3. Economic Evaluation

This chapter describes common applications of transportation benefit and cost analysis, including evaluation of transport policies and projects, pricing, mobility management, equity impacts and economic development.

3.1 Chapter Index

3.2 Defining Economic Evaluation

Economic Evaluation (also called *Appraisal*, *Assessment* or *Analysis*) refers to methods to determine the value of a good, service, activity, policy, program or project. This can help guide decisions toward *optimality*, which refers to maximum social benefit. Economic evaluation involves quantifying *incremental* (also called *marginal*) economic *impacts* (*benefits* and *costs*) to determine *net benefits* or *net value* (benefits minus costs), and the *distribution* (also called *incidence*) of these impacts. Economic evaluation is not limited to *market* (measured in monetary units) impacts, it can also incorporate *non-market* resources such as personal time, health and environmental quality. Any good that somebody values is an *economic resource*, including non-market goods. Chapter 4 describes methods used to monetize (measure in monetary units) non-market impacts.

Several specific techniques are used for transportation economic *evaluation*.[1]

- *Cost-Effectiveness* compares the costs of different options for achieving a specific objective, such as building a particular road or meeting a greenhouse gas emission reduction target. The quantity of outputs (benefits) are held constant, so there is only one variable, the cost of inputs.
- *Benefit-Cost Analysis* compares total incremental benefits with total incremental costs. It is not limited to a single objective or benefit. For example, alternatives may differ in construction costs and the quality of service (speed and safety) they provide.
- *Lifecycle Cost Analysis* is Benefit-Cost Analysis that incorporates the time value of money. This allows comparisons between alternatives that provide benefits and costs at different times. For example, one option may cost more but be quicker to implement than another.
- *Least Cost Planning* is a type of Benefit-Cost Analysis that considers demand management on equal terms with capacity expansion.
- *Multiple Accounts Evaluation* incorporates both quantitative and qualitative criteria, and can be used when some impacts cannot be monetized or to allow decision makers to evaluate each impact.
- Some evaluation techniques measure physical impacts and outcomes, such as health, longevity, education levels, crime and personal satisfaction with life, without converting them into dollar values (Cobb, Halstead and Rowe, 1999; GDRC, 2000).

[1] Todd Litman (2001), *What's It Worth? Life Cycle and Benefit-Cost Analysis for Evaluating Economic Value*, Victoria Transport Policy Institute (www.vtpi.org).

Analysis Perspective and Scope

Different types of evaluation use different perspectives and scopes. Some are only concerned with certain impacts, groups, areas or time periods, while others are more comprehensive. Common transportation evaluation perspectives are described below.

Individuals and Private Firms

Individual consumers are generally concerned with their direct, internal impacts, including both market costs such as expenditures on fares and vehicles, and nonmarket costs such as travel time, discomfort and safety. Similarly, private firms are concerned with their costs, including vehicle and labor costs. However, the term *consumer* implies an overly narrow perspective. Consumers are *people* with diverse interests, and most people care about indirect and external impacts that affect community livability, environmental quality, equity, and the efficiency of government services. Consumers and businesses may be willing to pay extra for transport options that provide community benefits such as improved livability, environmental quality, equity and sustainability.

Public Agency

Public agencies often evaluate options based on their own mandate and budget. For example, a city parking agency will identify the most cost-effective investment for increasing parking supply. As described earlier, this can result in conflicts between different agencies. For example, from this perspective, a city parking authority might implement parking 'improvements' that increase traffic congestion or environmental problems, and might fail to implement parking solutions that also help achieve other objectives, such as improved mobility for non-drivers. A narrow agency perspective can therefore result in decisions that make society worse off overall.

Conventional Transportation Evaluation

Conventional transport program and project economic evaluation tends to focus on a particular set of monetized impacts: project costs, travel time savings, crash costs on the roadway in question and vehicle operating costs.[2] Vehicle ownership and parking costs are occasionally included. Other impacts, such as pollution emissions and land use impacts are sometimes recognized but not usually quantified.

Comprehensive Community Perspective

More comprehensive transport planning considers a broader range of direct and indirect impacts occurring in community, including some impacts ignored by conventional transport economic evaluation, such as downstream congestion, vehicle ownership costs, parking costs, environmental impacts, mobility of non-drivers, equity objectives and land use impacts.[3] This tends to favor alternative modes and mobility management strategies, because it takes into account a wider range of impacts and users.

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[2] TTI (1997), *MicroBENCOST*, Texas Transportation Institute (http://tti.tamu.edu/); World Bank (2000), *Highways Design and Maintenance (HDM) 4 Model*, World Bank (www.worldbank.org).

[3] Todd Litman (2006), *Comprehensive Transport Planning Framework: Best Practices For Evaluating All Options And Impacts*, VTPI (www.vtpi.org); at www.vtpi.org/comprehensive.pdf.

Strategic or Comprehensive Planning

Strategic or *comprehensive* planning considers a wide range of economic, social and environmental impacts, including effects on long-term community development objectives, such as increasing transportation diversity, more efficient land use, and economic development. It represents comprehensive transport planning applied at a larger geographic and temporal scale. For example, a community, regional or state planning agency may develop a comprehensive plan that identifies strategic objectives, taking into account nonmarket, indirect and long-term impacts.

Sustainability Planning

Sustainability planning involves a wide scope of analysis, including nonmarket, indirect and long-term impacts in other regions and to future generations. It involves special efforts to evaluate difficult to measure impacts.

Equity Analysis

Equity analysis concerns the distribution of impacts, that is, who enjoys benefits or bears costs. Equity evaluation practices are described later in this chapter. Equity analysis can be applied to any evaluation perspectives. For example, equity evaluation may involve identifying how transportation impacts are distributed among demographic and geographic groups, and whether some groups are unacceptably disadvantaged.

Table 3.2-1 summarizes the scope of costs and benefits that are typically considered by these different evaluation perspectives. Of course, a particular evaluation may include more than one perspective and so its scope and emphasis may vary.

Table 3.2-1 **Impacts Considered By Different Analysis Perspective**

Perspective	Scope of Impacts	Impacts Typically Considered
"Selfish" consumers and firms	Direct, internal (to that consumer or firm).	Users' vehicle costs, travel time, discomfort, risk and pollution exposure.
"Considerate" consumers and firms.	Internal and external impacts to their community.	Vehicle costs, travel time, impacts on non-drivers.
Government agency – reductionist perspective	Agency expenses and specific planning objectives.	Agency expenditures, mobility, congestion, accident rates, pollution emissions.
Conventional Transportation Evaluation	Project financial costs and various user benefits.	Project expenses, user travel time, crash risk and vehicle operating costs.
Comprehensive Community Perspective	Direct economic, social and environmental impacts to community members.	Project expenses, travel time, vehicle costs, parking costs, crash risk, environmental impacts.
Strategic or Comprehensive Planning	Direct and indirect, short- and long-term, market and non-market impacts throughout a region.	Project expenses, mobility, vehicle costs, parking costs, crash risk, environmental impacts, land use impacts, transport diversity.
Sustainability Planning	All direct, indirect and long-term economic, social and environmental impacts including global-scale impacts.	All impacts, with special consideration to long-term, nonmarket, and difficult to measure social and ecological impacts such as climate change.
Equity Analysis	Can be added to any perspective.	Includes equity analysis

This table summarizes the typical scope and impacts considered by different evaluation perspectives.

Best Practices

A narrow scope reflects a *reductionist* approach; that is, individual problems are assigned to specialized organizations with narrowly defined responsibilities. This can lead to suboptimal decisions because an organization may implement solutions that exacerbate problems outside of its responsibility, and it undervalues strategies that provide multiple but modest benefits. For example, a transportation agency might implement a freeway widening project to reduce traffic congestion (its primarily responsibility), although this increases parking, traffic on municipal roads, and environmental problems (considered outside its responsibility), and will tend to undervalue alternative solutions, such as transit improvements and commute trip reduction programs (that provide more modest congestion reduction benefits on the stretch of freeway in question, but also help address parking and environmental problems).

It is generally best to use a comprehensive evaluation framework, and highlight impacts of special consideration. For example, a transport project funded by a local government might provide $5 million in annual benefits to residents of that jurisdiction, plus $2 million to residents of other communities. Rather than ignoring external benefits, the project evaluation should identify the full $7 million annual benefits, and indicate the portion provided to residents of the sponsoring city. Similarly, costs imposed on people outside the jurisdiction should be identified.

3.3 Policy and Project Evaluation

Accurate policy and project evaluation requires comprehensive analysis. As described earlier, evaluation that ignores some impacts can result in solutions to one problem that exacerbate other problems.[4] Conventional transport evaluation practices were developed to compare relatively similar options, such as alternative highway alignments, and tend to be unsuited to evaluating alternative modes or management strategies that affect transportation diversity or total vehicle mileage. Table 3.3-1 compares conventional and comprehensive transportation evaluation practices.

[4] Todd Litman (2005), *Efficient Vehicles Versus Efficient Transportation*, VTPI (www.vtpi.org); at www.vtpi.org/cafe.pdf

Table 3.3-1 **Conventional and Comprehensive Evaluation**[5]

	Description	Conventional	Comprehensive
Selection of Options	The range of solutions that are considered, including capacity expansion and TDM programs.	Often ignores TDM options	Includes TDM options
Investment Practices	How funding is allocated, and the flexibility with which it can be used for the best overall option.	Favors large investments	Applies least-cost planning
Underpricing	Degree to which vehicle use is underpriced, resulting in excessive travel demand.	Ignored	Considered
Modeling Practices	Whether transport modeling uses current best practices to predict travel and economic impacts.	Limited analysis capability	More comprehensive
Measuring Transportation	Methods and perspectives used to measure travel (vehicle traffic, mobility or accessibility)	Measures vehicle traffic	Measures accessibility
Uncoordinated Decisions	Whether transport and land use decisions are coordinated to support strategic regional objectives.	Not considered a problem	Considered a problem
Generated Traffic	Whether modeling and planning take into account generated traffic and induced travel impacts.	Ignores many impacts	Includes all impacts
Downstream Congestion	Additional congestion on surface streets that results from increased highway capacity.	Often ignored	Generally considered
Consumer Impacts	Techniques used to evaluate the consumer impacts of changes in the transport system.	Travel time changes	Consumer surplus analysis
Vehicle Costs	Whether all vehicle costs and savings are considered, including long-term costs.	Only short-term operating costs	All affected vehicle costs
Parking Costs	Parking costs, including costs borne by motorists, businesses and governments.	Only if paid by motorist	Includes
Construction Impacts	Whether increased congestion delays during construction periods are considered in evaluation.	Ignores	Includes
Nonmotorized Travel Impacts	Accessibility, convenience, safety, comfort and cost off walking and cycling.	Ignores	Includes
Transportation Diversity	Quantity and quality of travel options (particularly those used by non-drivers) are considered.	Limited analysis	Comprehensive analysis
Environmental Impacts	Impacts on air, noise and water pollution; greenspace preservation and community livability.	Limited analysis	Comprehensive analysis
Impacts on Land Use	The degree to which each option supports or contradicts strategic land use objectives.	Ignores	Includes
Equity Impacts	The degree to which each option supports or contradicts community equity objectives.	Limited analysis	Comprehensive analysis
Safety and Health Impacts	Impacts on traffic safety, personal security and public health.	Per vehicle-mile crash risks	Per-capita health risks

This table summarizes differences between conventional and comprehensive transport planning. Conventional evaluation is poorly suited for evaluating alternative modes or TDM strategies.

[5] Todd Litman (2006), *Comprehensive Transport Planning Framework: Best Practices For Evaluating All Options And Impacts*, VTPI (www.vtpi.org); at www.vtpi.org/comprehensive.pdf.

Best Practices

In general, policy and project evaluation should be as comprehensive as possible. Any cost or benefit that may be significant should be considered, including indirect, long-term and non-market impacts. It is particularly important to use a comprehensive evaluation framework when comparing alternatives that affect the range of transportation options available, or the total amount of vehicle travel that will occur in an area.

Some impacts are unsuitable for quantification, but should still be considered qualitatively in this analysis. For example, it is difficult to place a dollar value on the degree that a particular policy or project supports a community's strategic development or equity objectives, but it is important that these factors be described and quantified as much as possible as part of an evaluation process. Various rating systems and Level of Service (LOS) standards can be used to rank and prioritize these qualitative factors.

Information Sources

CUTEP (2001), *Guide to Transportation Benefit-Cost Analysis*, Committee on Urban Transportation Economics and Policy (CUTEP) of the Urban Transportation Division, American Society of Civil Engineers (www.asce.org); at http://ceenve.calpoly.edu/sullivan/cutep/cutep_bc_outline_main.htm

DETR (2000), *Guidance on the Methodology for Multi-Modal Studies*, Department of the Environment, Transport and the Regions (www.dft.gov.uk / www.defra.gov.uk); at www.info4education.com/CIS/SiteMap/D/DETR.asp?AuthCode=

Todd Litman (2001), *What's It Worth? Life Cycle and Benefit/Cost Analysis for Evaluating Economic Value*, Presented at Internet Symposium on Benefit-Cost Analysis, Transportation Association of Canada (www.tac-atc.ca); at VTPI (www.vtpi.org/worth.pdf).

NHI (1995), *Estimating the Impacts of Urban Transportation Alternatives*, National Highway Institute, Course 15257, USDOT (www.nhi.fhwa.dot.gov).

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

VTPI, *Online TDM Encyclopedia* chapters:
"Evaluation" (www.vtpi.org/tdm/tdm14.htm).
"TDM Planning" (www.vtpi.org/tdm/tdm50.htm)
"Comprehensive Transport Planning" (www.vtpi.org/tdm/tdm76.htm).

3.4 Pricing

Pricing refers to fees and financial incentives, including fares, vehicle fees, fuel taxes, road tolls, parking fees, vehicle insurance premiums, and other vehicle charges. For example, if driving a particular vehicle on a particular road at a particular time imposes costs totaling 25¢ per mile, motorists should be charged this amount. A vehicle, route or travel time that imposes lower costs should have a lower fee, and a vehicle, route or travel time that imposes higher costs should have a higher fee. This type of pricing results in economic efficiency. Efficient prices convey information about the costs of producing goods and the value that consumers place on goods. For example, it would be inefficient for a consumer to take a trip that they only value at $2 if the trip imposes costs totaling $5 (including vehicle, roadway, parking, crash risk and environmental damage costs). Such trips make society worse off overall.

There is growing interest in transportation pricing reforms.[6] Economists have long recommended pricing to manage congestion, facility costs and pollution.[7] Pricing strategies can help achieve demand management objectives.[8] Environmentalists recommend shifting taxes from desirable activities (such as labor and investment) to consumption activities, such as driving, that impose externalities.[9] Others support price and tax policies that encourage more efficient resource consumption.[10]

Optimal Transport Pricing

Optimal pricing means that prices are structured to maximize benefits to society. Optimal transport prices can reflect various perspectives and assumptions, as described below.

- *Short-Run Marginal Cost* (SRMC) considers a relatively limited set of variable costs, that is, the costs incurred by an individual trip, such as vehicle operating expenses, congestion, roadway wear, incremental crash risk and pollution emissions. Vehicle ownership costs, facility, and other fixed and sunk costs are generally ignored. SRMC pricing results in minimal fees charged for using road and parking facilities during uncongested periods.

- *Long-Run Marginal Cost* (LRMC) considers all long-run variable costs, that is, capital and operating costs, including vehicle ownership and roadway facility costs, and may include the opportunity costs of roadway land. Sunk costs (those which cannot be recovered, even if the facility were sold) can be ignored.

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[6] VTPI (2008), "Market Reforms," *Online TDM Encyclopedia*, (www.vtpi.org); at www.vtpi.org/tdm/tdm29.htm

[7] Anthony Downs (1992), *Stuck in Traffic*, Brookings Institute (www.brookings.edu).

[8] ICF Incorporated (1997), *Opportunities to Improve Air Quality Through Transportation Pricing Programs*, USEPA (www.epa.gov).

[9] Alan Durning and Yoram Bauman (1998), *Tax Shift*, Northwest Environment Watch (www.sightline.org).

[10] Timothy O'Riordan (1997), *Ecotaxation*, EarthScan (www.earthscan.co.uk).

- *Cost recovery* (also called *cost responsibility* or *fully allocated costs*) is similar to LRMC, but requires that all costs, including sunk costs, should be recovered from users.[11]

- *Facility expenditures.* Some perspectives consider only direct expenditures by a government agency or business when calculating costs. For example, tolls may be designed to recover highway costs, or parking fees may be designed to recover parking facility costs, with little or no consideration to other costs such as congestion, crash risk or environmental impacts.

- *Revenue maximization.* Private companies and some government agencies set prices to maximize revenue. This requires information on consumer demand for transportation activities, and often results in different prices for different groups and travel conditions.

- *Comprehensive cost.* Some perspectives include various indirect costs and non-market costs. For example, it may include charges for traffic congestion, barrier effects, crash risk, and pollution, and even undesirable land use impacts.

- *Progressive pricing.* Some people are concerned with vertical equity, that is, how public policies affect disadvantaged people, and so favor progressive pricing (lower income people pay relatively less than higher-income people). For example, they may favor funding road and parking facilities through general taxes, or user fees that include discounts for lower-income people.

- *Transaction costs and inconvenience.* Officials responsible for implementing pricing, and consumers who pay fees, may want to minimize transaction costs, including administrative costs to collect fees, and inconvenience to consumers to pay fees. As a result, officials often prefer to increase an existing tax or fee rather than establishing a new fee, and support simpler rate structures with fixed fees over more variable pricing.

Because of these various perspectives, different evaluation studies reach different conclusions as to what constitutes optimal pricing. Some economists emphasize short-run marginal cost pricing for the sake of economic efficiency. From this perspective, there is no need to charge travelers for sunk or fixed costs, since these are non-marginal, or to structure vehicle fees so they fully recover the costs of facilities and services.

Others emphasize cost recovery pricing, which can be justified on three grounds.[12] The first is horizontal equity, which implies that users should "get what they pay for and pay for what they get." If users pay less than the total cost they impose, somebody else subsidizes their consumption. The second is that cost recovery represents long-run marginal costs, that is, the full costs of providing a facility or service over its lifetime. The third justification is economic neutrality. Since prices in most markets are based on

[11] FHWA (1997) *1997 Federal Highway Cost Allocation Study*, (www.fhwa.dot.gov); Joseph Jones and Fred Nix (1995), *Survey of the Use of Highway Cost Allocation in Road Pricing Decisions*, Transportation Association of Canada (www.tac-atc.ca).

[12] Douglass Lee (1997), "Uses and Meanings of Full Social Cost Estimates," *The Full Costs and Benefits of Transportation*, Springer (www.springer.com), pp. 113-148.

cost recovery, transport services should be priced comparably. Such pricing encourages consumers and managers to use resources efficiently.[13] As Douglass Lee states,

> "From a short-run perspective, FCP ["Full Cost Pricing," Lee's term for cost recovery] is primarily an equity issue, but in the long run it has consequences for efficiency. First, agencies forced to recover all costs from their consumers will seek and find ways to reduce costs for each level of output. In addition, highway providers will be more careful to invest in productive facilities...FCP is aimed at efficiency through the concept of economic neutrality. Unless there is a particular reason to favor one activity or enterprise over another, then the government should attempt to make all decision making in the private sector neutral with respect to economic choices of pricing, investment, and whether to stay in business"[14]

Some people emphasize the importance of pricing that reflects vertical equity objectives, that is progressive and includes provisions for people who have special disadvantages, such as discounts for children, elderly and disabled groups.

Others emphasize administrative convenience and transaction costs. This tends to favor fixed pricing, with little or no difference between different types of vehicles or travel conditions. Such pricing is sometimes also promoted for the sake of horizontal equity, that is, charging all users an equal fee.

Best Practices

Different costs require different types of prices.[15] In theory, each estimated external costs of driving should be priced to internalize costs as accurately as possible. Congestion costs require variable road pricing. Parking costs require parking fees that differ by location and time. Pollution costs require an emission fee that reflects a vehicle's emission rate and annual mileage. Table 3.4-1 illustrates the theoretically most appropriate price categories for various transport costs.

Table 3.4-1 **Pricing of Various Transportation Costs**

	Roadway	Parking	Congestion	Crash	Pollution
Road Tolls (fixed rates)	X				
Congestion Pricing (variable rates)	X		X		
Parking Pricing		X			
Distance-Based Fees	X			X	X
Fuel Taxes					X
Pay-As-You-Drive Insurance				X	

Different costs imposed by vehicles require different types of pricing. This table illustrates what type of pricing is theoretically most appropriate for internalizing different costs.

[13] Gabriel Roth (1996), *Roads in a Market Economy*, Avebury Technical.
[14] Douglass Lee (1995), *Full Cost Pricing of Highways*, Volpe Transportation Systems Center (www.volpe.dot.gov).
[15] Todd Litman (2008), *Socially Optimal Transport Prices and Markets*, VTPI (www.vtpi.org); at www.vtpi.org/sotpm.pdf

Of course, a variety of factors must be considered in determining appropriate pricing, including transaction costs, political acceptability and equity objectives. For example, road pricing may be unsuitable in many situations, due to high implementation costs. In such situations, a weight-distance fee may be more appropriate. If that is not politically feasible, fuel taxes may be the best pricing strategy for funding roads and internalizing other costs. Although it is impractical to impose perfect pricing (that is, user fees that reflect the exact costs imposed by each individual vehicle for each instant of travel), prices can be far more efficient and fair than what currently exists.

Optimal pricing requires balancing efficiency, equity and convenience. Below are guidelines for optimal pricing based on a combination of objectives:[16]

1. *Identify all possible costs.* This includes direct costs, such as roadway construction and maintenance, accident risk and pollution costs from vehicle use, and opportunity costs, such as the value of land used for roadways.

2. *Price as close to marginal cost as is feasible*. Prices should vary by vehicle type, location and time. For example, road tolls and parking fees should be higher for larger vehicle, and under urban-peak conditions. Use a cost-effective pricing system, with long-run administrative costs of less than about 20% of revenue if possible.

3. *If marginal pricing revenue is insufficient to cover total costs, charge a basic user fee according to cost allocation principles.* For example, charge a basic road toll or parking even during off-peak periods as a way to repay facility costs.

4. *Charge rents (return on investment of capital expenditures) and general taxes or their equivalent in addition to special charges.* For example, vehicle fuel should be charged general sales taxes in addition to any special road user taxes, and land used for parking facilities and roadway rights-of-way should be charged property tax or an equivalent fee, regardless of whether it is privately or publicly owned.

5. *Subsidize services needed to ensure "basic mobility" (i.e. access to education, employment, and essential public services for disadvantaged groups)*. In theory basic mobility subsidies should be narrowly targeted at disadvantaged groups to avoid economic distortions, but exactly how narrow is a question of practical and political feasibility. If all other pricing is optimal, subsidies can originate from general funds, but to the degree that travel is underpriced, cross subsidies between groups of transportation users may be justified. For example, motor vehicle charges may be used to subsidize transit services until all externalities are internalized.

[16] ibid

Information Resources

CFIT (2002), *Paying For Road Use*, Commission for Integrated Transport (www.cfit.gov.uk); at www.cfit.gov.uk/docs/2002/pfru/index.htm

European Transport Pricing Initiatives (www.transport-pricing.net) includes various efforts to develop more fair and efficient pricing. Specific European transportation pricing research projects include:

AFFORD (www.vatt.fi/afford) is an evaluation of optimal transportation pricing policies.

CAPRI (www.its.leeds.ac.uk/projects/capri) is disseminating research on transport pricing.

ExternE (www.externe.info) involves research into external costs of transport.

IMPRINT (www.imprint-eu.org) promotes fair and efficient transport pricing.

PETS (www.cordis.lu/transport/src/pets.htm) assesses current pricing of transport modes in European Union member countries.

UNITE (www.its.leeds.ac.uk/projects/unite) involves transport cost accounting.

Timothy D. Hau (1998), *Congestion Pricing and Road Investment*, University of Hong Kong (www.sef.hku.hk); at www.econ.hku.hk/~timhau/download.html

Todd Litman (2007), *Socially Optimal Transport Prices and Markets*, VTPI (www.vtpi.org); at www.vtpi.org/sotpm.pdf

Todd Litman and Allen Greenberg (2000), *Response to Mark Delucchi's "Should We Try to Get the Prices Right?"* VTPI (www.vtpi.org).

William Vickrey (1992), *Principles of Efficient Congestion Pricing*, Columbia University (www.columbia.edu); at www.vtpi.org/vickrey.htm.

William Vickrey (1994), *Public Economics; Selected Papers by William Vickrey*, Cambridge University Press (www.uk.cambridge.org).

VTPI, *Online TDM Encyclopedia* chapters:
"Evaluation" (www.vtpi.org/tdm/tdm14.htm).
"Market Reforms" (www.vtpi.org/tdm/tdm29.htm).
"Price Evaluation" (www.vtpi.org/tdm/tdm70.htm).

3.5 Cost Allocation

Cost allocation (also called *cost responsibility*) refers various methods used to determine the share of a particular facility or service's costs imposed by various types of users. This is often used to determine fair and efficient pricing. These methods are usually applied to roadway costs, but most principles are transferable to other transportation activities, including paths, freight, and public transportation services.

Types of Infrastructure Costs

- *Short Run Marginal Cost* (SRMC) only includes costs imposed using current capital resources, ignoring all other costs, including the costs of building infrastructure such as vehicles and roads.
- *Long Run Marginal Cost* (LRMC) includes all costs imposed, including the costs of building capital resources, but ignoring all *sunk costs* (unrecoverable costs already incurred, such as the costs of constructing infrastructure)
- *Fully Allocated Costs* (FAC) includes all infrastructure costs, including sunk costs, allocated among users in some way that is considered most equitable.
- *Pay-As-You-Go* (PayGo) means that financial investments made each year are allocated to users as a group during that year, so no funds need be borrowed.

There are various perspectives and methods for defining costs and evaluating their allocation. How costs are defined and evaluated can significantly affect the costs and fees allocated to a particular travel activity. For example, Short Run Marginal Cost only considers immediate costs, such as road wear, and any incremental congestion delay, accident risk and environmental impacts imposed by a unit of vehicle travel. Other costs, including the costs of building infrastructure, and wear that results from aging and weather, are excluded. Long Run Marginal Cost includes all ongoing costs of building and maintaining infrastructure and accommodating additional capacity if needed, but may ignore sunk costs, such as past construction costs, and by many interpretations, the value of land devoted to infrastructure (this is actually incorrect, since almost all land has an opportunity cost that should be considered when evaluating LRMC).

FAC includes all costs, at least those reflected in financial accounts, but is often calculated to exclude costs imposed within a group, such as congestion, accident and environmental impacts imposed and borne by road users as a group. This means that costs depend on how groups are defined, for example, whether congestion or risks imposed by one vehicle or motorist type on another, are considered externalities. Table 3.5-1 summarizes the definitions of costs and appropriate charges based on various perspectives used for roadway cost allocation. Some include different sets of costs, and use different approaches to define and calculate fair and efficient user fees.

***Table 3.5-1* Comparison of Costs and Charge Concepts** (Booz Allen Hamilton, 2005)

Category	SRMC	LRMC	FAC	PayGo
Costs				
Return on capital.	Not relevant	Not relevant	Return on capital	Not relevant
Infrastructure costs	Facility wear caused by use.	Facility wear caused by use, and capital costs to increase capacity to accommodate growing demand.	All ongoing infrastructure costs (operations, maintenance and depreciation).	All costs (operating and capital) incurred during a year.
Service provider operating costs	Cost of an additional vehicle km.	Cost of an additional vehicle km.	All costs associated with providing services.	All costs.
Congestion	Costs imposed by one user on other transport system users.	Not included if capacity expansion leaves existing traffic unaffected.	Not relevant, since this cost is imposed and borne by infrastructure users as a group.	Not relevant, since this cost is imposed and borne by infrastructure users as a group.
Mohring Effect	Benefits of increased public transport service frequencies due to additional demand.	Benefits of increased public transport service frequencies due to additional demand.	Not relevant, since this impact is imposed and borne by infrastructure users as a group.	Not relevant, since this impact is imposed and borne by infrastructure users as a group.
Accidents	External crash risk costs of an additional unit of travel.	External crash risk costs of an additional unit of travel.	External costs attributed to user groups on the basis of responsibility.	Not relevant
Environmental Costs	Cost of an additional unit of travel.	Cost of an additional unit of travel.	Costs of total vehicle travel.	Not relevant
Charges				
Fuel excise tax and road user charges	Revenue associated with an additional vehicle km.	Revenue associated with an additional vehicle km.	Total revenues from fuel taxes and road user charges.	Total revenues from fuel taxes and road user charges.
Motor vehicle registration and licensing.	If related to additional vehicle travel	If related to additional vehicle travel	All motor vehicle registration charges	All motor vehicle registration charges
Goods and Services Tax (GST)	On all costs.	On all costs.	On all costs.	On all costs.
Fares, fright tariffs and traffic fines.	Associated with an additional unit of travel.	Associated with an additional unit of travel.	All fares, taxes.	All fares, taxes.

This table summarizes differences between various categories of costs and charges.

Best Practices

Various documents listed below can be used as guides for developing a cost allocation methodology. Because there are many different perspectives and methodologies, and their selection can significantly affect results, it is important to develop a transparent cost allocation process, which explains the perspectives and assumptions used.

Information Resources

David Anderson and Gerard McCullough (2003), *The Distribution of Transportation Costs in the Twin Cities Region*, Transportation and Regional Growth Study, Center for Transportation Studies, University of Minnesota, Report 15 (www.cts.umn.edu).

Booz Allen Hamilton (2005), *Surface Transport Costs and Charges Study*, Ministry of Transportation New Zealand (www.transport.govt.nz).

FHWA (1997), *Federal Highway Cost Allocation Study*, USDOT (www.dot.gov); at www.fhwa.dot.gov/policy/hcas/summary/index.htm

Joseph Jones and Fred Nix (1995), *Survey of the Use of Highway Cost Allocation in Road Pricing Decisions*, Transportation Association of Canada (www.tac-atc.ca).

Todd Litman (2007), *Socially Optimal Transport Prices and Markets*, VTPI (www.vtpi.org); at www.vtpi.org/sotpm.pdf

David Luskin (1999), *Facts and Furphies in Benefit-Cost Analysis: Transport*, Report 100, Bureau of Transport Economics (www.bitre.gov.au).

Brian D. Taylor, Hiroyuki Iseki and Mark Garrett (2000), *How Much Does A Transit Trip Cost?*, presented at the 2000 Conference of the Association of Collegiate Schools of Planning, University of California Transportation Center (www.uctc.net); at www.uctc.net/scripts/countdown.pl?702.pdf

TC (2006), *Allocation Options*, Transport Canada Policy Group (www.tc.gc.ca); at www.tc.gc.ca/pol/en/aca/fci/transmodal/menu.htm

Huib van Essen, Olivier Bello, Jos Dings, Robert van den Brink (2003), *To Shift Or Not To Shift, That's The Question: The Environmental Performance Of Freight And Passenger Transport Modes In The Light Of Policy Making*, CE (www.ce.nl) for the Dutch Ministry of Transport, Water Management and Public Works.

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

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

William Vickrey (1994), *Public Economics; Selected Papers by William Vickrey*, Cambridge University Press (www.uk.cambridge.org).

3.6 Transportation Demand Management Evaluation

Transportation Demand Management or (TDM also called *Mobility Management*) includes various strategies that result in more efficient use of transport resources. TDM Evaluation requires more comprehensive analysis than normally used for transport planning because it requires determining the economic impacts of different types of travel changes. The table below summarizes travel changes caused by various TDM strategies.[17]

Table 3.6-1 **Examples of TDM Travel Impacts**

TDM Strategies	Mechanism	Travel Changes
Traffic Calming	Roadway redesign.	Reduces automobile traffic speed, increases walking
Flextime	Improved transport choice.	Shifts travel time (when trips occurs).
Road/Congestion Pricing	Pricing	Shifts travel time, and route, reduces peak-period vehicle traffic.
Distance-based charges	Pricing	Reduces overall vehicle travel.
Transit improvements	Improved transport choice.	Shifts mode, increases transit use.
Rideshare promotion	Improved transport choice.	Increases vehicle occupancy, reduces trips.
Pedestrian and bicycle improvements	Improved transport choice, facility improvements.	Shifts mode, increases walking and cycling.
Carsharing	Improved transport choice.	Reduces vehicle ownership and trips.
Smart Growth, New Urbanism	More efficient land use, improved travel choices.	Shifts mode, reduces vehicle ownership and trip distances.

Different types of TDM strategies cause different types of travel changes.

Different travel changes provide different types of costs and benefits. For example, a strategy that shifts travel from peak to off-peak periods has different impacts than a strategy that shifts travel modes or encourages more efficient land use.

Many TDM strategies affect consumer choices, prices and service quality. Conventional transportation investment models are generally unable to account for these impacts. Conventional models which evaluate transportation system quality based on mobility often assume that consumers must be worse off whenever they shift from driving to a slower mode or reduce their vehicle travel, even if they choose to do so. However, if consumers change their travel patterns in response to positive incentives (i.e., rewards for using reducing vehicle use or shifting to alternative modes, with no additional costs for people who continue to drive), they must be better off overall or they would not make the change. Accurate TDM evaluation requires a *consumer surplus* based evaluation model, which is a method of measuring the value that consumers place on a change in the price or quality of the goods they consume (in this case travel is considered a good). The basic technique for evaluating consumer impacts of price changes is to use the incremental cost to consumers who don't change their travel, plus half the change in price times the number of trips that increase or decrease, known as the "rule of half."

[17] For more information see Transportation Elasticities and Land Use Impacts on Transport chapters of the *Online TDM Encyclopedia*, VTPI (www.vtpi.org).

For example, if a $1 highway toll increase causes annual vehicle trips to decline from 3 million to 2 million, the reduction in consumer surplus (the total net cost to consumers) is $2,500,000 ($1 x 2 million for existing trips, plus $1 x 1 million x ½ for vehicle trips foregone). Similarly, if a 50¢ per trip transit fare reduction results in an increase from 10 million to 12 million annual transit trips, this provides $6 million in consumer surplus benefits (50¢ x 10 million for existing trips, plus 50¢ x 2,000,000 x ½ for added trips).

Best Practices

Below is a list of best practices for accurate TDM Evaluation.

- Use *Accessibility-based* planning, rather than *mobility-based* planning. This allows consideration of the widest possible range of solutions to transport problems, including mobility substitutes and land use management that reduces the need for physical travel.
- Clearly define the *Base Case* and alternatives considered.
- Carefully define *incremental costs*. Identify the marginal costs of driving and alternative modes. Assign capacity expansion costs only to peak-period users.
- Use *comprehensive* estimates of costs and benefits, including all road and parking expenses, downstream congestion, impacts on nonmotorized transport, vehicle ownership costs, environmental impacts, impacts on travel choice and strategic land use objectives.
- Present results in units that are easy to understand and compare. For example, present costs and benefits in annualized dollars per capita, per vehicle, per vehicle-mile, per passenger-mile, or per additional vehicle trip.
- Indicate any impacts that are not quantified in the analysis because they are difficult to measure, and describe their impacts qualitatively. For example, describe how each option impacts equity objectives, economic development, and strategic land use goals.
- Use consumer surplus analysis to calculate consumer impacts of changes in route, mode and trip frequency. Do not assume that reduced mobility or travel speeds resulting from a voluntary change in travel patterns reflects increased consumer costs.
- Incorporate generated traffic impacts (additional vehicle travel that results from roadway improvements).
- Indicate the distribution of benefits and costs, and evaluate impacts in terms of equity objectives.
- Use sensitivity analysis and other statistical techniques to explicitly incorporate uncertainty and variability in economic analysis.
- Describe how different perspectives and assumptions could effect analysis conclusions.
- Produce reports that are understandable to a general audience and include all relevant technical information.

Information Resources

Cambridge Systematics (1998), *Economic Impact Analysis of Transit Investments: Guidebook for Practioners*, Report 35, Transit Cooperative Research Program, Transportation Research Board (www.trb.org).

Comsis Corporation (1994), *A Guidance Manual for Implementing Effective Employer-based Travel Demand Management Programs*, FHWA and FTA (www.fhwa.dot.gov); at www.bts.gov/ntl/DOCS/474.html

DETR (2000), *Guidance on the Methodology for Multi-Modal Studies*, Department of the Environment, Transport and the Regions (www.dft.gov.uk / www.defra.gov.uk); at www.info4education.com/CIS/SiteMap/D/DETR.asp?AuthCode=

Erik Ferguson (2001), "Three Faces of Eve: How Engineers, Economists, and Planners Various View Congestion Control, Demand Management and Mobility Enhancement Strategies," *Journal of Transportation and Statistics* (www.bts.gov), Vol. 4, No. 1, April 2001, pp. 51-73.

FDOT (2002 / 2007), *Quality/Level of Service Handbook*, Florida Department of Transportation (www.dot.state.fl.us); at www.dot.state.fl.us/planning/systems/sm/los/los_sw2.shtm

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

ICF (1997), *Opportunities to Improve Air Quality Through Transportation Pricing*, Office of Mobile Sources, EPA (www.epa.gov); at www.epa.gov/otaq/market/pricing.pdf

IFS (2001), *Virtual Learning Arcade – London Transport*, Institute for Fiscal Studies (www.ifs.org.uk). For technical information see Tony Grayling and Stephen Glaister (2000), *A New Fares Contract for London*, Institute for Public Policy Research (www.ippr.org.uk), ISBN 1 86030 100 2.

Todd Litman (2008), *Guide to Calculating Mobiltiy Management Benefits*, VTPI (www.vtpi.org); at www.vtpi.org/tdmben.pdf

NHI (1995), *Estimating the Impacts of Urban Transportation Alternatives*, National Highway Institute, Course 15257, USDOT (www.nhi.fhwa.dot.gov).

VTPI, "Evaluation" *Online TDM Encyclopedia* (www.vtpi.org/tdm/tdm14.htm).

3.7 Transportation Equity Evaluation and Compensation

Equity refers to the *distribution* (or *incidence*) of costs and benefits. There is no single correct way to evaluate equity. It may be appropriate to use several different methods to evaluate equity in a particular transportation planning process. There are three general types of equity related to transport:

1. *Horizontal Equity* (also called *fairness* or *egalitarianism*) is concerned with whether each individual or group is treated equally, assuming that their needs and abilities are comparable. It implies that consumers should "get what they pay for and pay for what they get" (i.e., the "user pays principle") unless subsidies are specifically justified.
2. *Vertical Equity With Regard to Income* considers the allocation of costs between different income classes, assuming that public policies should favor people who are economically disadvantaged. Policies that provide a benefit lower-income people are called "progressive," while those that make lower-income people relatively worse off are called "regressive."
3. *Vertical Equity With Regard to Mobility Need and Ability* considers whether a transportation system provides adequate service to people who have special transportation needs (i.e., they are *transportation disadvantaged*). It justifies facility design features and special mobility services that provide access to people with disabilities. It suggests that public subsidies should be used to provide basic access to people who are transportation disadvantaged.

Below are indicators for evaluating the equity impacts of transport policies and projects.

- *Treats everybody equally.* This reflects whether a policy or program treats each group or individually equally.
- *Individuals bear the costs they impose.* This reflects whether a policy or program makes individual consumers bear the costs they impose.
- *Progressive with respect to income.* This reflects whether a policy or program increases transportation affordability and makes lower-income households better or worse off.
- *Benefits transportation disadvantaged.* This reflects whether a policy or program makes people who are transportation disadvantaged better off by increasing their travel options or providing financial savings.
- *Improves basic access.* This reflects whether a policy or program favors high value transport (emergency response, commuting, essential shopping) over less important transport.

Equity objectives sometimes conflict. For example, providing basic mobility for people with disabilities and progressive transport pricing (which help achieve vertical equity objectives), often requires subsidies (which contradicts horizontal equity objectives). These trade-offs should be considered in transportation equity analysis. Transportation equity analysis is also affected by the units that are used to measure impacts (e.g., per vehicle-mile, per passenger-mile, per capita), and the perspective and scope of analysis.

Determining appropriate compensation for crash victims or pollution damages is an equity issue. The proper conceptual framework for determining fair and efficient compensation is *willingness-to-accept*, that is, the amount of financial compensation that

a particular victim requires before he or she would volunteer to bear such damages. This reflects the assumption that individuals have a right to live without being injured by others. Many cost studies are based on willingness-to-pay values, that is, the amount consumers would voluntarily pay to avoid a risk or injury.[18] Willingness-to-pay tends to result in lower values than willingness-to-accept due to budget constraints (e.g., a consumer may value increased safety but cannot afford to pay for it, so willingness-to-pay values are low, yet they would be unwilling to accept reduced safety in exchange for a financial reward, so their willingness-to-accept values are relatively high). As a result, published non-market cost values based on willingness-to-pay represents a lower-bound of the true fair compensation values.

Best Practices

Below are suggestions for incorporating equity objectives into transport decision-making.

- Equity analysis should be incorporated explicitly in transportation planning.
- Transportation equity should be evaluated in several different ways, including horizontal equity, vertical equity with respect to income, and vertical equity with respect to need.
- Equity analysis should be as comprehensive as possible, taking into account direct and indirect, market and non-market, short- and long-term impacts.
- Evaluate the distribution of impacts by income, need, driving ability and geographic location to determine if any groups will bear an excessive burden.
- Consider different demographic groups when evaluating transportation equity impacts, including drivers and non-drivers, and people who are economically, socially or physically disadvantaged.
- In general, equity analysis should be based on per capita measurement units, rather than per vehicle or per vehicle-mile, which tends to give greater weight to higher income people who travel more, and gives far less consideration to people who are transportation disadvantaged.
- Involve affected communities in planning decisions. Effective public involvement in decision-making, including disadvantaged populations, is essential to make transportation planning more equitable.

[18] The difference between willingness-to-pay and willingness-to-accept reflects the allocation of "rights," including the right of individuals to be free from injuries caused by other people's actions. If people have no inherent right to safety, they would be obliged to pay others to avoid crashing into them, so the appropriate test is willingness-to-pay for crash reduction. However, if road users are considered to have a right to safety, then the appropriate test is willingness-to-accept for crash damages. Standard legal and economic practice assume that individuals have a fundamental right to be safe from damages caused by other people's actions, indicating that willingness-to-accept is the appropriate measurement technique for compensation analysis.

Information Resources

David Anderson and Gerard McCullough (2003), *The Distribution of Transportation Costs in the Twin Cities Region*, Transportation and Regional Growth Study, Center for Transportation Studies, University of Minnesota, Report 15 (www.cts.umn.edu); at www.cts.umn.edu/trg/research/reports/TRG_15.html

Rahman Paul Barter and Tamim Raad (2000), *Taking Steps*, SUSTRAN Network (www.geocities.com/sustrannet); at www.geocities.com/sustrannet/actionguide/Outline.htm

Community Impact Assessment Website (www.ciatrans.net) provides information for considering impacts on human environments in transportation planning.

Environmental Justice Resource Center (www.ejrc.cau.edu) at Clark Atlanta University publishes the quarterly *Transportation Equity* newsletter.

FHWA (1997), *1997 Federal Highway Cost Allocation Study*, USDOT (www.fhwa.dot.gov); at www.fhwa.dot.gov/policy/hcas/summary/index.htm

FHWA, *Environmental Justice Website* (www.fhwa.dot.gov/environment/ej2.htm) provides information on community impact assessment, public involvement in transportation planning.

FHWA, *Toolbox for Regional Policy Analysis; Distribution of Impacts Case Studies*, Federal Highway Administration (www.fhwa.dot.gov/planning/toolbox).

David Forkenbrock and Lisa Schweitzer (1997), *Environmental Justice and Transportation Investment Policy*, Public Policy Center, University of Iowa (www.uiowa.edu).

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); at http://onlinepubs.trb.org/Onlinepubs/nchrp/nchrp_rpt_456-a.pdf

Todd Litman (2002 / 2007), "Evaluating Transportation Equity," *World Transport Policy & Practice* (http://ecoplan.org/wtpp/wt_index.htm), Volume 8, No. 2, Summer 2002, pp. 50-65; also available at VTPI (www.vtpi.org/equity.pdf).

Social Exclusion Unit (2003), *Making the Connections: Transport and Social Exclusion*, Department for Environment, Transport and the Regions (www.dft.gov.uk / www.defra.gov.uk); at www.carplus.org.uk/Resources/pdf/Making_the_Connections_Final_Report_on_Transport_and_Social_Exclusion.pdf

Jeff Turner, *Transport and Social Exclusion Toolkit*, University of Manchester (www.manchester.ac.uk).

The *Surface Transportation Policy Project* (www.transact.org) provides information and advocacy for more balanced transportation policies.

3.8 Economic Development

Economic Development refers to progress toward a community's economic goals, such as increases in economic productivity, employment, and business activity. Transportation facility investments and subsidies are often justified with the claims that they will stimulate economic development. Various techniques can be used to measure the economic development impacts of a particular transport policy or project. Although most economic activities require transportation, not every transport improvement increases economic development. Polices that violate market principles (such as underpricing and distortive taxes) and inefficient investments (roads or railroads that are not cost effective) can increase mobility but reduce overall economic development. Transport policies tend to increase economic development if they:

- Increase and improve cost-effective transportation options.
- Result in more cost effective transportation facility and service investments.
- Increase transport system efficiency (reduce total costs or increase total benefits).
- Create more efficient pricing by making prices more accurately reflect marginal costs.
- Create more neutral public policies (such as less distortive tax policies).
- Reduce resource costs, such as the amount of fuel consumed per unit of transport, and the amount of land devoted to transport facilities.

In many cases the perceived economic development that results consists more of economic transfers (some businesses or areas benefit at the expense of others) than true net economic gains. *Only if inadequate transport is a significant limiting economic factor and transport facility investments or subsidies are the most cost-effective way to improve accessibility are such policies likely to increase economic development.* More comprehensive costs and benefit analysis can better evaluate economic development impacts by identifying policies that reflect market principles, and investments that are most cost effective overall, including indirect and nonmarket impacts.

Information Resources

Marlon Boarnet (1995), "New Highways & Economic Productivity: Interpreting Recent Evidence," *Journal of Planning Literature*, Vol. 11, No. 4, May 1997, pp. 476-486; at www.uctc.net/scripts/countdown.pl?291.pdf

David J. Forkenbrock and Glen E. Weisbrod (2001), *Guidebook for Assessing the Social and Economic Effects of Transportation Projects*, NCHRP Report 456, Transportation Research Board (www.trb.org); at http://gulliver.trb.org/publications/nchrp/nchrp_rpt_456-a.pdf

Todd Litman and Felix Laube (2002), *Automobile Dependency and Economic Development*, VTPI (www.vtpi.org); at www.vtpi.org/ecodev.pdf

VTPI (2008), "TDM and Economic Development," *Online TDM Encyclopedia*, Victoria Transport Policy Institute (www.vtpi.org); at www.vtpi.org/tdm/tdm54.htm

Glen Weisbrod (2007), *Models to Predict the Economic Development Impact of Transportation Projects: Historical Experience and New Applications*, Annals of Regional Science, December 2007; at www.edrgroup.com/edr1/bm%7Edoc/models-to-predict-the-eco.pdf.

3.9 Conclusions

Most current transportation economic evaluation studies consider a relatively limited range of impacts. This may be adequate for comparing relatively similar options, such as various highway alignments, but is inadequate for comparing different modes, evaluating pricing and other TDM options, performing strategic and sustainability planning, or evaluating equity impacts. In general, transportation evaluation should be as comprehensive as possible, including indirect, long-term and nonmarket impacts.

More comprehensive cost analysis can help guide more optimal policy and planning decisions. Conventional evaluation practices that only consider a limited set of impacts can result in solutions to one problem that exacerbate others. For example, congestion reduction solutions that increase total vehicle travel usually increase parking costs, crashes, pollution and sprawl. Emission reduction strategies that increase fuel efficiency reduce the per-mile cost of driving, which tends to increase traffic congestion, crashes, sprawl and even some types of pollution. Only when all of these impacts are considered can decision-makers insure that they are making truly optimal decisions.

Table 3.9-1 describes various transportation evaluation applications and perspectives, and the types of impacts they should include.

Table 3.9-1 **Impacts To Include In Various Evaluation Applications**

	Definition	Impacts to Include
Project Funding	Develop funding for a particular transport facility or service.	Marginal costs associated with use of the facility or service. Sunk costs often ignored.
Project Planning	Evaluate and compare transport projects, such as a road or transit improvement.	Project costs, user impacts, and changes in external and indirect impacts, such as downstream congestion and parking costs.
Strategic Planning	Long-term, comprehensive transportation and land use plan for a particular area.	All costs, including indirect, long-term and nonmarket impacts within that jurisdiction.
Pricing	Determining optimal transport pricing.	External costs. May include indirect and long-term externalities, depending on analysis perspective.
TDM	Evaluating and comparing transport programs that include alternative modes, pricing or other demand management incentives.	All costs, including indirect, long-term and nonmarket impacts.
Sustainability	Long-term, comprehensive transportation and land use plan.	All costs, including indirect and long-term impacts.
Equity	Support for equity objectives, including horizontal equity (fairness) and vertical equity (impacts on disadvantaged groups.	All costs, including indirect and nonmarket impacts, and changes in transportation affordability, diversity and accessibility.
Economic Development	Evaluates how specific transportation policies and projects will affect economic development.	All impacts as they relate to market principles, and to the cost effectiveness of investments and subsidies.

This table summarizes the types of impacts to consider in various evaluation applications.

Table 3.9-2 identifies which costs in this guidebook should be included in various evaluation applications. Of course, exactly which costs are included, and how they are quantified, will depend on the perspective, needs and resources of a particular situation.

Table 3.9-2 **Impacts To Include In Various Evaluation Applications**

	Project Funding	Project Planning	Strategic Planning	Pricing	TDM	Sustain-ability	Equity	Econ. Dev
5.1 Vehicle Costs- Fixed		2	3	1	3	3	3	3
5.1 Vehicle Costs- Variable		3	3	2	3	3	3	3
5.1 Vehicle Costs Subsidies		3	3	1	3	3	3	3
5.2 Travel Time		3	3		3	3	3	3
5.3 Internal Safety & Health		2	3		3	3	3	3
5.3 Crash & Health Externalities	1	3	3	3	3	3	3	3
5.4 Parking – Internal		2	3		3	3	3	3
5.4 Parking – External		3	3	3	3	3	3	3
5.5 Congestion	2	3	3	3	3	3	3	3
5.6 Roadway Costs	3	3	3	3	3	3	3	3
5.7 Roadway Land Value	2	3	3	2	3	3	3	3
5.8 Traffic Services	3	3	3	3	3	3	3	3
5.9 Transportation Diversity		2	3	1	3	3	3	3
5.10 Air Pollution	1	3	3	3	3	3	3	3
5.11 Noise		3	3	2	3	3	3	3
5.12 Resource Consumption		2	3	3	3	3	3	3
5.13 Barrier Effect	1	3	3	2	3	3	3	3
5.14 Land Use Impacts	1	2	3	1	3	3	3	3
5.15 Water Pollution	1	3	3	2	3	3	3	3
5.16 Waste Disposal		3	3	1	3	3	3	3

This table indicates which costs should be considered for different types of transportation evaluation. 3=Always Include, 2=Usually Include, 1=Sometimes Include.

Determining evaluation perspective and scope is a policy decision that should reflect community values. Some costs can reasonably be excluded from some evaluations. For example, parking externalities and sprawl costs are traditionally excluded from road project evaluation because they are considered indirect costs that should be addressed directly, through appropriate policies and pricing. Ideally, parking externalities should be internalized through parking fees and sprawl should be addressed through land use regulations. However, until such reforms are implemented, it is appropriate to recognize that projects such as road widening that increase total vehicle travel will tend to increase parking and sprawl costs, and mobility management strategies that encourage use of alternative modes provide additional benefits if they reduce parking externalities and encourage more efficient land use than would otherwise occur.

Although not all of these impacts are suitable for quantification, unquantified impacts should be identified and evaluated based on community objectives. For example, if a community has objectives to increase transport diversity or reduce sprawl, each option can be rated according to the degree to which is supports or contradicts them.

3.10 Chapter Information Resources

Information sources on transportation evaluation and impact analysis are described below.

AASHTO (2003), *User Benefit Analysis for Highways*, American Association of State Highway Officials (www.transportation.org).

David Anderson and Gerard McCullough (2003), *The Distribution of Transportation Costs in the Twin Cities Region*, Transportation and Regional Growth Study, Center for Transportation Studies, University of Minnesota, Report 15 (www.cts.umn.edu); at www.cts.umn.edu/trg/research/reports/TRG_15.html

ASCE (no date), *Guide to Transportation Benefit-Cost Analysis*, American Society of Civil Engineers (www.asce.org); at http://ceenve.calpoly.edu/sullivan/cutep/cutep_bc_outline_main.htm

Peter Bein (1997), *Monetization of Environmental Impacts of Roads*, Highway Planning and Policy Branch, Ministry of Transportation and Highways (www.gov.bc.ca/tran); at www.geocities.com/davefergus/Transportation/0ExecutiveSummary.htm

Booz Allen Hamilton (2005), *Surface Transport Costs and Charges Study*, Ministry of Transportation New Zealand (www.transport.govt.nz).

Clifford Cobb, Ted Halstead and Jonathan Rowe (1999), *The Genuine Progress Indicator*, Redefining Progress (www.rprogress.org).

CPB (2001), *Evaluatie Van Infrastructuurprojecten Leidraad Voor Kosten-Batenanalyse* (Dutch Guide To Cost -Benefit Analysis For The Evaluation Of Infrastructure Projects), CPB and NEI (www.cpb.nl); at www.cpb.nl/nl/pub/cpbreeksen/bijzonder/22/bijz22.pdf An English summary is on pages 21-28.

CUTR (2007), *Economics of Travel Demand Management: Comparative Cost Effectiveness and Public Investment*, Center for Urban Transportation Research (www.nctr.usf.edu); at www.nctr.usf.edu/pdf/77704.pdf

DETR (2000), *Guidance on the Methodology for Multi-Modal Studies*, Department for Transport (www.dft.gov.uk); at www.info4education.com/CIS/SiteMap/D/DETR.asp?AuthCode=

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 documents discussing methodologies for more comprehensive transportation project evaluation.

EC, (2005), *ExternE: Externalities of Energy - Methodology 2005 Update*, Directorate-General for Research Sustainable Energy Systems, European Commission (www.externe.info).

ECMT (2004), *Assessment and Decision Making for Sustainable Transport*, European Conference of Ministers of Transportation, Organization of Economic Coordination and Development (www.oecd.org).

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

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

Michael Edwards (1998), "Impact and Cost Benefit Analysis," *Urban Regeneration: Evaluation as a Tool for Policy Development*, South Bank University, London (www.lsbu.ac.uk); at www.bartlett.ucl.ac.uk/planning/information/texts/lepu.htm

EEB (1994), *Guide to Benefit-Cost Analysis in Transport Canada*, Economic Evaluation Branch, Transport Canada (www.tc.gc.ca); at www.tc.gc.ca/finance/BCA/en/TOC_e.htm

European Transport Pricing Initiatives (www.transport-pricing.net) includes various research on fair and efficient pricing.

FDOT (2002 / 2007), *Quality/Level of Service Handbook*, Florida Department of Transportation (www.dot.state.fl.us); at www.dot.state.fl.us/planning/systems/sm/los/los_sw2.shtm

FHWA (1997), *1997 Federal Highway Cost Allocation Study*, USDOT (www.fhwa.dot.gov); at www.fhwa.dot.gov/policy/hcas/summary/index.htm

FHWA (2000), *Transportation Performance Measures Toolbox*, Federal Highway Administration (www.fhwa.dot.gov); at _www.ops.fhwa.dot.gov/perf_measurement/index.htm

FHWA (2002), *Highway Economic Requirements System: Technical Report*, Federal Highway Administration (www.fhwa.dot.gov); at www.fhwa.dot.gov/infrastructure/asstmgmt/hersindex.htm

FHWA, *Toolbox for Regional Policy Analysis Website* (www.fhwa.dot.gov/planning/toolbox/index.htm) describes analytical methods for evaluating regional economic, social and environmental impacts of transportation and land use policies.

FHWA, *Environmental Guidebook*, Federal Highway Administration (www.environment.fhwa.dot.gov/guidebook/index.asp) provides policies, procedures, and guidance related to the environment and transportation.

FHWA and FTA (2002), *Transportation & Environmental Justice: Effective Practices*, Federal Highway Administration, Federal Transit Administration, FHWA-EP-02-016 (www.fhwa.dot.gov/environment/ej2.htm).

FHWA and FTA (2002), "Establishing Meaningful Performance Measures for Benefits and Burden Assessments," *Transportation & Environmental Justice: Effective Practices*, Federal Highway Administration, Federal Transit Administration, FHWA-EP-02-016 (www.fhwa.dot.gov/environment/ej2.htm).

FMT (2005), *Federal Transport Infrastructure Plan 2003: Basic Features Of The Macroeconomic Evaluation Methodology*, German Federal Ministry of Transport (www.bmvbs.de); at www.bmvbw.de/artikel,-13237/Federal-Transport-Infrastructu.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); at http://onlinepubs.trb.org/Onlinepubs/nchrp/nchrp_rpt_456-a.pdf

GAO (2005), *Highway And Transit Investments: Options for Improving Information on Projects' Benefits and Costs and Increasing Accountability for Results*, Report 05-172, Government Accountability Office (www.gao.gov); at www.gao.gov/new.items/d05172.pdf

GDRC (2000), *Notes on 'Quality of Life,'* Global Development Research Centre (www.gdrc.org); at www.gdrc.org/uem/qol-define.html

José A. Gómez-Ibáñez, William B. Tye and Clifford Winston – editors (1999), *Essays in Transportation Economics and Policy: A Handbook in Honor of John R. Meyer*, Brooking Institution (www.brookings.edu).

Phil Goodwin and Stefan Persson (2001), *Assessing the Benefits of Transport*, European Conference of Ministers of Transport; OECD (www.oecd.org).

Guidelines Assessment Methodology Working Group (2004 / 2006), *National Guidelines For Transport System Management In Australia*, Department of Transport and Regional Services, (www.dotars.gov.au); at www.atcouncil.gov.au/documents/ngtsm.aspx

Walter Hook (2003), *Appraising the Social Costs and Benefits of Road Projects*, Institute of Transportation and Development Policy (www.itdp.org); at www.itdp.org/index.php/information_center/document_detail/costs_benefits_road_projects/

Halsnæs, et al. (2001), *Transport and the Global Environment: Accounting for GHG Reductions in Policy Analysis*, UNEP Collaborating Centre on Energy & Environment (www.uccee.org).

IFS (2001), *Virtual Learning Arcade – London Transport*, Institute for Fiscal Studies (www.ifs.org.uk).

Douglass B. Lee (2000), "Methods for Evaluation of Road Projects in the USA," *Transport Policy*, Vol. 7, No. 1, (www.elsevier.com/locate/tranpo), Jan. 2000, pp. 41-50.

Todd Litman (2001), *What's It Worth? Life Cycle and Benefit/Cost Analysis for Evaluating Economic Value*, Presented at Internet Symposium on Benefit-Cost Analysis, Transportation Association of Canada (www.tac-atc.ca), at www.vtpi.org/worth.pdf.

Todd Litman (2003 / 2005), "Measuring Transportation: Traffic, Mobility and Accessibility," *ITE Journal* (www.ite.org), Vol. 73, No. 10, October 2003, pp. 28-32; at www.vtpi.org/measure.pdf

Todd Litman (2006), *Comprehensive Transport Planning Framework: Best Practices For Evaluating All Options And Impacts*, VTPI (www.vtpi.org); at www.vtpi.org/comprehensive.pdf.

Todd Litman (2006) "Transportation Market Distortions," *Berkeley Planning Journal*; issue theme *Sustainable Transport in the United States: From Rhetoric to Reality?* (www-dcrp.ced.berkeley.edu/bpj), Volume 19, 2006, pp. 19-36; at www.vtpi.org/distortions_BPJ.pdf.

Todd Litman (2007), *Socially Optimal Transport Prices and Markets*, VTPI (www.vtpi.org); at www.vtpi.org/sotpm.pdf.

Todd Litman (2008), *Well Measured: Developing Indicators for Comprehensive and Sustainable Transport Planning*, VTPI (www.vtpi.org); at www.vtpi.org/wellmeas.pdf.

Todd Litman (2008), *Planning Principles and Practices*, Victoria Transport Policy Institute (www.vtpi.org); at www.vtpi.org/planning.pdf.

Todd Litman (2008), *Multi-Modal Transport Planning*, Victoria Transport Policy Institute (www.vtpi.org); at www.vtpi.org/multimodal_planning.pdf.

Louis Berger Inc (1998), *Guidance for Estimating the Indirect Effects of Proposed Transportation Projects*, NCHRP Report 403, Transportation Research Board (www.trb.org); at Also see Louis Berger Group (2001), *Guidance for Assessing Indirect and Cumulative Impacts of Transportation Projects in North Carolina*, State of North Carolina, Department of Transportation/Department of Environment and Natural Resources Raleigh, North Carolina Under Project No. 81777722 (www.ncdot.org/~research).

David Luskin (1999), *Facts and Furphies in Benefit-Cost Analysis: Transport*, Report 100, Bureau of Transport Economics (www.bitre.gov.au).

M. Maibach, et al. (2008), *Handbook on Estimation of External Cost in the Transport Sector*, CE Delft (www.ce.nl); at http://ec.europa.eu/transport/costs/handbook/doc/2008_01_15_handbook_external_cost_en.pdf

Marsden Jacob Associates (2005), *Frameworks For Economic Impact Analysis And Benefit-Cost Analysis*, Economic Regulation Authority, Western Australia (www.era.wa.gov.au); at www.era.wa.gov.au/water/library/Frameworks_for_economic_analysis_and_benefit_cost_analysis.pdf.

Virginia McConnell and Margaret Walls (2005), *The Value of Open Space: Evidence from Studies of Nonmarket Benefits*, Resources for the Future (www.rff.org).

NHI (1995), *Estimating the Impacts of Urban Transportation Alternatives*, National Highway Institute, Course 15257, USDOT (www.nhi.fhwa.dot.gov).

OECD (2002), *Road Travel Demand: Meeting the Challenge*, Organization for Economic Cooperation and Development (www.oecd.org); at www.oecdbookshop.org/oecd/display.asp?lang=EN&sf1=identifiers&st1=772002041p1
Office of Highway Policy Information (www.fhwa.dot.gov/policy/ohpi) provides information on U.S. highway system planning, funding and use.

Ian W. H. Parry, Margaret Walls and Winston Harrington (2007), *Automobile Externalities and Policies*, Discussion Paper 06-26, Resources for the Future (www.rff.org); at www.rff.org/rff/Documents/RFF-DP-06-26-REV.pdf

Emile Quinet (2004), "A Meta-Analysis Of Western European External Cost Estimates," *Transportation Research D*, Vol. 9 (www.elsevier.com/locate/trd), Nov. 2004, pp. 465-476.

SACTRA (1999), *Transport Investment, Transport Intensity and Economic Growth*, Dept. of Environment, Transport and Regions (www.dft.gov.uk); at www.dft.gov.uk/pgr/economics/sactra/

Donald Shoup (2002), "Roughly Right or Precisely Wrong," *Access 20* (www.uctc.net), Spring 2002, pp. 20-25; at www.uctc.net/access/access20.shtml

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

Michael Spackman, Alan Pearman, Larry Phillips (2001), *Multi Criteria Analysis: A Manual*, Department for Transport (www.dft.gov.uk).

TC (2003-2007), *The Full Cost Investigation of Transportation in Canada* (multiple documents), Transport Canada (www.tc.gc.ca); at www.tc.gc.ca/pol/en/aca/fci/menu.htm. For technical analysis see Anming Zhang, Anthony E. Boardman, David Gillen and W.G. Waters II (2005), *Towards Estimating the Social and Environmental Costs of Transportation in Canada*, Centre for Transportation Studies, University of British Columbia, for Transport Canada (www.sauder.ubc.ca/cts); at www.sauder.ubc.ca/cts/docs/Full-TC-report-Updated-November05.pdf.

TERM (2000), *Are We Moving in the Right Direction?; Indicators on Transport and Environmental Integration in the EU*, European Environment Agency (www.eea.europa.eu).

Transport Analysis Guidance Website (www.webtag.org.uk) by the UK Department for Transport, provides advice on transport modeling and economic evaluation.

Transport For Development (www.transport-links.org) includes several documents concerning the evaluation of social benefits and costs of transportation improvements and activities.

William Vickrey (1992), *Principles of Efficient Congestion Pricing*, Columbia University (www.columbia.edu), at www.vtpi.org/vickrey.htm.

William Vickrey (1994), *Public Economics; Selected Papers by William Vickrey*, Cambridge University Press (www.uk.cambridge.org).

VTPI, *Online TDM Encyclopedia*, VTPI (www.vtpi.org). In particular see:
- "TDM Evaluation: Assessing Benefits and Costs," (www.vtpi.org/tdm/tdm14.htm).
- "Market Principles: TDM Impacts on Market Efficiency and Equity," (www.vtpi.org/tdm/tdm60.htm).