Overcoming Barriers to Smart Growth: Surprisingly Large Role of Better Transportation Modeling

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ABSTRACT

Computerized traffic models are widely used to evaluate traffic problems and predict the effects of transportation and land use changes. These models can significantly influence transport and land use planning decisions. The models currently used in most communities contain assumptions and biases which tend to exaggerate the benefits of roadway capacity expansion and understate the benefits of transport and land use management strategies. This paper describes some of these biases and offers suggestions as to how they can be corrected to better evaluate location efficient development, public transit improvements, and other mobility management strategies.

Introduction

In recent years various innovative transportation and land use policies have been proposed to help address a variety of economic, social and environmental problems. Transportation innovations include various types of improvements to alternative modes (walking, cycling, ridesharing, public transit and telework) and *mobility management* (also called *Transportation Demand Management*) strategies, which encourage more efficient travel behavior (VTPI, 2006). Land use management strategies, generally called *smart growth*, *new urbanism* or *location efficient development*, include land use policies that result in more compact, mixed, connected and multi-modal land use development patterns (USEPA, 2001; Kuzmyak and Pratt, 2003; "Smart Growth," VTPI, 2006). These innovations can help solve a variety of problems and provide multiple benefits. They are increasingly advocated by professional organizations ranging from the Transportation Engineers (ITE, 2003) to real estate agents (Smart Growth Leadership Institute).

However, implementation of these strategies often faces resistance because they are new and are not well supported by current evaluation techniques. Many conventional tools used for evaluating transportation and land use policies are biased in ways that overestimate the benefits of conventional solutions, such as expanding roads and parking facilities, and undervalue the benefits of innovative alternative solutions such as mobility management and smart growth. In particular, the types of computer models widely used to evaluate traffic problems in most communities, called *Four Step Gravity Models*, contain assumptions and biases which tend to exaggerate the benefits of roadway capacity expansion, and understate the benefits of transport and land use management strategies. This tends to create a self-fulfilling prophecy, as planning techniques predict ever-increasing vehicle traffic demand, which justifies automobile-oriented transportation and land use policies and projects, which leads to increased vehicle travel. Yet, there is plenty of evidence that, given suitable alternatives, many consumers will choose more multi-modal communities where they drive less and rely more on alternative modes, and are better off overall as a result.

This paper describes some of the biases in current transportation planning practices, and offers suggestions as to how they can be corrected to better evaluate location efficient development, public transit improvements and mobility management strategies

Land Use Impacts on Travel

A considerable and growing body of research indicates that land use factors such as *density* (the number of residents, households or jobs in an area), *mix* (the combination of different types of land uses, such as residential and commercial, in an area), *connectivity* (the degree to which roads and paths are connected and allow direct travel between destinations), and *multi-modalism* (the degree to which land use supports use of alternative modes such as walking, cycling and public transit) affect travel behavior (Kuzmyak and Pratt, 2003; Frank, Kavage and Litman, 2006; Litman, 2006). By applying these factors it is possible to create more accessible, multi-modal communities, where people drive less and rely more on alternative modes than if the same people where to live in more automobile-dependent communities. The results can be significant. Although most of these land use factors have modest individual effects, typically reducing automobile trips by 5-15%, their impacts are cumulative and synergistic (total impacts are greater than the sum of individual impacts). As a result, residents of automobile dependent communities tend to drive up to five times as much as otherwise similar residents of smart growth communities (Holtzclaw, 2004).

Location efficiency (also called *smart growth* and *new urbanism*) is defined as the extent to which automobile use can be reduced by land use factors. It is determined from statistical measurements of vehicle ownership and automobile driving behavior as a statistical fit of neighborhood characteristics such as density, transit service, and pedestrian design, and socio-economic data such as household income and household size. This analysis can be applied in a variety of ways:

- Reductions in per capita vehicle travel can provide household travel cost savings, which can be incorporated into analysis of household borrowing capability, treating transportation cost savings as additional household income compared with a more automobile-dependent location that requires more driving and associated vehicle expenses ("Location Efficient Development," VTPI, 2006).
- Reductions in vehicle traffic in more accessible locations can be used to adjust development and utility fees, recognizing that the costs of providing infrastructure and public services tends to be lower in such locations, due to improved accessibility and reduced trip generation ("Smart Growth Policy Reforms," VTPI, 2006)
- Reductions in per capita vehicle travel can provide environmental benefits, including reductions in per capita energy consumption, pollution emissions and impervious surface (USEPA, 2001; "Land Use Evaluation," VTPI, 2006)
- Public policies that reduce automobile travel and increase nonmotorized travel can be implemented as part of programs to improve public health (Frank, Kavage and Litman, 2006).

Table 1. Land Use Impacts on Travel

Factor	Definition	Travel Impacts
Density	People or jobs per unit of land area (acre or hectare).	Increased density tends to reduce per capita vehicle travel. Each 10% increase in urban densities typically reduces per capita VMT by 1-3%.
Mix	Degree that related land uses (housing, commercial, institutional) are located close together.	Increased land use mix tends to reduce per capita vehicle travel, and increase use of alternative modes, particularly walking for errands. Neighborhoods with good land use mix typically have 5-15% lower vehicle-miles.
Regional Accessibility	Location of development relative to regional urban center.	Improved accessibility reduces per capita vehicle mileage. Residents of more central neighborhoods typically drive 10-30% fewer vehicle-miles than urban fringe residents.
Centeredness	Portion of commercial, employment, and other activities in major activity centers.	Centeredness increases use of alternative commute modes. Typically 30-60% of commuters to major commercial centers use alternative modes, compared with 5-15% of commuters at dispersed locations.
Network Connectivity	Degree that walkways and roads are connected to allow direct travel between destinations.	Improved roadway connectivity can reduce vehicle mileage, and improved walkway connectivity tends to increase walking and cycling.
Roadway design and management	Scale, design and management of streets.	More multi-modal streets increase use of alternative modes. Traffic calming reduces vehicle travel and increases walking and cycling.
Walking and Cycling conditions	Quantity, quality and security of sidewalks, crosswalks, paths, and bike lanes.	Improved walking and cycling conditions tends to increase nonmotorized travel and reduce automobile travel. Residents of more walkable communities typically walk 2-4 times as much and drive 5-15% less than if they lived in more automobile-dependent communities.
Transit quality and accessibility	Quality of transit service and degree to which destinations are transit accessible.	Improved service increases transit ridership and reduces automobile trips. Residents of transit oriented neighborhoods tend to own 10-30% fewer vehicles, drive 10-30% fewer miles, and use alternative modes 2-10 times more frequently than residents of automobile-oriented communities.
Parking supply and management	Number of parking spaces per building unit or acre, and how parking is managed.	Reduced parking supply, increased parking pricing and implementation of other parking management strategies can significantly reduce vehicle ownership and mileage. Cost-recovery pricing (charging users directly for parking facilities) typically reduces automobile trips by 10-30%.
Site design	The layout and design of buildings and parking facilities.	More multi-modal site design can reduce automobile trips, particularly if implemented with improved transit services.
Mobility Management	Policies and programs that encourage more efficient travel patterns.	Mobility management can significantly reduce vehicle travel for affected trips. Vehicle travel reductions of 10-30% are common.

Source: Kuzmyak and Pratt, 2003; Litman, 2006

This table describes various land use factors that can affect travel behavior and population health.

Quantitative information on location efficiency is relatively new, with the first comprehensive study being performed by Newman and Kenworthy (Newman & Kenworthy, 1989), followed by an expanding body of research (Litman, 2006).

The basic concept of location efficiency is validated by numerous studies, all of which show the important influence of density and transit on reducing automobile travel, and many of which also note influences of mixed use or urban connectivity, pedestrian and bicycle friendliness, and proximity to jobs (Benfield and Replogle 2002, Cervero and Duncan 2002).

Some researchers have criticized these analyses by asserting that they depend on self-selection or are not sensitive to income or stage of life. The self-selection issue was addressed in Cervero and Duncan 2002, who found a self-selection effect at a 40% level but interpreted it in the opposite way that critics suggest: “The presence of residential self-selection does not in any way diminish the value or importance of targeting housing development to transit station areas. If anything, it underscores the importance of removing barriers to residential mobility so that households are able to sort themselves, via the marketplace, to areas well served by transit.”

In other words, self-selection does not mean that the effects of transit and density on auto ownership and usage are actually less than what is shown by the statistics; instead the presence of density and transit allows those who are inclined to rely less on autos to do so. In metro areas that lack the choice of compact transit-oriented neighborhoods, this self-selection is not possible, or at least is more difficult.

Frank, Kavage and Litman (2006) describe several other studies which show significant effects of land use on travel behavior, taking into account self-selection. Before-and-after studies confirm that households change their travel behavior when they move to more accessible locations. For example, Podobnik (2002) found that residents of Orenco Station, a transit-oriented suburban community on a commuter rail line outside of Portland, Oregon, use public transit significantly more than residents of other, comparable, higher-income suburban communities. The study found that 22% of Orenco commuters regularly use public transit, far higher than the 5% average for the region. Sixty-nine percent of Orenco residents report that they use public transit more frequently than they did in their previous neighborhood, and 65% would like to use public transit more than they do now, indicating that they may be receptive to other TDM strategies.

Given attractive conditions and suitable destinations (such as neighborhood schools, parks and shops), many people will choose to walk for a portion of trips, resulting in reduced traffic problems, increased physical fitness and health, and increased community cohesion (positive interactions with neighbors. Although many people enjoy driving on uncongested roads; most dislike driving in congestion and paying auto costs. Do those who like to walk more sort themselves out to locate in dense areas? Maybe in New York City where they have choices; but where are these walkers in LA, Phoenix, Atlanta, Indianapolis, etc.? Even in New York and San Francisco, with a wealth of good walking areas, there is a huge unmet desire for more, as attested to by their notoriously high housing costs. For instance, housing in ZIP code 94133 in San Francisco’s North Beach is 6 times more expensive in $/sq. ft. than in upper-middle-class second-ring suburban San Ramon. So there is a huge unmet potential to sell walking neighborhoods in LA, et al, where few exist (Reconnecting America, 2004).

The issue of separating income and family size was addressed directly in Holtzclaw 2002 by fitting the equations for these variables. The question of stage of life was addressed informally but was not found to make much difference: in the limited number of cases examined, correcting for stage of life would have given slightly *more* credit to density in reducing driving.

Market surveys indicate that many households prefer communities that reflect Smart Growth features such as accessibility and transportation diversity (Levine, et al., 2002; Molinaro, 2003). The 2004 American Community Survey sponsored by the National Association of

Realtors and Smart Growth America found that consumers value a shorter commute time and having sidewalks and places to walk in their neighborhood (Belden Russonello & Stewart, 2004). Among people planning to buy a home in the next three years, 87% place a high importance on a shorter commute as their top priority. Asked to choose between two communities, six in ten prospective homebuyers chose a neighborhood that offered a shorter commute, sidewalks and amenities like shops, restaurants, libraries, schools and public transportation within walking distance over a sprawling community with larger lots, limited options for walking and a longer commute. Those who are in the market to buy a home are also more likely to say they want to be in or near a city as opposed to living in a farther out suburb or rural area.

Minorities are even more likely than other Americans to choose a walkable neighborhood that has a shorter commute, with 59% of women, 57% of Hispanics and 78% of African-Americans selecting those communities over communities with bigger lots and longer commutes. After hearing detailed descriptions of two communities, Americans favored the attributes of walkable, smart growth communities over sprawling communities with longer commutes 55% to 45%.

Americans also want government and business to be investing in existing communities before putting resources into newer communities farther out from cities and older suburbs. Nearly nine in ten want their states to fund improvements in existing communities over incentives for new development in the countryside.

A major market survey of 2,010 adult California residents found that 86% of respondents prefer to live in a single-family, detached home, compared with 65% who actually do live in such a house (PPIC, 2002). This seems to support the contention that sprawl reflects consumer preferences.

Question	Responses
Want to live in a single-family, detached home.	86%
Actually live in a single-family, detached home.	65%

Source: *Special Survey on Land Use*, PPIC, 2002

Most survey respondents prefer living in a single-family home.

However, about half of these consumers would prefer a smaller house if it meant having a shorter commute.

Question	Responses
Would you choose to live in a small house with a small backyard, if it means you have a short commute to work?	49%
Would you choose to live in a large home with a large backyard, even if it means you would have a long commute to work?	47%
Don't know.	4%

Source: *Special Survey on Land Use*, PPIC, 2002

Many survey respondents prefer a smaller home if it reduces their commute distance.

About half of survey respondents show a preference for living in a mixed use neighborhood, with shops and services within walking distance, in order to reduce their dependence on driving.

Question	Responses
Would you choose to live in a mixed-use neighborhoods where you can walk to stores, schools, and services?	47%
Would you choose to live in a residential-only neighborhood, event if it means you have to drive a car to stores, schools and services?	50%
Don't know.	3%

Source: *Special Survey on Land Use*, PPIC, 2002

About half of survey respondents prefer living in a mixed-use neighborhood.

Similarly, about a third of survey respondents show a preference for living in a higher-density, transit-oriented neighborhood, in order to reduce their dependence on driving.

Question	Responses
Would you choose to live in a high-density neighborhood where it was convenient to use public transit when you travel locally?	31%
Would you choose to live in a low-density neighborhood where you would have to drive your car when you travel locally?	66%
Don't know.	3%

Source: *Special Survey on Land Use*, PPIC, 2002

About a third of survey respondents prefer living in a compact, transit-oriented neighborhood.

Similar results were found in a major transportation survey performed in Atlanta, Georgia, which asked residents to make trade-offs between house and community attributes (Steuteville, 2004). The results showed that many residents of automobile dependent communities would prefer living in a more compact, multi-modal neighborhood if it had attributes such as low crime rates, affordable housing and high quality schools.

Location efficiency can provide significant financial savings to households (CTOD and CNT, 2006). The economic advantages of increasing location efficiency are larger than those of any other efficiency measure because the savings in transportation costs are several times larger than the associated savings in gasoline costs. Most of the cost of transportation consists of fixed costs such as buying a car, insuring it, garaging it, and keeping it in good working order. Variable costs include significant non-energy expenditures such as maintenance incurred as a result of automobile usage, tire replacement, parking charges, etc.

The overall benefits of location efficiency are so large that if all new residential construction in the United States resembled self-declared smart growth projects that were actually built and this occurred for 10 years, the economic benefits to the economy would exceed \$2 trillion or about 20% of one year's GDP. The magnitude of these benefits would grow over time because of the extremely long lifetime of neighborhood infrastructure (Bürer, Goldstein & Holtzclaw, 2004).

Barriers to Location Efficiency

The two primary determinants of location efficiency are net residential density and transit access. There are a number of practical barriers to projects that enhance both of these parameters. Many of them, as will be discussed in this paper, are due to the current inability of traffic models to correctly evaluate the full benefits of alternative modes, smart growth development policies and other mobility management strategies.

The most direct barrier occurs in the endeavor of transportation infrastructure planning. Transit projects are evaluated based on planning models that look at their effectiveness at reducing traffic congestion or the need to construct highways, and their cost-effectiveness compared to the car and highway alternative. But the models that are used for these comparisons are not up to the task.

The current generation of planning models generally assumes that a given land use pattern generates a fixed number of trips and vehicles miles traveled per household, irrespective of the state of development of the transit system. If transit is overlaid upon a model of a current geographic region, the model will predict that some of the trips are diverted from cars to transit, but that the total passenger miles traveled remains the same.

Recent research has shown that quality public transit service tends to reduce per capita vehicle travel by nearby residents (typically people within ½ mile of a transit station) far more than just the miles shifted directly to transit. This occurs because high quality public transit creates *transit oriented development*, that is, more compact, multi-modal communities where residents and employees tend to own fewer vehicles and drive fewer miles than residents of more automobile-oriented communities (Kuzmyak and Pratt, 2003; "Transit Oriented Development," VTPI, 2006). As a result, quality transit (rail transit and perhaps high quality Bus Rapid Transit) tends to have a leverage effect, by which each mile of transit ridership results in a proportionally larger reduction in vehicle-miles (Litman, 2004).

Indeed, one of the authors' calculations shows that the typical reduction in passenger miles traveled is roughly four times as large as the diversion of passenger miles from automobiles to transit as shown at http://www.sierraclub.org/sprawl/articles/reducedriving.asp. While the exact formula determining the reduction in passenger miles traveled as a function of transit access is not known with certainly, other research corroborates this general conclusion. (Williams 2002, Cervero and Duncan 2002; Litman, 2004)

To the extent that this factor is not present in the transportation model, the cost effectiveness of transit projects is underestimated, often by a factor of 5.That is, a model that assumes no reduction in passenger miles traveled estimates that a given level of investment in a new transit system or an upgrade of an existing system will produce projected benefits in terms of congestion relief that are lower than what really happens by a large factor; in the case suggested above, about a factor of 5.

More detailed issues with the specifics of the design of the transit system are discussed later.

A second problem with the current generation of transportation models is that they underestimate the effect of land use factors such as density and mix. Some models assume that the trip and VMT generation of a new residential unit is the same as for existing units (historical levels) located in the same neighborhood, irrespective of changes in density. This is not as erroneous as assuming that all households in any neighborhood generate the same number of trips and VMT regardless of energy, but it still overpredicts the VMT in smart growth development.

For example, suppose a new development doubles the population of a given neighborhood while not expanding its geographic limits (imagine an infill project in an urban downtown). Not only will the new development generate about 30% less traffic per household than the preexisting neighborhood average, but it will also reduce the VMT generation *by the existing households* that are already in the area by 30%, http://www.sierraclub.org/sprawl/articles/design.asp. (The result can also be enhanced by two indirect factors: 1) the additional wallets attract markets, coffee shops, restaurants, and other services to move into the neighborhoods; and 2) the additional riders support transit service improvements.)

So the current models will grossly overstate the traffic impacts of new developments with strong smart growth characteristics.

This is a major barrier because such analyses are used for environmental impact statements for development projects. They provide information to neighbors who may oppose the project based on its predicted traffic generation. This is a shame because the traffic impacts for many urban infill projects are illusory. These issues are described in detail in Section II and III.

Interactions of Transportation and Location Efficiency

The existence of transportation infrastructure affects the level of development and location efficiency that is likely to occur. If new highway capacity is constructed, lowering travel time to a particular area, then the area will be more attractive for real estate development. Buildings that would otherwise have been built elsewhere will instead be constructed where they can take advantage of the conveniences provided by the highway.

This diversion of development has several effects on travel behavior, most of which are not included in the models. First, the new highway will generate new travel, referred to as “induced traffic” that will reduce the first-order predictions of congestion relief (Goodwin, 1996; Hansen & Huang, 1997; Johnston & Ceerla, 1996; Marshall. 2000; Noland & Cowart, 2000; Litman, 2001). Second, the type of development diverted will likely have lower levels of location efficiency, due to both lower density and lower or zero transit access. Third, the development may delay smart growth projects that would have been built elsewhere in the region.

The Role of Modeling

Traffic models are used for a variety of important planning purposes. Most directly they are used to evaluate the need for highway expansions and transit projects. Secondly, the results are used to evaluate traffic congestion that is likely to occur. These calculations of traffic congestion feed into both evaluations of highway needs and of prospective “choke points” for traffic and into air quality models used by state environmental agencies in developing their State Implementation Plans (SIPs) for compliance with the Federal Clean Air Act. And finally, the over-predicted increases in traffic and congestion are used by residents and public officials to oppose smart growth development.

In all of these cases, models that over-predict the traffic generation of smart growth developments and of transit-oriented transportation infrastructures provide decisionmakers with misleading data that encourage traditional sprawl development by underrating the benefits of smart growth alternatives.

Transportation models also are deficient in their failure to predict the consequences of constructing transportation infrastructure. In the case of both highways and transit, the presence of a new piece of infrastructure encourages land use developments that take advantage of the improved level of transportation services. In the case of highways, a new freeway that circumvents a congested freeway reduces travel times and allows the development of new residential and commercial space near the freeway exits that would not have occurred without the highway. These developments and the increased use of travel and reduced time generate "induced travel," which reduces the amount of effective new capacity provided by the highway by 60%-120% (Litman, 2001).

Similarly, the addition of a transit system or inter-city rail can promote development around the stations. But the current models do not reflect this. Instead, many models assume that growth will continue in the geographic areas where it had been occurring during the past, as if transportation system upgrades had no effect on land use. Currently, the more sophisticated models account for transportation improvements by simulating the additions to property value that they cause and estimating how this added value affects the density of residential and commercial development.

Perhaps the most important and direct use of transportation planning models is in developing methods for relieving highway congestion. This is important to transportation system managers who wish to reduce travel time and are concerned that congestion is an impediment to economic development. It also weighs heavily on the air quality models, since cars traveling slowly in stop and go traffic emit more per mile than cars traveling in free flowing traffic at 30-50 miles per hour. (Although much of the air quality benefits of free flowing traffic go away if the free flow occurs at above 50 miles per hour.) Therefore, developing models that predict peak traffic flows and respond with the correct incremental effect of changes in transit system service are critically important.

The present set of transportation models is based on an untested assumption that a given land use pattern generates a given number of passenger miles of travel demand, regardless of the characteristics of the transportation infrastructure. This assumption leads to an evaluation methodology for transit that looks at the number of trips taken on transit and simply subtracts the passenger miles (with correction for load factor, circuitousness of travel, etc.) from the automobile travel demand. This modeling structure requires that new transit projects be evaluated on the basis of how many customers they attract, which has proven notoriously difficult to predict.

In contrast, more recent research suggests strongly that the presence of transit service reduces *overall travel requirements* (length of trips), with the reduction critically dependent on how many people live within walking distance of the bus stop or train station. Incorporation of this research into transportation models would have several major beneficial effects. First, a source of guesswork is removed from the equation. While it may be difficult or impossible to predict ridership on a new transit system, it is simple and direct to predict service levels: these are the levels provided by the agency that is proposing the project. If the best correlation of automobile traffic demand is with transit service level, then patronage figures are never needed to predict the impact of the system on VMT.

There are two practical consequences of making this correction. First, the effectiveness of transit at either reducing congestion on existing highways or reducing the need for new highways has been drastically underestimated in existing models. So options that may be very effective in the real world do not even get evaluated, because the models will not show them to be powerful enough even to warrant further study.

Thus, solutions to traffic congestion in existing urban areas may be feasible in ways that were not previously thought to be.

Second, for transit systems outside of the urban center, there is generally a tradeoff between providing stations in areas currently containing high density residential development or prospectively containing such development, and running the line down existing rights of way, where the stations may be in the middle of freeways, next to railroad yards, or in industrial areas with very little trip generation within walking distance of the station.

There is a direct economic tradeoff to be made between more convenient siting of the station and higher cost of the system. Unless transportation models can determine the quantitative benefits of the transit oriented development style of location in a particular neighborhood versus the cheap right of way style, planners have no basis for selecting one option or the other.

Transportation models are also used in generating environmental impact statements for land use projects, predicting air quality benefits, and more importantly, local traffic impacts.

Planners with the San Francisco Department of City Planning have observed that new infill projects initially attract neighborhood opposition, but this opposition is not based on a concern about having more people in the neighborhood, but rather having more cars. Models that incorrectly calculate increased traffic impacts generate unnecessary NIMBY opposition. This opposition often leads to the cancellation of the project. It can also lead to modifications in the project that reduce its effectiveness in controlling traffic: increases in the amount of required parking (due to projected high ownership levels for cars that are not realized), reductions in the number of units in the project (ostensibly to reduce traffic impacts, but also reducing densities and thus sacrificing some of the traffic-reducing benefits of the project).

Compounding the problem, all of these sorts of modifications increase the cost of infill housing development, thus reducing the number of circumstances in which it is profitable enough to build. Restricting the number of units leads to a higher price per unit. Sometimes a company builds more square footage per unit, which may be more than the market optimally wants. The provision of unnecessary parking also raises project development costs. The likelihood that neighborhood opposition will delay the project or stop it raises the risk and thus the development cost (and the possibility that traffic mitigation measures) for the project (Jia and Wachs, 1998; “Parking Management,” VTPI, 2006).

Another set of problems occur during the economic evaluation phase of the transportation planning process. Current transportation investment evaluation models (such as MicroBenCost) were designed to compare highway routes, and so assume that the same number of vehicle trips will occur regardless of which investment is made. As a result they generally overlook or undervalue the benefits that result from reductions in vehicle trips. For example, these economic evaluation models generally ignore vehicle ownership and parking facility costs, assuming that when travelers shift from driving to alternative modes they will still need the same number of cars and parking spaces (“Comprehensive Transport Planning,” VTPI, 2006).

These criticisms are by no means new. Most modelers are aware of these problems and biases, and there are several efforts to develop more accurate traffic and economic evaluation models (Beimborn, Kennedy and Schaefer, 1996; FHWA, 2006; USDOT, 2006; “Transport Model Improvements,” VTPI, 2006). Table 2 summarizes various categories of transport modeling problems and ways to correct them.

Of particular concern is the fact that most of the errors are biased in the same direction, in favor of automobile-oriented improvements at the expense of transport and land use management innovations such as investments in alternative modes, mobility management strategies and smart growth land use policies. It is therefore particularly important for planners, public officials and the general public to understand these factors and take them into account when making transport and land use decisions.

Table 2. Traffic Model Problems and Corrections

Name	Common Problems With Current Models	Appropriate Correction
Travel data	Travel surveys often undercount short trips, non-motorized travel, travel by children, non-work travel, and off-peak travel.	Improve travel surveys to provide more comprehensive information on travel activity.
Nonmotorized travel	Most travel models do not accurately account for nonmotorized travel, and so fail to identify ways that improving nonmotorized travel conditions can help achieve planning objectives.	Modify existing models or develop special models for evaluating nonmotorized transportation improvements.
Transit elasticities	Transit elasticity values used in transport models are largely based on studies of short- and medium-run impacts, and so they significantly understate the long-term impacts of changes in fares and service quality on transit ridership, transit revenue, congestion and pollution emissions.	Use more appropriate values for evaluating long-term impacts of transit fares and service quality.
Travel time	Assigns a standard value of time to all travel activity, which tends to place a cost on shifts from driving to alternative modes.	Measure consumer surplus, which recognizes that travel changes that result from positive incentives (such as improved walking conditions and transit service) represent benefits to consumers, even if they are slower per mile of travel.
Self-fulfilling prophesies	Modeled traffic projections are often reported as if they are unavoidable and must be accommodated. The result is often a self-fulfilling prophesy of increased roadway capacity, generated traffic, increased traffic problems and sprawl.	Transportation planners should not report travel demand as a fixed value ("traffic volumes will grow 20% over the next decade"), but rather as a variable ("traffic volumes will grow 20% over the next decade if current policies continue, 10% if a parking fee averaging $1.00 per day is implemented, and 0% if a $3.00 per day average parking fee is implemented.")
Accessibility	Most transportation models primarily evaluate *traffic* (vehicle travel), or at best personal *mobility* (person-trips), and fail to reflect *accessibility* (people's ability to obtain desired goods and activities).	Develop multi-modal models which indicate the quality of nonmotorized and transit travel, and integrated transportation/land use models which indicate accessibility.
Generated traffic	Traffic models fail to account for the tendency of congestion to limit traffic growth, and expanded roadways to generate additional peak-period traffic.	Incorporate various types of feedback into the traffic model.
Induced travel costs	Economic models fail to account for the additional external costs that result from expanded roadways and the savings that can result from TDM solutions, including downstream congestion, parking costs, vehicle ownership costs, accidents, pollution emissions, and sprawl-related costs.	Develop more comprehensive economic analysis models which account for all significant economic impacts.
Construction impacts	Economic models often fail to account for the traffic congestion costs during construction periods.	Take congestion delays into account when evaluating projects and comparing capacity expansion with TDM solutions.
Transportation diversity	Quantity and quality of travel options (particularly those used by non-drivers) are often ignored or undervalued.	Give particular attention to the transportation options and service quality to disadvantaged groups, including lower-income, people with disabilities, seniors, and isolated areas.
Impacts on	Models often fail to identify how transportation	Develop integrated transportation and land use

Name	Common Problems With Current Models	Appropriate Correction
land use	decisions are likely to affect land use patterns, and how land use decisions affect accessibility, and the degree to which these reflect strategic planning objectives.	planning models which predict how transport decisions affect land use patterns and how land use decisions affect accessibility.

Source: "Transport Model Improvements," VTPI, 2006

This table summarizes ways of improving traffic and transportation investment models.

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