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Build for Comfort, Not Just Speed

Valuing Service Quality Impacts In Transport Planning

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People value convenience and comfort features such as safe walking conditions, pleasant waiting areas, real-time vehicle arrival information and uncrowded transit vehicles.

Abstract

Travelers tend to place a high value on qualitative factors such as convenience, comfort, security and prestige. However, conventional transport planning practices tend to focus on quantitative impacts and undervalue qualitative impacts. This paper describes ways to evaluate qualitative impacts. Improved travel convenience and comfort tend to reduce unit travel time costs and so are equivalent in value to increased travel speed. Improved analysis of qualitative factors can expand the range of impacts and options considered in transport evaluation, leading to better planning decisions. It is particularly important for efforts to encourage use of alternative modes such as walking, cycling and public transit.

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I ain't go no diamonds, I ain't go no boat,
But I do have love that's gonna fire your soul,
Cause I'm built for comfort, I ain't built for speed.
But I got everything, all a good women needs. —Willie Dixon

Introduction

Virtually every new automobile can exceed normal legal speed limits. Consumers choose vehicles based primarily on convenience and comfort (remote door openers, navigation systems, sound systems and cupholders) rather than maximum speed. In response, vehicle manufactures are continually improving their product's service quality. In contrast, walking, cycling and public transit are generally provided at basic service levels, just adequate to meet the minimal needs of dependent users (people who lack alternatives), rather than to attract sophisticated consumers who demand high quality products. As a result, as people become wealthier they tend to shift from alternative modes to driving.

This is unfortunate because surveys indicate that many people would prefer to drive less and rely more on alternative modes, provided they have adequate service quality (Handy, Weston and Mokhtarian 2005). Walking, cycling and public transit travel tend to increase significantly when their service quality is improved ("Success Stories," VTPI 2008). Satisfying latent demand for higher quality travel options can provide various benefits:

- To current users, who are directly better off from increased comfort and convenience.
- To people who shift from driving to alternative modes in response to service improvements.
- To travelers and employers from more productive use of travel time (working or resting).
- To other road users, from reduced congestion and accident risk.
- To society, from reductions in external costs such as pollution and parking subsidies.
- Due to increased efficiency in the provision of alternative modes, since they often experience scale economies (for example, as walking increases the cost of providing facilities per pedestrian-mile declines, and as public transit ridership increases service frequency and coverage can expand and load factors tend to rise which reduces the cost per passenger-mile).

These benefits are increasing due to factors such as aging population, increasing congestion, rising fuel costs, urbanization, increasing health and environmental concerns, and shifting consumer preferences. In general, as consumers become more affluent their demand for service quality increases. Failing to serve this demand reduces consumer benefits and reduces transport system efficient by reducing use of alternative modes.

Described differently, transport planning is increasingly applying a *marketing paradigm*, in which travelers are considered customers with various needs and preferences, rather than just objects to be moved around. This type of planning uses surveys and behavior studies to identify consumer preferences, and develops goods and services that respond to those demands, often involving services targeting specific types of users, such as express commuter bus services and walking improvements around schools.

Table 1 **Examples of Service Quality Improvements** (VTPI, 2008)

Walking	Cycling	Public Transit
More and better sidewalks and paths Pedestrian shortcuts More crosswalks Traffic calming Streetscaping Comfort features, such as shade trees	Bike path and lane improvements Bike parking and storage Clothes changing facilities Education and promotion	More comfortable vehicles Reduced crowding Nicer stations Better user information Improved security Marketing and promotion

There are many possible ways to improve the quality of alternative modes. Current planning practices generally undervalue of such improvements when measuring impacts and benefits.

However, current planning practices tend to undervalue these impacts. Transport system evaluation focuses on quantitative factors (speed, operating costs, and traffic fatality rates) while undervaluing qualitative factors (convenience, comfort and prestige). This results in a less diverse transport system than is optimal.

Tremendous resources are often invested to increase travel speeds, for example, to build new highways, rail lines and bridges that provide more direct travel to destinations; to expand congested roads to reduce delays; and to improve transit facilities to increase bus and rail travel speeds. These travel time savings are the main benefit of many transportation improvements. Most travel models and economic evaluation methods assign the same travel time value, regardless of service quality. There is usually no adjustment to reflect traveler convenience, comfort or productivity. Yet, for most applications a reduction in unit travel time costs (cents per minute or dollars per hour) is equivalent in travel time (minutes or hours of travel).

For example, a transit service improvement that, by increasing rider comfort, reduces travel time unit costs 20% can be considered equivalent to a 20% increase in transit travel speeds, both in terms of the system's ability to attract travelers and the monetized value of the improvement. Yet, most transportation evaluation models only recognize travel speed, they are insensitive to service quality factors.

More accurate evaluation of transport service quality can provide many benefits:

- It allows service quality improvements to be valued. For example, current evaluation practices would place a high value on a project that increases travel speeds by 20%, but would place little or no benefit on a project that, by improving the convenience and comfort of walking, cycling or transit travel, reduces travel time unit costs by 20%, although they provide the same economic benefit.
- It increases the range of potential transport improvement options that can be considered. For example, improving transit service convenience and comfort (better user information, more convenient payment systems, nicer waiting areas, less crowded buses, etc.) may increase ridership at a lower cost than travel speed improvements achieved by grade separation.
- It is progressive and equitable since it increases service quality for disadvantaged people.
- It helps identify when consumers would willingly pay for higher quality service. For example, travelers may sometimes be willing to pay extra for walking and cycling improvement, or higher quality transit services.

- Since discretionary travelers (people who have the option of driving) tend to be particularly sensitive to service quality, considering service quality impacts helps identify opportunities to achieve mode shifts, vehicle traffic reductions and associated benefits.
- It reflects sustainability principles, which emphasize *development* (qualitative improvements) over *growth* (quantitative improvements).

Traveling At Good Speed: Transportation Policy Shouldn't Be Reduced To Average Commuting Times.
Alex Marshall, *Governing Magazine*, August 2009 (www.governing.com/column/traveling-good-speed)

Years ago, I drove 35 minutes each day from Virginia Beach to Norfolk to a job as a schoolteacher. Because I lived blocks from a freeway and the school was blocks from an off ramp, I was able to drive at 60 mph almost the entire way. Not a bad commute—but a tiring one. When you drive at high speed on a freeway, you need to pay attention or you may kill someone, yourself included.

Now I live in Brooklyn, and commute 45 minutes to my office in Manhattan. This involves a 15-minute walk to the subway, a five-minute wait for the train, a 20-minute subway ride, plus a five-minute walk to work. This is longer than my old 35-minute car commute but is less tiring. I enjoy the walk. I can read or watch TV on my iPhone while on the subway—or talk to strangers, which is something I enjoy.

I make this comparison to point out that, when it comes to transportation, time is an elastic, subjective, almost mystical thing. One minute spent traveling one way is not the same as another. Yet we seldom acknowledge this. This squishy side of transportation has little place in serious policy discussions at city council tables and in legislative chambers. It isn't easy to start talking about how transportation feels.

Instead, policy makers often present transportation as if it can be effectively summarized in miles-per-hour, average commuting times, cost-per-passenger, or capacity figures. This is unfortunate because how a transport system feels determines how and whether it is used, as well as its long-term potential. It's up to mayors, legislators and planning directors to find ways to talk about these softer sides without blushing.

To jump-start that discussion, here are some more examples of how my transportation experience varies: Sometimes I bike to work. This is actually shorter in time than the subway, but it's qualitatively much different. I arrive invigorated from the challenge of urban cycling (unfortunately, it is dangerous) while also physically tired. And, I have to take weather into consideration.

Then there's walking. I've never walked to work, but I sometimes walk part of the way, say a mile. Walking 20 blocks in a crowded city is fun. But let's say I lived in a typical suburban city. I wouldn't choose to walk a mile along a suburban arterial with cars whizzing by me, even if I covered the same distance in the same amount of time.

Travel between cities offers qualitative differences as well. Plane travel seems to have become a series of lines that one waits in, broken up by small quantities of actually flying. Train travel, if available and good, can offer unbroken hours for sustained concentration. Driving for hours in a car between cities, with or without company, can be good or bad depending on temperament, one's physical size and the quality of one's stereo.

Speaking of stereos, years ago I did a story as a reporter for the Virginian-Pilot in Norfolk called "Drive Time." It was a counter-intuitive story about the guilty pleasure many people experienced while commuting to work because it was often the only time they had to themselves. If they had young children, it was often the only time they had to listen to music or simply to sit quietly. Even being stuck in traffic wasn't so bad, particularly if they had a nice car.

Quality matters, that's clear. My 35-minute commute to Norfolk was in my aunt's old 1973 Ford LTD that I had bought from her. Not a bad car, but a Jaguar might have eased my way. I love train travel, but in the early 1980s, I hated boarding the slow, uncomfortable and crowded trains in Spain, where I was living at the time. The country was still recovering from decades of dictatorship, and its infrastructure was poor. From this, I learned that we need comfort and confidence not just in the vehicle we are seated in but in the wider context for that vehicle.

There is no objective way to pronounce that one way of travel is better than another. Transportation, or at least one's experience of it, is subjective. Ultimately, it depends on what you like. But if policy makers want to push one form of transportation over another, they'd do well to consider making that form of travel a primo experience.

Serving Sophisticated, Affluent Consumers

Modern, affluent consumers willingly pay extra for high quality goods and services: they often purchase brand name clothes, bottled water and organic produce, although cheaper alternatives are available. When choosing a vehicle they often pay extra for features such as in-vehicle navigation systems, better sound systems and optional safety devices. They sometimes pay extra for more convenient parking or even for better roads (such as a toll road). Similarly, commercial airline passengers are often pay significantly more for first-class service that offers increased convenience, comfort and prestige (nicer airport waiting areas, larger seats, personal service) although it does not significantly increase travel speed or reduce delay.

Other transport modes offer fewer consumer options. Walkers can purchase better shoes and cyclists can purchase better bikes, but cannot individually purchase better sidewalks or paths. Public transit travelers must generally accept whatever level of service is available; individual transit passengers generally cannot purchase a nicer waiting area, uncrowded vehicles or more convenient user information. This puts these modes at a competitive disadvantage compared with automobile and air travel which provide service quality options that respond to consumer demands.

This occurs, in part, because most components of automobile and air travel are privately supplied, while all components of public transit are publicly supplied, as indicated in Figure 1. Decisions that affect transit service quality are made primarily through public planning and budgeting processes.

Table 2 **Who Provides Components of Various Modes**

	Automobile	Air Travel	Walk/Bike	Public Transit
Path/Road/Rails/Airspace	Public	Public	Public	Public
Vehicle	Private	Private	Private (shoes & bikes)	Public
Terminals/Parking	Mixed	Mixed	Mixed	Public (stations & stops)

This table compares the provision of infrastructure for different modes. Automobile, air, walking and cycling use private vehicles and mostly private terminals and parking facilities. All public transit components are publicly provided so their quality depends on public planning decisions.

Currently, few qualitative factors are incorporated in transport modeling and economic evaluation. They may be considered at other stages, such as public input and project design, but convenience and comfort factors are generally ignored in models used to predict travel impacts and economic valuation. As a result, alternative mode convenience and comfort impacts tend to be undervalued, resulting in suboptimal planning decisions.

Ways To Incorporate Qualitative Factors Into Planning

Factors such as traveler convenience and comfort can be measured using methods such as *stated preference surveys* (which ask people to value a particular option or impact) and *revealed preference studies* (which measure how people actually respond to an option or impact) (Forkenbrock and Weisbrod, 2001). This information can be incorporated into transport planning and project evaluation through *level-of-service* (LOS) ratings, and by adjusting travel time values to better reflect travel conditions as discussed below.

Level-Of-Service Ratings

Level-of-service ratings are grades from A (best) to F (worst) commonly used to evaluate travel conditions and identify problem areas. LOS ratings are easy to understand and use, and carry considerable weight in decision-making since they are so similar to school grades – nobody wants to receive a bad grade.

Traffic engineers use roadway LOS ratings, which reflect volume-to-capacity ratios (which indicates if traffic volumes exceed a road's optimal capacity) and average traffic delays. Level-of-service (also called *quality of service*) ratings have recently been developed for other modes, including walking, cycling and public transit (FDOT, 2002; Phillips, Karachepone and Landis, 2001; Kittleson & Associates, 2003a and 2003b; "Multi-Modal LOS Indicators," VTPI, 2008; Hensher, 2007). Table 3 lists factors that can be incorporated into such ratings. These can be adjusted and calibrated to reflect specific needs, preferences and conditions.

Table 3 **Level-of-Service Factors** ("Multi-Modal LOS Indicators," VTPI, 2008)

Transit Vehicles	Transit Waiting Areas	Walking and Cycling
Availability (daily service hours).	Ease of access (walking conditions) to transit stops and stations.	Quality of sidewalks, paths and bike lanes.
Frequency (trips per hour or day).	Security.	Quality of crosswalks.
Speed (particularly relative to automobile travel).	Shade and weather protection.	Separation from vehicle traffic.
Reliability (how well service follows schedules).	Lighting quality.	Adjacent motor vehicle traffic volumes and speeds.
Comfort (whether passengers have a seat and adequate space).	Seat comfort and crowding.	Topography (inclines).
Stop/station quality.	Cleanliness and aesthetics.	Security.
Fare payment convenience.	Services (such as washrooms and refreshments).	Bicycle parking and clothes changing facilities.
Security (feelings of safety).		Integration with other modes (such as bikeracks on buses and trains).
Affordability (user costs relative to incomes, and other travel options).		Portion of activities and destinations accessible by walking and cycling.
User information availability.		
Cleanliness and aesthetics.		

This table indicates factors included in transit, pedestrian and cycling level-of-service ratings.

Roadway level-of-service ratings are often used to justify roadway expansion. For example, traffic engineers often prioritize transportation system investments based on road and intersection LOS ratings. This analysis is generally only applied to motor vehicle traffic conditions, which favors roadway expansion over other transport improvement options, and ignores negative impacts that wider roads and increased traffic volumes and speeds may have on walking, cycling and public transit. Most decisions-makers rely primarily on automobile transport and seldom receive information indicating the severity of problems facing users of other modes. Applying LOS ratings to walking, cycling and public transit travel can help consider a wider range of impacts and options in the planning process.

For example, it can be useful to identify roads and intersections where pedestrian and cycling LOS ratings are D or worse, and to rank common destinations (such as schools and commercial districts) according to their walking and cycling LOS ratings in order to identify areas with poor service quality. This type of analysis can be used to prioritize investments, and indicate trade-offs, such as where roadway widening will improve driving conditions but worsen walking conditions.

Similarly, it can be useful to produce transit LOS ratings and compare this with automobile travel conditions in order to indicate the magnitude of problems facing transit travelers and prioritize improvements. LOS ratings can be provided for individual transit stations, routes, corridors, neighborhoods and jurisdictions. Transit service quality can be evaluated by comparing it with commercial airline services. Although there are exceptions, airlines generally offer their customers convenient user information, respectful service, comfortable terminals, amenities such as washrooms and refreshments, clean vehicles, and updates concerning delays. Much of the preference many people express for rail transit over bus transit may reflect rider convenience and comfort features, such as vehicles with comfortable seats, and stations with amenities like washrooms and refreshments. Bus systems should be able to attract more discretionary travelers by providing such amenities.

Multi-modal LOS is particularly important because many jurisdictions now require development *concurrency*, which may limit infill development if it causes local roads to exceed a certain LOS rating. With multi-modal LOS ratings, development is not restricted if other modes (particularly public transit) are adequate. This not only allows more infill development, it also gives developers an incentive to locate near high quality transit service, support improvements to alternative modes, and encourage their use, in order to maximize development potential.

Travel Time Values

Travel time values are a major factor in transport planning and project evaluation. They are used to predict the effects travel system changes will have on travel behavior, and travel time savings are often the largest single benefit of transport improvement projects such as new or expanded highways. As a result, travel time valuation can significantly affects analysis results. A particular project may appear cost-effective and optimal if travel time is measured in one way, but ineffective and wasteful if measured differently. Improving travel time valuation in transport planning and evaluation models can provide more accurate analysis and help identify more cost effective solutions. This section describes ways to incorporate these factors.

Numerous studies have *monetized* (measured in monetary units) the value people place on travel time. Travel time unit costs (dollars per minute or hour) are usually calculated relative to average wages. Personal travel time values typically ranges from 25% to 50% of prevailing wage rates, with variations due to factors discussed below (Mackie, et al. 2003; Wardman 2004; Litman 2007; Espinoa, Ortúzarb and Román 2007):

- Commercial (paid) travel costs should include driver wages and benefits, and the time value of vehicles and cargo reflecting efficient use of assets and ability to meet delivery schedules.
- Travel time costs tend to be higher for uncomfortable, unsafe and stressful conditions.
- Travel time costs tend to increase with income, and are lower for children and people who are retired or unemployed (put differently, people with full-time jobs usually have more demands on their time and so tend to be willing to pay more for travel time savings).
- A moderate amount of daily travel often has little or no time cost, since people generally enjoy a certain amount of daily travel. Unit time costs tend to increase if trips exceed about 20 minutes in duration or total personal travel exceeds about 90 minutes per day.
- Travel time costs increase with variability and arrival uncertainly, and tend to be particularly high for unexpected delays.
- Waiting time tends to have relatively high unit costs (typically 2-5 times in-vehicle travel time), particularly if conditions are unpleasant or wait duration is unpredictable.
- Under pleasant conditions walking, cycling and waiting can have low or positive value, but under unpleasant conditions (walking along a busy highway or waiting for a bus in an area that seems dirty and dangerous) their costs are significantly higher than in-vehicle time.
- Transit travel time unit costs are extremely variable. Under pleasant conditions (waiting areas and vehicles are comfortable, clean and safe) transit has lower unit travel time costs than driving because passengers experience less stress and are able to use their time productively, but under unpleasant conditions, transit travel times are much higher than automobile travel.
- Individual's travel needs and preferences vary. For example, some people place a higher cost on time spent driving while others place a higher cost on transit travel. If travelers have various travel options available, they can choose the one that best meets their needs and preferences, and therefore has the lowest travel time costs.

This research indicates that travel time unit costs are quite sensitive to qualitative factors such as comfort, convenience, productivity and security. Under optimal conditions, walking, cycling and transit travel costs typically average 25-35% of prevailing wages, less than the 35-50% of average wages for drivers, reflecting the reduced stress and increased enjoyment these modes can offer. However, under unpleasant conditions (crowding, noise and dirt) travel time costs for these modes exceeds that of driving.

Similarly, studies indicate that time spent walking to and waiting for transit vehicles generally has unit costs averaging two to five times higher than in-vehicle time, or 70% to 175% of prevailing wages. Improved walking, cycling and waiting conditions can reduce these relatively high unit costs, particularly if people are able to choose their mode based on their preferences. Transfers are estimated to impose penalties equivalent to 5-15 minutes of in-vehicle time, plus waiting time costs. Real-time transit vehicle arrival signs are found to reduce perceived wait times by at least 20%, and probably more.

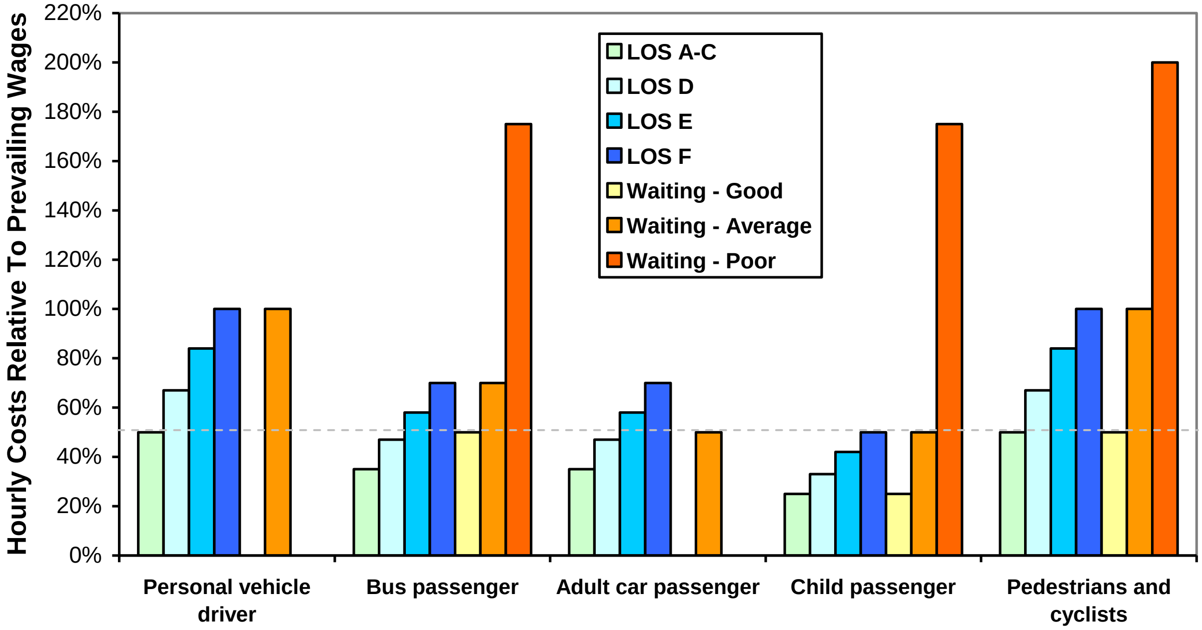
Table 4 **Travel Time Values Relative To Prevailing Wages** (Litman 2008)

Category	LOS A-C	LOS D	LOS E	LOS F	Waiting Conditions		
					Good*	Average	Poor
Commercial vehicle driver	120%	137%	154%	170%		170%	
Comm. vehicle passenger	120%	132%	144%	155%		155%	
City bus driver	156%	156%	156%	156%		156%	
Personal vehicle driver	50%	67%	84%	100%		100%	
Adult car passenger	35%	47%	58%	70%		100%	
Adult transit passenger – seated	35%	47%	58%	70%	35%	50%	125%
Adult transit passenger – standing	50%	67%	83%	100%	50%	70%	175%
Child (<16 years) – seated	25%	33%	42%	50%	25%	50%	125%
Child (<16 years) – standing	35%	46%	60%	66%	50%	70%	175%
Pedestrians and cyclists	50%	67%	84%	100%	50%	100%	200%
Transit Transfer Premium					5-min.	10-min.	15-min.

This summarizes travel time values that incorporate traveler convenience and comfort factors. (Wait time unit costs are reduced another 20-30% where real-time vehicle arrival information is provided.)*

Table 4 indicates how travel time values vary depending on the quality of conditions, using level-of-service ratings to reflect comfort and convenience factors. Figure 1 summarizes some of these values. Of course, these values may vary depending on individual and community needs and preferences. For example, some people or groups may enjoy walking or cycling and so place a lower than average value on time spent on these activities, while others may be particularly sensitive to the discomfort of standing while waiting or traveling on transit vehicles, so their unit costs would increase even more than these “generic” adjustment factors indicate. Special surveys may be used to calibrate these values to a particular situation.

Figure 1 **Summary Values**



This figure compares personal travel time unit cost values under various conditions. Research in this report suggests that under favourable conditions (comfortable, safe, predictable and prestigious) transit travel unit time costs are relatively low, but under current average conditions unit costs are often comparable to automobile travel, and under very unfavourable (crowded, dirty, frightening) transit and walking unit travel time costs exceed virtually all other travel time values. Dashed line indicates the typical value of uncongested automobile driver time.

Conventional transport project evaluation models generally apply a single value to all travel time, or a few values that reflect type of trip (commercial or personal) and traveler (driver or passenger), without adjustments for travel convenience and comfort (USDOT, 1997). They therefore tend to undervalue qualitative improvements to alternative modes. This tends to undervalue many types of improvements (those that increase travel convenience and comfort, rather than speed) and skews planning decisions to favor automobile-oriented improvements over alternative modes.

Survey and Modeling

Travel surveys can include questions related to qualitative factors, such as transit convenience and comfort, to develop models which predict how these factors affect travel behavior. For example, Espinoa, Ortúzarb and Román (2007) use a stated preference survey to analyze mode choice (bus versus automobile) for suburban corridor trips in Gran Canaria, Spain, taking into account transit service comfort, travel time, prices (fares and parking fees) and transit service frequency. The analysis found that travel time cost values increase with transit service discomfort, and that travelers respond more to other incentives (increased transit frequency, lower transit fares and increased parking fees) if transit service has high comfort levels. Douglas (2016), surveyed Sydney, Australia rail passengers to determine their preferences concerning transit travel conditions, and determined that may prefer surface over underground rail.

Pricing

Another way to determine the value consumers place on transport service quality is to offer various service levels and prices to determine consumers' willingness-to-pay for improved convenience and comfort. For example, transit agencies can charge extra premium service, which could offer extra features such as uncrowded vehicles, a guaranteed seat, extra comfortable seats, worktables, refreshments and attendants. Multiple grade service is common on air travel, and for interregional rail and bus service, and has at times been provided on some urban rail lines. Where transit services are provided by competitive, private companies it is common for some to offer premium services at a premium price.

There are, however, practical and political problems with multi-grade public transit service:

- Most transit systems lack sufficient demand to justify multiple vehicles and services.
- It may be difficult to enforce, particularly since few transit vehicles now have conductors.
- Most transit trips are too short to justify special services such as refreshments.
- Since public transit travel is considered socially desirable, it may seem contradictory to charge extra for automobile-competitive service.
- Since public transit provides basic mobility for economically disadvantaged people, it may seem regressive to offer inferior service to people who cannot afford to pay a premium.

It would be even more problematic to offer multi-grade service for other modes, such as walking and cycling, since their use is also considered socially desirable and they provide basic mobility for disadvantaged people. For example, it would seem contradictory and regressive to charge users a premium for using nicer sidewalks or paths.

For these reasons, pricing probably has a limited role in determining the value that consumers place on walking, cycling and public transit service quality. Pricing differentiation would be most appropriate for longer-distance commuter services (vanpool, bus and rail), in which premium services may sometimes be justified. However, to the degree that automobile travel imposes external costs (congestion, parking, accidents and pollution) and higher quality service attracts people who would otherwise drive, it may be better to offer higher quality service to all users.

Travel Impacts

Improving walking, cycling and transit travel service quality improvements tend to increase use of these modes, a portion (typically 30-60%) of which substitutes for automobile travel (Kittleson & Associates 1999; Phillips, Karachepone and Landis 2001; Evans 2001; Litman 2004; DfT 2006). Discretionary travelers (people who could drive) tend to be particularly sensitive to qualitative factors, so in a typical situation, about half of new transit trips induced by service improvements substitute for automobile trips.

Traffic congestion tends to maintain equilibrium: it gets bad enough that some motorists shift travel time, route, destination or mode. The quality of alternative modes affects the point of equilibrium: if alternatives are relatively slow, inconvenient or uncomfortable, motorists are less likely to shift, causing more severe congestion, but if the quality of alternatives improves, motorists will be more willing to shift, reducing congestion overall.

Various methods, described below, can be used to predict the travel impacts of service quality improvements. Of course, actual impacts vary depending on demographic, geographic factors, and specific conditions.

- The elasticity of transit ridership with respect to transit service is typically 0.7 to 1.1, while the elasticity of automobile travel with respect to transit costs is -0.15-0.3, meaning that a 10% increase in service tends to increase transit ridership 7-11% and reduce automobile trips 1.5-3% (Litman, 2004; Pratt, 2004). However, new North American rail and bus rapid transit (BRT) systems have attracted higher ridership than such models would predict, due their greater convenience and comfort. It is now common practice to apply up to a 12-minute in-vehicle travel time “bias constant” for LRT and BRT (that is, the travel times for mode-split modeling purposes would be 12 minutes shorter compared to conventional local bus service) due to their relatively high service quality (Kittleson & Associates, 2007).
- Impacts can also be modeled using *generalized cost values* (the combined monetary and time costs of travel). A typical value is -0.5, meaning that a 10% reduction in a mode’s generalized costs increases its use by 5%. Multi-modal models are available in many cities. For example, Dowling Associates (2005) describes a Portland, Oregon model which indicates the elasticity of transit travel with respect to transit travel time is -0.04 to -0.129, and the cross elasticity with automobile travel is -0.005 to -.01, meaning that a 10% reduction in transit travel time increases ridership by 0.4% to 1.3%, and reduces automobile travel by 0.5% to 1%.
- Case studies of comparable improvements can indicate likely impacts. Sources include Evans (2001), Levinson, et al. (2003), Katherine and Pratt (2003), and Wall and McDonald (2007). Litman (2008) summarizes the effects of various service quality improvements on transit ridership. For example, transit ridership increased 30% in Birmingham, UK after introduction of various service improvements including real time information displays.
- Travelers can be surveyed to determine the value they place on service quality improvements and the effects specific improvements would have on their travel behavior.

This review suggests that significant transit service quality improvements can increase affected ridership by 10-30%, and about half of this increase typically substitutes for automobile travel. Larger shifts can be achieved by also implementing other incentives, such as increased transit speeds, reduced fares, and road and parking pricing.

Example

Table 5 summarizes the cost reductions that would result from improving the convenience and comfort of a transit trip from LOS E to LOS C by improvements such as adding sidewalks and attractive bus stop shelters, and providing seats in vehicles. As a result, the generalized cost of the trip declines 41%, from $14.66 to $6.69, compared with $10.14 for an automobile trip on the same corridor. Such improvements reduce the ratio of transit to automobile costs from 145% down to 86%. This represents the upper bound of cost savings from comfort and convenience improvements alone, since not all transit trips require transfers or involve travel on crowded vehicles.

Table 5 **Travel Time Cost Reductions From Service Quality Improvements**

	Walk	Wait	In Vehicle	Transfer	In Vehicle	Walk	Total	Fare	Generalized Cost
Transit - Current									
Minutes	5	10	20	5	15	5	60		
LOS Rating	E	E	E	E	E	E			
Portion of wages	84%	70%	70%	175%	70%	84%			
Travel Time Costs	$1.05	$1.75	$3.50	$2.19	$2.63	$1.05	$12.16	$2.50	$14.66
Transit - Improved									
Minutes	5	10	20	5	15	5	60		
LOS Rating	C	C	C	C	C	C			
Portion of wages	50%	50%	35%	50%	35%	50%			
Travel Time Costs	$0.63	$1.25	$1.75	$0.63	$1.31	$0.63	$6.19	$2.50	$8.69
Difference	*$0.43*	*$0.50*	*$1.75*	*$1.56*	*$1.31*	*$0.43*	*$5.98*	*$0.00*	*$5.98*
Percent Change	*40%*	*29%*	*50%*	*71%*	*50%*	*40%*	*49%*	*0%*	*41%*
Automobile Trip									
Minutes	1	0	30	0	0	3	34		
LOS Rating	E	E	E	E	E	E			
Portion of wages	84%	0%	84%	0%	84%	84%			
Travel Time Costs	$0.21	$0.00	$6.30	$0.00	$0.00	$0.63	$7.14	$3.00	$10.14
Transit-Current/Auto									*145%*
Transit-Improved/ Auto									*86%*

Improvements of this magnitude should increase transit ridership by about 20%, assuming an elasticity of transit travel to generalized costs of -0.5, about half of which would probably substitute for automobile travel. For example, assume an urban corridor has 12,000 total daily trips, of which 2,000 are by transit, half of which occur during peak periods. Table 6 illustrates the benefits from improving transit service LOS from E to C. These benefits include travel time cost reductions to current transit users (off-peak traveler benefits include no in-vehicle benefits, since these consist largely of reduced crowding, which is a peak period problem), consumer surplus gains to travelers who shift mode (calculated by dividing monetized unit benefits by two, based on the rule-of-half), and reduced external costs (traffic congestion, parking subsidies and accident risk) from reduced driving, estimated at $5.00 per trip during peak periods and $2.00 during off-peak periods (Litman, 2005). The results indicate that these improvements would provide benefits that average more than $10,000 per day, or more than $350,000 annually.

Table 6 **Monetized Benefits From Service Quality Improvements**

Travel Changes	Number	Unit Benefits	Total Benefits
Peak Period riders	1,000	$5.98	$5,980
Off-Peak riders	1,000	$2.92	$2,920
New peak riders	200	$2.99	$598
New off-peak riders	200	$1.46	$292
Reduced peak automobile trips	100	$5.00	$500
Reduced off-peak automobile trips	100	$2.00	$200
Total			*$10,490*

This table estimates the benefits from improving transit service quality on a particular corridor.

Although the vehicle traffic reductions may appear small (about 2%), these service quality improvements can be implemented with other mode shift incentives, such as improved transit speeds, fare reductions, parking pricing and commute trip reduction programs to achieve additional travel impacts and benefits (VTPI, 2008). These strategies tend to be synergistic, resulting in larger total benefits when implemented together than the sum of their individual impacts.

This illustrates how convenience and comfort improvements can significantly reduce travel time costs and provide benefits that are virtually invisible to most current transportation economic evaluation models.

The Additional Research

This study identifies several types of research needed to improve our ability to quantify and monetize transit service quality factors and incorporate them into transit evaluation.

1. Survey transit operators who have implemented service quality improvements, such as reduced crowding and real-time information signs, to better understand their experience. This research should attempt to identify impacts on patron satisfaction and transit ridership.
2. Perform detailed studies to evaluate the value that travelers place on various service quality attributes, particularly for walking, cycling and public transit. Such surveys should include both current users of these modes and people who currently drive but may be amenable to using transit.
3. Apply the unit cost values in this paper to calculate the value of various types of transit service improvements. Consult planners, transit users and non-users to determine whether the results make sense, based on their perspectives and experience.
4. Perform detailed before-and-after studies of any service quality improvements. For example, before implementing service improvements collect appropriate baseline data through surveys and traffic counts as a basis for evaluating how they affect patron satisfaction, travel and operations.
5. Develop level-of-service standards for walking, waiting conditions and transit travel that can be used to adjust unit travel time values in order to evaluate specific improvements and changes. These can be based on existing multi-modal LOS rating systems, with testing and calibration to quantify and monetize travel time costs.

Conclusions

Travelers place a high value on qualitative factors such as convenience, comfort and prestige. Motorists and air travelers can express their preferences by paying extra for premium vehicles and services. Other modes offer fewer upgrade options. Walking and cycling conditions, and public transit service quality, are determined through public planning processes. Users must accept the service quality provided or change modes. If given the option, many consumers might willingly pay extra for higher quality walking, cycling and public transit travel. Yet, conventional transport planning has no way to incorporate these factors into economic evaluation.

Conventional evaluation practices tend to focus on travel speed and give little weight to convenience and comfort. This biases transport planning decisions in various ways that reduce transport system optimality (compared with what would maximize efficiency, equity and social welfare). It reduces transport options (since alternative modes tend to be slower and so are undervalued by conventional evaluation), service options (since it overlooks the value of offering multiple levels of service), service quality (since qualitative improvements are undervalued). The following benefit categories should be considered when evaluating service quality improvements to alternative modes:

1. Benefits to existing users (people who would use alternative modes anyway).
2. Benefits to new users attracted by the improvements.
3. Benefits to other road users due to reduced congestion and accident risk.
4. Benefits to society overall from road and parking facility cost savings, health and safety benefits, energy savings and pollution emission reductions.
5. Benefits to transit agencies from increased fare revenue.

This paper describes practical ways to incorporate service quality into transport planning, by developing level-of-service standards for alternative modes that incorporate qualitative factors, and incorporate qualitative factors into travel time values. These methods are already applied to some degree, so only modest additional research is needed to make these standard practices in transport planning and project evaluation.

Research summarized in this paper indicates that unit travel time cost values (cents per minute or dollars per hour) for walking, cycling and transit travel range from below that of automobile travel if conditions are good, to much higher than automobile travel if conditions are poor. Improved walking and cycling facilities, more comfortable transit vehicles and stations, and more convenient user information can significantly reduce travel time costs and increase use of these modes, providing direct benefits to users and external benefits if such improvements cause travelers to shift to more efficient modes.

Improving our ability to evaluate multi-modal service quality expands the range of impacts and options considered in the transport planning process, allowing more optimal decisions that better respond to consumer demands.

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