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Author
Martens, Karel

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Basing Transport Planning on Principles of Social Justice

Karel Martens

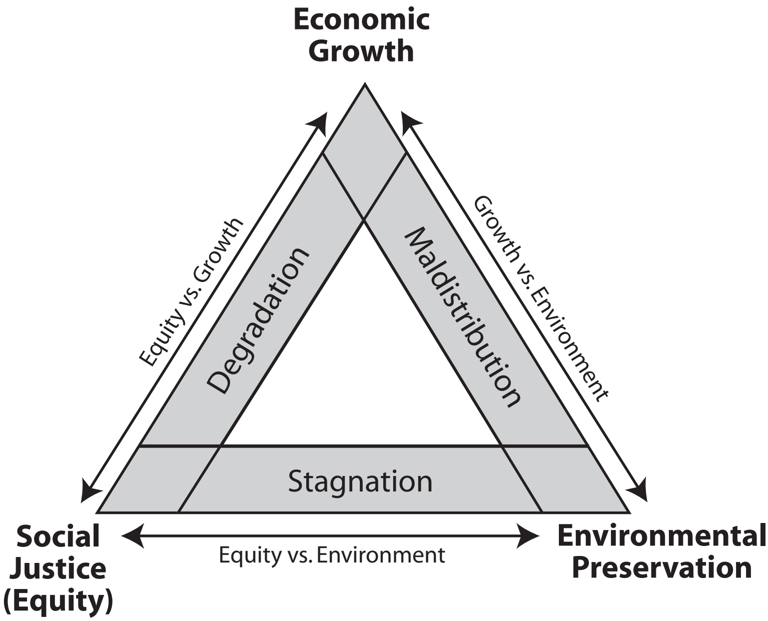
Abstract

Transport modeling and cost-benefit analysis are two key tools used in transport planning. Both tools have been adapted substantially to cope with the challenges posed by the goal of sustainable development. However, the changes have primarily focused on the negative environmental impacts of the transport sector. Hardly any attention has been paid to another key dimension of sustainable development: social justice. This paper critically analyzes the two tools from this perspective. It concludes that transport modeling is implicitly based on the distributive principle of demand. Given the importance of mobility in current society, it is suggested to replace current demand-based approaches by transport modeling that is based on the principle of need. Likewise, cost-benefit analysis has a built-in distributive mechanism that structurally favors transport improvements for highly mobile groups. This problem could be solved by replacing travel time savings by so-called accessibility gains as the key benefit taken into account in cost-benefit analysis. If the suggested changes were realized, both transport modeling and cost-benefit analysis could become key tools for promoting sustainable transport.

Introduction

The concepts of sustainable development and sustainable transport have swept through the academic literature since the publication of the UN report Our Common Future (Brundtland 1987). The sustainability concept links three overarching policy goals to one another: economic development, environmental preservation, and social justice. Following Feitelson (2002), each of these three dimensions can be depicted as the corner of a triangle, with the trade-offs between the key dimensions demarcated along the triangle's sides, as shown in Figure 1. Using the figure, the search for sustainable transport can be reformulated as a search for solutions that address all three trade-offs simultaneously so as to avoid the three "faces" of unsustainable development: environmental degradation, economic stagnation, and maldistribution of resources.

Figure 1. The Three Dimensions of Sustainable Development



Source: Feitelson 2002, 101.

The publication of the Brundtland report and the ensuing discussions have resulted in a new wave of policies and plans to reduce the environmental impacts of the transport sector. In the U.S., both the Intermodal Surface Transportation Efficiency Act (ISTEA) and the 1990 amendments to the Clean Air Act are, at least in part, an outcome of the renewed environmental awareness generated by the sustainability debate (Garrett and Wachs 1996). The environmental provisions in more recent U.S. transport legislation, such as TEA-21 (Transportation Equity Act for the 21st Century) and SAFETEA-LU (Safe, Accountable, Flexible, Efficient Transportation Efficiency Act: A Legacy for Users), suggest that the environmental dimension of sustainable development has become well institutionalized.

This emphasis on the environmental impacts of the transport sector contrasts sharply with the still limited consideration for the social justice dimension of sustainable transport. The recent literature on justice and transport is largely disconnected from the sustainability discourse, and the number of policy initiatives that address the gaps in mobility and accessibility between population groups has been limited. Much of the literature deals with issues like accessibility poverty (Higgs and White 1997; Denmark 1998; Blumenberg 2002) and transport exclusion (Church et al. 2000; Hine and Grieco 2003), without exploring the broader implications for a comprehensive transport policy that integrates all three dimensions of sustainable development. Most policy initiatives, in turn, do not insert equity considerations into mainstream transport policy, but merely add auxiliary instruments to address the special needs of weak population groups. Such “stop-gap” policies include the U.S. Welfare to Work program (Blumenberg 2004), and the recent U.K. experiments with accessibility planning (Lucas 2006).

This narrow perspective is reflected in the development of two key tools of transport planning: transport modeling and cost-benefit analysis. Over the past two decades, both tools have been adapted so as to better address the environmental impacts of the transport sector. In contrast, the implications of the social justice component of sustainability for transport modeling and cost-benefit analysis have hardly been explored. This article aims to begin filling that void. It provides a critical analysis of both transport modeling and cost-benefit analysis from the perspective of social justice. Social justice is understood here as the morally proper distribution of goods and bads across members of society (Elster 1992; Miller 1999a). Although both transport modeling and cost-benefit analysis implicitly help determine the distribution of transport-related goods and bads, there has hardly been any explicit reflection on the distributional mechanisms that are currently built into both planning tools. The aim of this paper is to critically discuss these main distributional mechanisms and suggest possible alternatives. These alternatives, apart from promoting equity in the field of transport, are also expected to strengthen the trend towards a more sustainable transport system.

Transport Modeling

Transport modeling is a tool to forecast future demand for transport with the goal of generating information concerning the future performance of the existing or expanded transport system. The fundamentals of transport modeling were developed in the U.S. during the 1950s, in the context of the pioneering Detroit and Chicago Transportation Studies. Since then, this forecasting tool has gained widespread use in the industrialized world and is now an integral part of transport planning in virtually all motorized countries (Bates 2000).

The first generation of transport models consists of variations on the four-step model. While widely criticized as outdated and irrelevant, the four-step model is still in common use in industrialized countries including the U.S. (Bates 2000; McNally 2000b). As shown in Figure 2, the model forecasts future transport demand in four steps (see for example de Dios Ortuzar and Willumsen 2001; McNally 2000b; McNally 2000a). The first step, trip generation, estimates the number of trips originating in each transport activity zone, based on socio-economic and land use data. The second step, trip distribution, divides the total number of trips generated by each transport activity zone among destination zones, based on estimates of zonal attraction and travel impedance. The third step, mode choice, estimates the distribution of trips among the available modes (typically car and public transport). Finally, the fourth step, traffic assignment, allocates the trips between a specific origin and destination to the available roads or public transport links. The four-step model ultimately results in a forecast of future travel demand per transport link. These data are then used to assess the future performance of the existing transport system, to identify transport links in the region that lack sufficient capacity, and to forecast the impact of possible transport investments on the performance of the system.

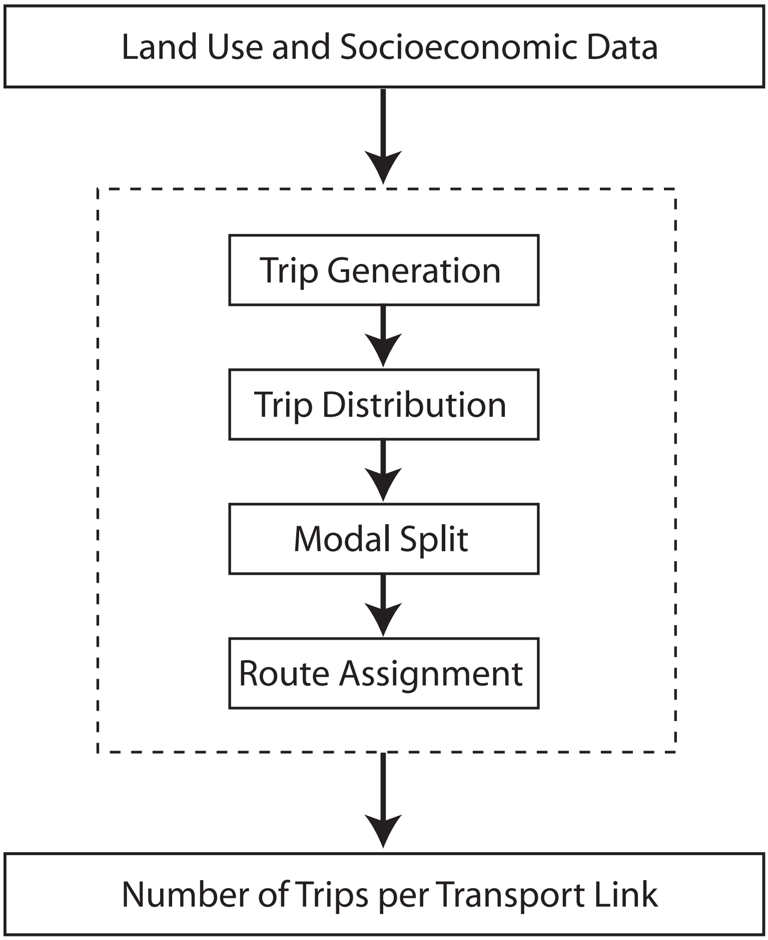
In response to growing environmental concerns, transportation planners have both adjusted the traditional four-step model and developed a new generation of transport models. The most important adjustment, in the U.S. and elsewhere, has been the addition of a pollution emissions model. This additional step estimates the extent to which new transport infrastructures and the resulting future travel patterns will create concentrations of air pollutants at different locations (Garrett and Wachs 1996).

The inability of the four-step model to assess policies that may reduce the environmental impacts of car-based travel (McNally 2000a), such as parking fees and congestion charges, has strengthened interest in activity-based models (Ettema and Timmermans 1997). Because these models focus on activity patterns rather than trips, they are better able to forecast behavioral responses to car restraint policies. However, because activity patterns are complex, activity-based transport models have only been applied sporadically in practice.

The efforts to address environmental aspects in transport modeling have not been matched by similar attempts to address equity impacts. This oversight is remarkable, as demand-based models—whether they take the shape of a four-step or an activity-based model—have direct social justice implications. From a social justice perspective, both types of models are comparable in one crucial respect: both aim to forecast future travel demand based on current travel patterns. As Sheppard (1995) rightly points out, the concept of travel demand should be treated with care:

"Conventionally, it implies the notion that consumers have freely chosen one possibility over all others, which in turn suggests that the observed

Figure 2. The Four-Step Model



Source: Garrett and Wachs 1996, 8.

pattern of trips [on which modeling efforts are based] represents the best possible set of actions that individuals could have taken given their preferences and the spatial structure of the city" (Sheppard 1995).

However, as the activity-based approach rightfully stresses, current travel demand is as much the result of constraint as it is of choice. This assertion implies that transport modeling that starts from current travel patterns may actually reinforce the existing differences in mobility and accessibility between various population groups.

A further analysis of the four-step model augments this argument. From a social justice perspective, the first step of the model is of key importance.

In this step, the number of trips per household is predicted for some year in the future. Generally, households are distinguished according to a number of characteristics, the most important of which are household size, car ownership level, and household income. Then, for each household type, the average number of trips is calculated using large-scale travel data. These average trip rates, in turn, are used to forecast future trip generation levels at the level of transport activity zones. Table 1 presents a typical example of the trip rates used in transport modeling. The table shows, for instance, that a one-person household with a car is predicted to make more than seven times as many trips per day as a one-person household without a car. These differences in trip generation rates translate into the results of the transport model and, ultimately, into suggestions for major transport capacity improvements.

Table 1. Typical Example of Trip Rates Used in Transport Modeling

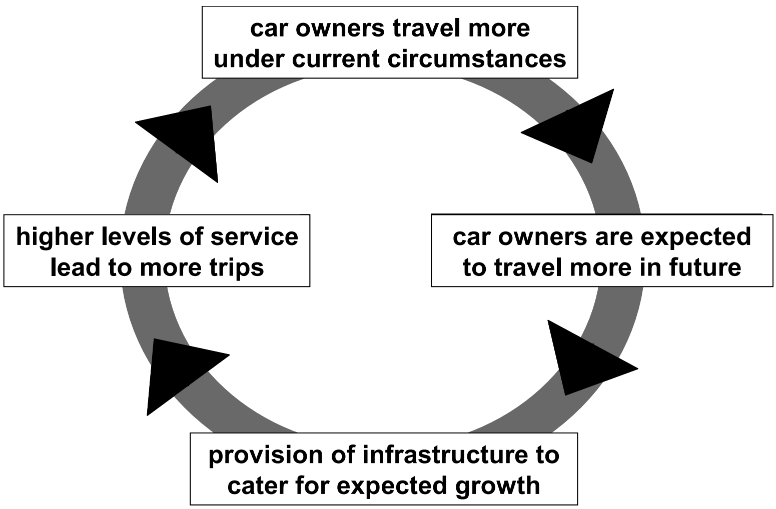
Household Size	Car Ownership Level		
	0 cars	1 car	2+ cars
1 person	0.12	0.94	--
2 or 3 persons	0.60	1.38	2.16
4 persons	1.14	1.74	2.60
5 persons	1.02	1.69	2.60

Source: de Dios Ortuzar and Willumsen 1994, 137.

By ignoring the fact that current travel patterns are a reflection of the way in which transport resources have been distributed in the past, transport models thus create an inherent feedback loop. The models use the high trip rates among car owners in the present to predict high trip rates among car owners in the future. These predictions favor policies that cater to this growth through improved services for car owners (e.g., road building or investment in costly rapid rail). These improved services, in turn, result in higher trip rates among car owners and the circle begins again, as shown in Figure 3.

This analysis can be translated into social justice terms. The fact that current approaches to transport modeling aim to forecast future travel demand suggests an implicit assumption that demand constitutes the just principle upon which to distribute new transport facilities. After all, the forecast of future travel demand is the basis for generating policy recommendations about future investments in transport infrastructure. While traditional transportation planning has thus focused on the overall performance of the transport network, a social justice approach would focus on the distribution of transport investments over population groups and the related performance of the network for each of these groups. Since the criterion of demand encompasses current wants backed by a willingness and an ability to pay (Hay and Trinder 1991), the future distribution of a good based on this criterion will essentially reflect the current distribution of income in society. Transport modeling based on demand will thus tend to recommend transport improvements that serve the rich rather than the poor.

Figure 3. The Vicious Circle Underlying Transport Modeling



The importance of mobility and accessibility in contemporary lifestyles makes the distribution of transport facilities according to the criterion of demand difficult to defend. Access to efficient motorized transport systems is of key importance to fulfill the tasks that are expected from every ordinary citizen in contemporary society, such as work, study, or child care. The sprawling urban development that has accompanied the increase in car ownership has made motorized mobility a necessity rather than a luxury. Motorized accessibility to key destinations such as employment centers, schools, or medical facilities, has become, in the words of Dworkin (1985), a prerequisite for “a life of choice and value” (Frankfurt 1987). But if this accessibility has indeed become a prerequisite for such a life, and if we posit that each citizen deserves such a life, the provision of transport facilities can hardly be based on the criterion of demand. Rather, need comes to the fore as the just principle upon which to distribute key transport facilities.

This conclusion suggests that current transport demand models will have to be replaced by a whole new generation of models based on the criterion of need. The goal of such a need-based model would be to assess to what extent the existing or future transport network is able to secure a minimal level of accessibility for all population groups. Unlike demand-based models that apply a seemingly neutral methodology, the development of a need-based model will require an explicitly normative approach, as needs will have to be distinguished from wants and explicit accessibility standards will have to be set.

Classifying certain activities as needs and others as wants is not simple; however, such efforts can build on the extensive existing literature on basic needs (e.g., Braybrooke 1987; Thomson 1987; Doyal and Gough 1991). The resulting model would start from a matrix of basic transport needs for different population groups, rather than from the traditional matrix of trip generations and attractions based on current travel patterns. The activity set will include basic needs like health, education, work, and social contacts. The risk of an extremely paternalistic approach — in which planning institutions rather than people themselves determine which trips count as "needs" and which as "wants" — can be avoided to some extent, since groups with different needs (such as the young and the old, women and men) will often live together in one area or "transport activity zone." The transport system will thus have to be robust to serve for all these needs, as well as for changes in population over time (Apparicio and Seguin 2006). At the same time, areas may differ in their transport needs, for instance, because of their socio-economic or ethnic composition, and the model will have to be sensitive to this.

The second challenge posed by a need-based model is the setting of accessibility standards. Without explicit standards it is impossible to assess the performance of a transport network in terms of its success or failure to provide minimal levels of accessibility to all population groups. Furthermore, without explicit accessibility standards, the model will be unable to assist decision-makers in setting priorities between possible transport investments. The accessibility standards will have to be defined in terms of travel time and costs, as well as in terms of the number of opportunities that are within reach of a specific area or transport activity zone. The latter condition is of key importance as the availability of alternatives (e.g., in terms of employment locations or educational opportunities) is a major element in 'a life of choice and value.' The need-based model could benefit from recent advances in the measurement of accessibility, largely inspired by activity-based transport modeling (e.g., Miller 1999b; Recker et al. 2001; Dong et al. 2006).

Paradoxically, the third component of a need-based transport model would consist of a demand-based model. Such a traditional model is necessary, because accessibility depends on the level of congestion on transport links (roads or public transport), which, in turn, depends on the actual or predicted use of transport infrastructure. The need-based and demand-based models are thus complementary: the former identifies which transport links are needed, while the latter indicates the necessary capacity on these links. The combination of both models also avoids bias towards needs that ignores demands.

The development of a need-based transport model could benefit from recent experiments to provide accessibility to weak population groups, such as the U.S. Welfare to Work program (Blumenberg 2004) and the U.K. initiative to institutionalize accessibility planning (Lucas 2006). But where these experiments aim to identify accessibility needs of marginalized groups and generate solutions to solve their specific problems, need-based transport modeling would inform transport planning overall. This would avoid the paradoxical situation that mainstream transport modeling primarily serves the wants of the strong, while small-scale experiments and alternative financing schemes have to provide for the accessibility needs of the weak, whose problems were created by mainstream transport planning and the related maldistribution of resources in the first place.

Cost-Benefit Analysis

Cost-benefit analysis (CBA) is a procedure of identifying, measuring, and comparing the benefits and costs related to an investment project or program (Campbell and Brown 2003). It has become the accepted standard for evaluating transport projects since the early 1960s (e.g., Talvitie 2000; Quinet 2000). Early types of cost-benefit analysis applied in the transport sector generally included only a limited number of benefits and costs. Typically, the focus was on the costs of infrastructure construction and maintenance and on the benefits of travel time savings, reductions in vehicle operating costs, and — to some extent — improvements in road safety. The growing concern about the environmental impacts of the transport sector in general, and road building in particular, has resulted in a broadening of the approach in many countries over the past two decades (Morisugi and Hayashi 2000). Currently, many countries include a number of environmental impacts in the standard cost-benefit analysis, most notably air and noise pollution. In addition, cost-benefit analysis has been adjusted in several countries in order to enable a direct comparison of the costs and benefits of various transport modes (e.g., Vickerman 2000).

Social justice considerations have traditionally played a role in the development of cost-benefit analyses, most notably in the monetary valuation of travel time savings. Since time savings typically account for the vast majority of benefits generated by a transport investment, the way in which the monetary value of these savings is calculated is of the utmost importance. In virtually all countries using CBA, the value of travel time savings is linked to wage rates, so the key question is which wage level to use in the calculation. The theoretical foundations underlying CBA suggest the use of market-based values and to differentiate the value of travel time savings according to differences in income levels of groups of travelers. The possible consequences of such an approach were recognized as early as the 1960s (Mackie et al. 2003). If market-based values were to be used, transport investments that primarily benefit higher income groups would score substantially better in cost-benefit analyses than alternatives that would serve poor population groups, all else being equal. In order to address this bias, the so-called "equity value of travel time" was introduced in virtually all cost-benefit analysis used in the U.S. and abroad (Morisugi and Hayashi 2000). The equity value of time is based on an average income level and is used for all travel time savings, independent of the income level of the traveler that benefits from the time saving. Currently, most cost-benefit analyses also use equity values for the calculation of the benefits related to improvements in road safety.

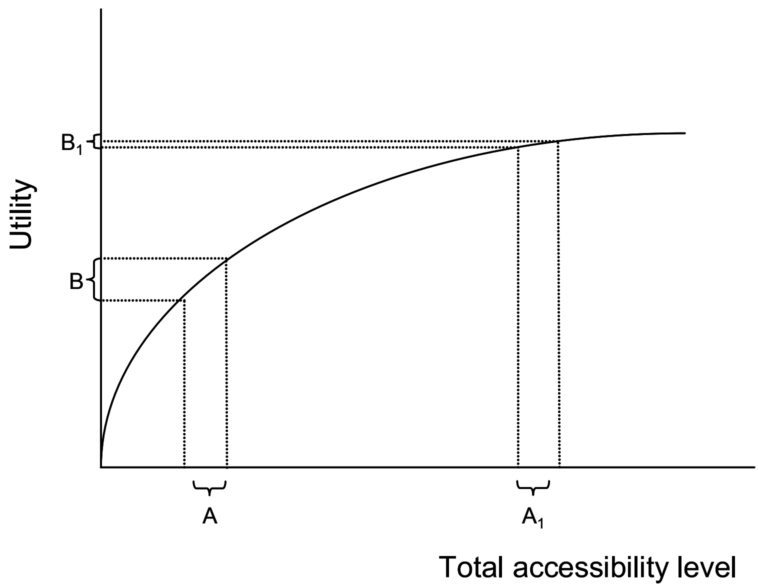
While the use of equity values is certainly to the benefit of weaker groups in society, the focus on these values hides another, even more powerful, distributional mechanism at work in cost-benefit analysis. This mechanism concerns the link between the total number of trips and the total benefits generated by a transport improvement. The more trips are forecasted for a specific link for a certain year in the future, the more travel time savings can be earned by improving that link, and the higher the total benefits related to that improvement. This principle works to the advantage of stronger population groups with high levels of car ownership, as they are characterized by substantially higher trip rates than weaker population groups with low levels of car ownership (see above). For instance, the improvement of the link between a well-to-do suburb and a large employment area will virtually always perform better in a cost-benefit analysis than an improvement in the transport link between a disadvantaged neighborhood and the same employment area. This is especially true in societies like the U.S., in which the spatial segregation of population groups is to some extent replicated in their use of particular infrastructures (Hodge 1995).

A reassessment of the impacts of improvements in the transport network challenges the existing approach to travel time savings in cost-benefit analysis. The current emphasis on time savings is implicitly based on the assumption that travelers will use higher travel speeds to reduce the travel time between fixed origins and destinations. Empirical research from around the world shows that this is a mistaken assumption (Levinson and Kumar 1994; Whitelegg 1997; Noland and Lem 2002; Harris et al.

2004; Mokhtarian and Chen 2004). A large number of studies show that higher travel speeds are not translated into shorter travel times, but rather into increases in travel distances. These increases in travel distances, in turn, reflect people's desire for an improvement in accessibility. People use higher travel speeds to access places that they were unable to access before. This suggests that the main benefit of a transport investment does not consist of travel time savings, but rather of accessibility gains generated by higher travel speeds.

The identification of accessibility gains as the prime benefit of transport investments has profound consequences for cost-benefit analysis. The monetary value of accessibility gains is not related to income group dependent wage levels, but in large part to the existing level of accessibility of a person. More specifically, the value of an additional destination that comes within reach due to a transport improvement will depend on the choice set of destinations already within the reach of an individual. Following the principle of diminishing marginal utility, an individual with a large choice set of destinations may be expected to attach a lower value to the addition of an extra destination, than a person with a relatively small choice set of destinations, all else being equal, as shown in Figure 4.

Figure 4. The Principle of Diminishing Marginal Utility Applied to Accessibility Gains



One unit of accessibility gain (A) for persons with low levels of accessibility will generate a larger improvement in utility (B) than the same unit of accessibility gain for population groups with high levels of accessibility (A_1 and B_1).

Following this analysis, it is now possible to distinguish two alternative approaches to correct the distributional flaw in current cost-benefit analysis. In the first approach, CBA calculations will continue to include travel time savings as the most important benefit generated by a transport project. However, the savings will only be used as an indicator of accessibility gains, and the monetary value attached to time savings will be based on the understanding that they reflect accessibility gains. Following the principle of diminishing marginal utility discussed above, the monetary value attached to a specific accessibility gain should differ between individuals or population groups in reverse relation to their current levels of accessibility. Using travel time savings as a proxy for accessibility gains, this means that time savings for the mobility-poor should be valued higher than travel time savings for the mobility-rich. Note that this argument is not based on considerations of justice, but solely on the concept of diminishing marginal utility as applied in the classical approach to welfare economics (Sen 1973).

The drawback of this first option is that the link between total number of trips and total benefits of a transport investment remains intact. Travel time savings will still be a result of the number of trips, the time savings per trip, and the value of travel time savings. The reverse relation between income and travel time value may correct the current situation to some extent, but will not solve the basic distributional flaw built into cost-benefit analysis.

The second option would be to disconnect total trip numbers and total benefits altogether by replacing travel time savings with accessibility gains as the key benefit of a transport project. The argument here would be that travel time savings are not an adequate proxy of accessibility gains generated by higher travel speeds, since the value of accessibility gains does not depend solely on the number of trips made. This is because accessibility has both a use value and an option value (Campbell and Brown 2003). Having accessibility to a wide number of jobs, shops, medical services, or educational facilities is a value in itself, even if no actual use is made of these destinations, as it increases choice and thus future options. The emphasis on option value rather than use value will strengthen the inverse relation between existing accessibility levels and the monetary values attached to accessibility gains. It would guarantee that transport investments that improve accessibility levels of the mobility-poor would perform well in cost-benefit analysis, independent of the low number of trips made by this group. The use of accessibility gains as the primary benefit of transport improvements would thus have two advantages from a social justice perspective. First, it would direct the attention in transport planning and cost-benefit analysis to equity in terms of accessibility and accessibility gains, rather than focus on the absolute size of travel time savings. Second, it would disconnect the direct link between trip numbers and benefits, as the value ascribed to accessibility gains will be a function of both actual use and option value (Geurs and Ritsema van Eck 2001).

The challenge will be to develop a practically feasible method to ascribe monetary values to accessibility gains. Of all the accessibility measures developed since the early article of Hansen (1959), the measures that are based on economic theory and apply the concept of user benefits to assess accessibility offer the most potential (e.g., Ben-Akiva and Lerman 1985). But even these methods still fall short of translating accessibility and accessibility gains to monetary values (Miller 1999b). The development of a practically feasible method is further complicated by the conditions set by cost-benefit analysis. These conditions include an often limited data set with regard to travel and accessibility, which does not incorporate information on spatial or temporal constraints necessary for accessibility measures developed along the lines of time-space geography. This suggests the application of a relatively simple accessibility measure, which uses only data that are commonly generated within the framework of transport (demand) modeling and cost-benefit analysis. At the same time, the measure will have to be sophisticated enough to assess differences in accessibility between population groups, as defined, for example, by income or car ownership level. Classic accessibility measures that generate aggregate accessibility indices at the level of land uses or transport activity zones are thus not enough, as they do not provide the information necessary from the perspective of social justice.

Conclusions and Discussion

The increasing concern over the environmental impacts of the transport sector and road building in particular have substantially changed the features of two key tools of transport planning: transport modeling and cost-benefit analysis. The difficulties of applying the classic four-step transport model to assess the impacts of policy measures that are part of the sustainable transport planner's toolbox, such as parking fees and congestion pricing, have helped to stimulate the development of activity-based approaches. Likewise, the tool of cost-benefit analysis has been adapted to include key environmental impacts of transport.

The efforts to adapt transport modeling and cost-benefit analysis to the environmental challenge have not been paralleled by comparable attempts to address the social justice dimension of sustainable development. While both transport modeling and cost-benefit analysis implicitly help to determine how transport-related goods and bads are being distributed in modern societies, there is hardly any explicit reflection on the distributional mechanisms that are built into both tools.

The analysis in this paper suggests that both transport modeling and cost-benefit analysis are driven by distributive principles that serve highly mobile groups, most notably car users, at the expense of weaker groups in society. Transport modeling is implicitly based on the distributive principle of demand. By basing forecasts of future travel demand on current travel patterns, transport models are reproducing current imbalances in transport provision between population groups. The result is that transport models tend to generate suggestions for transport improvements that benefit highly mobile population groups at the expense of the mobility-poor. Given the importance of mobility and accessibility in contemporary society for all population groups, this paper suggests basing transport modeling on the distributive principle of need rather than demand. This shift would turn transport modeling into a tool to secure a minimal level of transport service for all population groups.

The criticism of cost-benefit analysis is comparable. Like transport modeling, cost-benefit analysis has a built-in distributive mechanism that structurally favors transport improvements for the mobility-rich. The direct link between total trip numbers, travel time savings, and total benefits in cost-benefit analysis automatically favors transport investments that serve highly mobile groups in cost-benefit calculations over transport improvements that primarily serve less mobile groups. This paper suggests replacing travel time savings with the concept of accessibility gains. This shift would result in an inverse relation between the value of travel time savings and income levels and/or in a disconnection between the number of trips and the total benefits generated by a transport investment.

The suggestions in the paper for change in both transport modeling and cost-benefit analysis can have far-reaching consequences for current transport planning practices. They imply the replacement of several deeply rooted beliefs of the goals of transport planning, most notably the goal to provide for future travel demand. So far, the sustainability agenda has not been able to make this shift. While the environmental concerns have led to a reluctant replacement of the "predict and provide" paradigm by a "predict and prevent" approach (e.g., Vigar 2002), the focus has remained on the demands of the highly mobile traveler. The only shift that has taken place is in how to provide for the "needs" of this mobile traveler: by building ever more roads (predict and provide) or by providing attractive public transport in combination with a rise in the costs of car-based mobility (predict and prevent). The social justice approach to sustainable transport promises to bring about a much more profound, if not revolutionary, change in the field of transport planning and policy.

Acknowledgments

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***Karel Martens** is a researcher and lecturer at the Institute for Management Research, Radboud University Nijmegen, the Netherlands. He has worked in the Netherlands and Israel on issues ranging from compact city development to modern wind energy parks. His research interests include transport and land use, interconnectivity in transport systems, and road safety. Currently, most of his research efforts focus on justice and transport, and in particular, how considerations of equity, fairness and justice could be integrated into key transport planning tools. The paper was written during his time as a research fellow at the Environmental Simulation Laboratory, Porter School of Environmental Studies, Tel Aviv University, Israel.*