delivery services (such as the availability and price of guaranteed overnight delivery).
- Portion of retail businesses (particularly those providing essential goods, such as grocery stores and pharmacies) that deliver, and the charges required.

Support for Transportation Objectives

Delivery services can benefit most transportation disadvantaged people, support telework (working at home), and substitute for some non-work travel.

Support for Transportation Objectives

	Transportation Disadvantaged			**TDM**	
	Non-Drivers	Low-Income	Physically Disabled	Commuting	Non-Work Travel
Delivery Services	3	2	3	1	3

Rating from 0 (no benefit) to 3 (very beneficial).

Transportation Management

Various transportation management strategies can improve transport diversity (VTPI, 2000):

- Flextime allows employees to adjust their travel schedules.
- Parking Cash Out allows commuters to choose between receiving free parking or another transportation benefit.
- Guaranteed Ride Home provides commuters with a fallback commute option.
- HOT lanes allow motorists the option of avoiding congestion if they pay a toll or rideshare.
- Most commute trip reduction, campus and school trip management, tourist trip management, and freight transport management programs improve transportation options and information about these options.

Some transportation management strategies have mixed impacts on transportation diversity. For example, Traffic Calming and New Urbanist development practices tend to improve nonmotorized transportation and transit, but reduces motorists' option of driving fast or taking short cuts through neighborhoods.

Demand

There tends to be considerable demand for transportation management strategies that increase diversity.

Performance Indicators

Performance indicators include:

- Implementation of TDM and Commute Trip Reduction programs.
- User involvement in developing TDM programs.
- Consideration of transportation diversity objectives in transport and TDM program planning.
- Least-cost transportation planning.

Support for Transportation Objectives

Transportation management strategies that improve transportation diversity can benefit people who are transport disadvantaged and help support TDM objectives. Some strategies primarily affect commuters, and HOT lanes provide minimal benefit to non-drivers and low-income people. Transportation management programs can support all transport diversity objectives, depending on their design and conditions.

Support for Transportation Objectives

	Transportation Disadvantaged			**TDM**	
	Non-Drivers	Low-Income	Physically Disabled	Commuting	Non-Work Travel
Flextime	3	3	3	3	0
Parking Cash Out	3	3	3	3	0
Guaranteed Ride Home	3	3	3	2	0
HOT lanes	1	1	3	3	2
TDM Programs	3	3	3	3	3

Rating from 0 (no benefit) to 3 (very beneficial).

Land Use Management

A variety of land use factors affect access and transport diversity (VTPI, 2000, "Land Use Impacts on Transportation"). Below are examples of land use management strategies that can improve access and transportation diversity:

- Increased land use density and mix (Smart Growth or New Urbanism).
- *Transit Oriented Development* and clustered commercial centers.
- *Location-Efficient Housing*, which maximizes the economic benefits to households that result from choosing a more accessible home location that reduces transportation costs.

Demand

Some studies indicate significant demand for New Urbanist and Location-Efficient housing, suggesting that some consumers prefer living in areas that offer improved transportation diversity.

Performance Indicators

Performance indicators include:

- Average annual per capita vehicle mileage.
- Average number of public services (e.g., schools, shops, medical offices) and employment within a ½ mile walk of residents.
- Overall quality of transit, walking and cycling conditions in an area.
- Affordability and quality of accessible neighborhoods, particularly for people who are transportation disadvantaged (i.e., can non-drivers afford to live in a nice neighborhood with good walking and cycling conditions, and good transit service).
- Degree to which zoning laws and development policies support accessible land use objectives (e.g., urban infill, clustering, Transit Oriented Development, etc.).

Support for Transportation Objectives

Land use management strategies that improve transportation diversity can benefit people who are transportation disadvantaged and help support TDM objectives.

Support for Transportation Objectives

	Transportation Disadvantaged			TDM	
	Non-Drivers	Low-Income	Physically Disabled	Commuting	Non-Work Travel
Smart Growth/New Urbanism	3	3	3	3	3
Transit Oriented Development	3	3	3	3	3
Location Efficient Housing	3	3	3	2	3
Accessible Employment Centers	3	3	3	3	1

Rating from 0 (no benefit) to 3 (very beneficial).

Summary

The table below summarizes how the twenty-five transportation options described above support the five transportation diversity objectives. This can help identify options that are particularly appropriate for achieving a particular objective. This analysis can be modified to meet the values and needs of a particular planning application.

Table 4 Summary of Transportation Diversity Evaluation

	Transportation Disadvantaged			TDM	
	Non-Drivers	Low-Income	Physically Disabled	Commuting	Non-Work Travel
Mobility Options					
Pedestrian	3	3	3	3	3
Universal Design	1	1	3	1	1
Cycling	3	3	1	3	3
Moped	1	2	1	1	1
Taxi	3	2	3	0	0
Fixed Route Bus	3	3	3	3	3
Commuter Bus	1	1	1	3	1
Light Rail	2	2	2	3	2
Heavy Rail	1	1	1	3	1
Intercity Bus and Rail Services	3	3	3	1	1
Commercial Air Service	2	1	2	0	0
Automobile Travel	1	2	2	0	0
Ridesharing	3	3	3	3	3
Vehicle Rentals and Carsharing	0	3	1	2	2
Mobility Substitutes					
Telecommunications	3	3	3	3	3
Delivery Services	3	2	3	1	3
Transportation Management					
Flextime	3	3	3	3	0
Parking Cash Out	3	3	3	3	0
Guaranteed Ride Home	3	3	3	2	0
HOT lanes	1	1	3	3	2
TDM Programs	3	3	3	3	3
Land Use Management					
Smart Growth/New Urbanism	3	3	3	3	3
Transit Oriented Development	3	3	3	3	3
Location Efficient Housing	3	3	3	2	3
Accessible Employment	3	3	3	3	1

This table indicates how much each transportation option supports various objectives.

Method 5: Network Analysis of Transportation Diversity

Below are some indicators that can be used to evaluate network level transport diversity.

Comparing Transportation Costs of Drivers and Non-drivers

Non-drivers can travel just about anywhere a driver can go, but their cost is often higher. A non-driver can hire a taxi or chauffeur, at a significant financial cost. They can walk or bicycle, but this often has high time, discomfort and risk costs. Transportation diversity can therefore be evaluated by comparing the generalized cost (financial and time, with time costs incorporating discomfort and risk factors) of travel between drivers and various types of non-drivers. This analysis can be disaggregated into different transportation disadvantaged groups, such as people with disabilities, people with low incomes, youths, elders, etc. The incremental costs they bear for basic access relative to motorists can be considered an indicator of transportation diversity.

Comparing Household Transportation Expenditures

Holtzclaw (1994) and McCann (2000) compare household surface transportation expenditures (i.e. automobile and transit) by geographic area. The higher expenditures associated with automobile-dependent land use can be considered, in part, to reflect a lack of transportation options. This analysis can also be disaggregated into different groups, such as households with low incomes, youths, elders, etc. For example, if low-income residents in one area spend 30% more on transportation than otherwise similar residents in another area, the difference may be explained by differences in transport diversity. Higher expenditures may be considered a cost of inferior transport options.

Mobility, Cost and Satisfaction Surveys

Another approach for evaluating the quality of transportation diversity is to survey users (residents, commuters and visitors to an area) concerning the quality of transportation they experience, with special attention to comparing differences in mobility, costs and satisfaction between motorists (people who can driver and afford an automobile) and people who are transportation disadvantaged.

Mode Split

Another indictor of transportation diversity is the mode split in an area compared with otherwise similar communities. For example, a neighborhood with higher levels of walking, cycling and transit than other neighborhoods with similar demographics can be considered to offer relatively good transport options. Even relatively small differences (i.e., between 4% and 8% of total trips made by transit) may represent a significant difference the quality of service available to non-drivers.

Method 6: Planning Process Analysis of Transportation Diversity

This approach evaluates how well the planning process incorporates transportation diversity objectives. The following are indicators of whether transportation diversity is given appropriate consideration and support.

- Transportation is evaluated based on access rather than vehicle traffic or mobility (VTPI, 2000, "Measuring Transportation").
- Non-motorized trips are considered equally in travel surveys and models (VTPI, 2000, "Evaluating Nonmotorized Transportation").
- Transportation surveys and other data collection activities effectively incorporate transportation-disadvantaged populations.
- Transportation disadvantaged populations are consulted and effectively involved in transportation policy and planning decisions.
- Transportation services and policy options are evaluated from different perspectives, including the perspectives of transportation disadvantaged people.
- Least Cost planning principles are followed in transportation planning and funding (VTPI, 2000, "Least Cost Planning").
- A broad range of costs is considered, including vehicle ownership costs, parking costs, safety and health costs, and environmental impacts.
- Equity and basic mobility objectives are incorporated in transportation planning (VTPI, 2000, "Evaluating Equity").
- Land use accessibility factors are considered in transportation planning (VTPI, 2000, "Land Use Impacts on Transportation").
- At least some neighborhoods are suitable for people who are transportation disadvantaged, with good walking and cycling conditions, good public transit services, and convenient access to basic services such as shops and parks (VTPI, 2000, Location Efficient Development," and "Transit Oriented Development").
- Transportation policies and planning practices support development and use of a wide range of transportation options, including nonmotorized travel, shuttle services, transit, carsharing, delivery services and tele-access. For example, Parking Cash Out is implemented to allow non-drivers benefits similar in value to parking subsidies, and Parking Management is implemented to allow non-drivers to avoid paying for parking spaces they don't use.

Land Use Factors

As mentioned earlier, land use patterns affect accessibility and transport system quality. Automobile-oriented land use patterns are offer few transportation options for non-drivers, making them mobility disadvantaged. Accessibility and basic mobility can be improved by locating more activities closer together, increasing land use mix, creating more connected road and path networks, and designing more mulit-modal streets.

Evaluating Investments That Increase Transportation Diversity

Many transportation diversity benefits are difficult to measure so it can be difficult to determine exactly how much society should invest in a particular option. It may seem most fair and efficient to allocate public resources based on current travel activity, so if walking represents 2% of travel then it should receive 2% of transport funding. From this perspective, many transport diversity improvements may seem inefficient and unfair.

But current practices tend to create an inefficient, self-fulfilling prophecy: if alternative modes receive inadequate support, their quality of service is inferior, use is low, and so they continue to receive inadequate support. As a result, they may never achieve their true potential. There are several justifications for increasing support for alternative modes beyond what is indicated by current travel surveys and models.

- Current transportation surveys and models tend to undercount use of alternative modes, particularly nonmotorized travel (VTPI, 2000, “Measuring Transportation”).
- Non-drivers and lower-income people tend to take shorter trips and travel less per year than motorists and higher income people. Much greater funding per passenger-mile can be justified for alternative modes in order for non-drivers to receive a fair share of transportation funds. For example, although since people who are transit dependent tend to travel less than one-third as many miles per day as motorists, an equal per capita expenditure would result in three times the public funding for transit as automobile travel per passenger-mile.
- Improvements to alternative modes may be justified to provide basic access. The most cost effective way to improve access to medical services, education, employment, and other basic services to transport disadvantaged people is often an improvement to non-automotive travel.
- Some alternative modes are particularly cost effective under urban-peak conditions, where automobile improvements are relatively expensive. Although transit improvements are expensive in congested urban areas, increasing roadway capacity on the same corridor is often even more expensive.
- Paths and trails for nonmotorized modes are justified for recreation as well as transportation purposes. For that reason, a portion of the cost of building such facilities can come from recreation budgets, rather than transportation budgets.
- The cost burden of automobile travel is dispersed, and so many costs tend to be ignored in conventional investment analysis. Vehicle ownership, parking facility expenses, and other external costs are often overlooked, making highway investments appear cheap relative to transit investments (VTPI, 2000, “Evaluating TDM”).

For these reasons, non-automobile transportation modes may deserve a far greater portion of transportation resources than indicated by their portion of trips or passenger-miles.

Conclusions

Transportation diversity refers to the quantity and quality of transportation options available to an individual or group, taking into account their differing needs and abilities. It includes various modes, transportation services and pricing options. Transportation diversity can provide a variety of benefits. Increased options can help solve many specific transportation problems, and tends to create a more efficient, equitable and robust transportation system.

Because many of these benefits are difficult to measure, it is difficult to determine exactly what level of transport diversity is optimal, but it is almost certainly greater than what is recognized by current planning practices. Arbitrary barriers to transport diversity tend to be economically harmful and unfair, particularly if they reduce the options available to transportation disadvantaged people.

Transportation diversity includes not only the type of modes and vehicles, but also the range of service and price options available. For example, consumers can benefit from being able to choose between different levels of transit service, since they sometimes place greater value on financial savings and at other times on comfort or speed. Similarly, motorists can benefit from being able to pay for different levels of road and parking services, such as Value Pricing lanes that provide higher travel speeds for toll payers, and the option of more convenient but paid parking. Transportation options can also include improved pricing options such as carsharing, distance-based vehicle insurance, and Parking Cash Out. Because transportation and land use are interrelated, transport diversity can also include land use and location options, such as the ability to afford living in a more accessible, less automobile-dependent neighborhood.

In order to evaluate transportation diversity it is useful to prioritize trips, recognizing that some types of transportation, called “basic access,” provide a very high value to society. It would be difficult to underestimate the economic and social benefits of basic access, that is, the ability of people and industry to reach the goods, services and activities they need.

This indicates that evaluating transportation diversity requires economic analysis, not simply engineering analysis. For example, it is not adequate to simply determine whether a particular travel option exists and is physically accessible, it is equally important to determine whether it is affordable, particularly to people who rely on it for basic access.

In general, most transportation and land use systems do a good job of accommodating automobile transportation. Motorists can drive to most destinations with modest cost, discomfort or risk. Improving transportation diversity involves improving alternatives to automobile transport, creating more accessible land use options, and providing new options for motorists, such as carsharing. Although most of these strategies individually affect only a small portion of total travel, they have large network effects if several coordinated strategies are implemented together.

Transportation diversity goals and solutions tend to be defined narrowly. Conventional transportation planning tends to recognize some, but not all of these benefits. Other benefits are difficult to measure and so are often overlooked and undervalued. Similarly, conventional planning tends to focus on a limited set of solutions, often a special mobility service to deal with a specific problem.

This paper describes a more comprehensive range of transportation diversity objectives and solutions, and describes several methods for evaluating transportation options. Some methods focus on particular transportation problems, others on particular transportation modes, and others focus on the transportation planning process. These methods can be modified as needed to meet the requirements of a particular planning application.

Twenty-five specific transportation options are considered, including mobility modes, substitutes for physical travel, and land use strategies that improve access. This is a broader range of solutions than is usually considered in transport planning. Many of these solutions are justified for a number of reasons, including consumer benefits, reduced transportation problems, economic benefits, and community livability. An optimal transportation system would probably be more balanced, with better transport options and less automobile use.

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