Grounding transport planning on principles of social justice

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Paper submitted to the Berkeley Planning Journal, July 2005

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. The paper critically analyses 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 approaches by transport modeling 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 the concept of accessibility gains as the key benefit used in cost-benefit analysis. If the suggested changes would turn into reality, both transport modeling and cost-benefit analysis could turn into key tools to promote sustainable transport.

Keywords: sustainable transport, transport modeling, cost-benefit analysis, social justice, equity, four-stage model, activity-based approaches

1. Introduction

Two key tools play a crucial rule in nowadays transport planning, in the USA and elsewhere: transport modeling and cost-benefit analysis. Transport modeling developed since the late 1950s as a tool to forecast future demand for transport with the goal to generate information concerning the future performance of the existing or expanded transport system (e.g. Bates 2000). Cost-benefit analysis has a much longer history, but came into widespread use in the transport field since the early 1960s (Nakamura 2000). It is basically a tool to systematically assess the costs and benefits related to new transport infrastructure (e.g. Boardman, Greenberg et al. 2001; Campbell and Brown 2003). Where the results of transport modeling feed decision-makers with data on where to provide what kind of transport infrastructures, cost-benefit analysis provides decision-makers with data about the economic efficiency of the investment in each of these infrastructures.

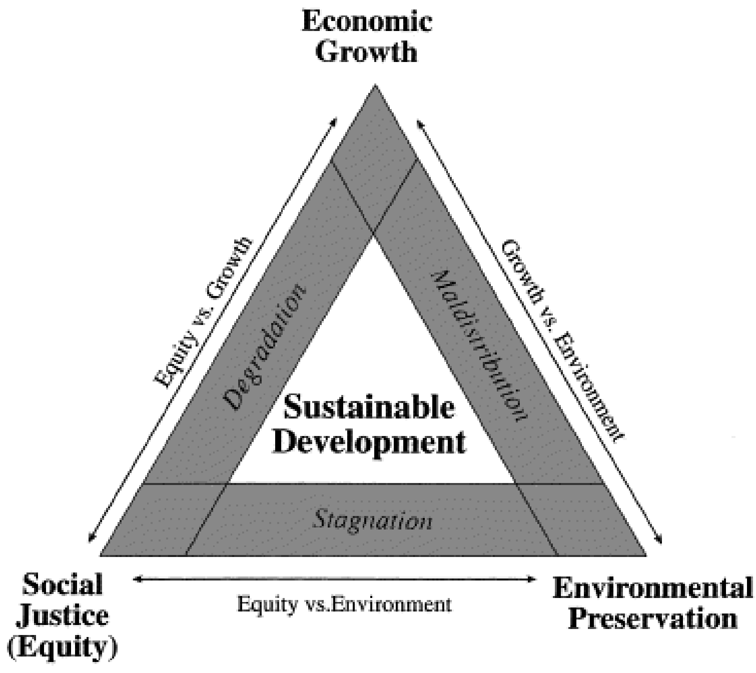
This article provides a critical analysis of both transport modeling and cost-benefit analysis from the perspective of social justice. Social justice is the field of study that focuses on the question how certain goods and bads are and should be distributed over members of society (e.g. Elster 1992; Miller 1999). 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-in in both tools. The aim of this paper is to critically discuss the main 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.

2. Sustainable transport and social justice

The concept of sustainable transport has swept through the academic literature since the publication of the UN rapport ‘Our common future’ (Brundtland 1987). The concept has primarily strengthened the growing concern about the negative environmental impacts related to (car-based) transport. Much of the discussions have focused on issues like transport sector’s contribution to greenhouse gases, local air pollution, resource depletion, and reduction in open spaces. However, the concept of sustainable development is wider than the trade-off between economic development and environmental preservation (Feitelson 2002). In addition to these concerns, the notion of sustainable development also includes an equity or social justice dimension (e.g. Dobson 1998; Foley 2004). Following Feitelson (2002), each of the dimensions can be depicted as the corner of a triangle, with the trade-offs between the key dimensions demarcated along the triangle’s sides. 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 unsustainable development (the shaded areas in Figure 1). The triangle shows how the current emphasis in the transport field on the tension between economic development and environmental preservation can come at the expense of social justice. Policies that primarily seek to balance economy and environment are prone to result in a maldistribution of transport resources.

Where the environmental dimension of sustainable development directs the attention to the environmental impacts of transport, the social justice dimension is all about the distribution of resources in the transport sector (e.g Boucher and Kelly 1998; Miller 1999). Like environmental concerns, social justice concerns are all-pervasive. Every policy or investment decision has distributional impacts – its benefits will be enjoyed by particular groups of people, while its burdens will be carried by another set of people. The investment in a new road, for instance, will benefit car-users that travel along a specific corridor, while the burdens in terms of tax payments, air pollution, reduction in open spaces etcetera, will be spread over much larger segments of the population. The key question from a social justice perspective is whether the ensuing distribution is fair or just – a question that obviously gives rise to a lot of debate. The sustainable development discourse places this question in a wider perspective. Following the 'sustainable development triangle' the question 'what is fair' should not be answered in isolation, but be linked to the economic and environmental dimensions, so as to avoid policies or investment decisions that lead to stagnation or degradation (Figure 1). The concept of sustainable development thus widens the traditional conflict between efficiency (economic development) and fairness (social justice).

Figure 1 The three dimensions of sustainable development.



Source: Feitelson 2002, 101.

The lack of attention for the social justice dimension of sustainable transport is only slowly being corrected. So far, the rising interest in the issue of justice and transport has hardly linked up to the sustainable development discourse. Much of the literature on this issue focuses on the distribution of transport or transport-related goods without exploring the implications for a comprehensive transport policy integrating all three dimensions of sustainable development. This holds true, for instance, for the recent discussions around concepts like ‘transportation ethics’ (e.g. Richardson 1995; Hosmer 1996), ‘accessibility poverty’ (e.g. Higgs and White 1997; Denmark 1998; Blumenberg 2002), ‘just transportation’ (e.g. Bullard and Johnson 1997; Grengs 2002), and ‘transport exclusion’ (e.g. Church, Frost et al. 2000; Hine and Grieco 2003). The exceptions that explicitly place equity considerations within the context of sustainable transport are few and far-between (e.g. Zeitler 1999; Feitelson 2002; Foley 2004).

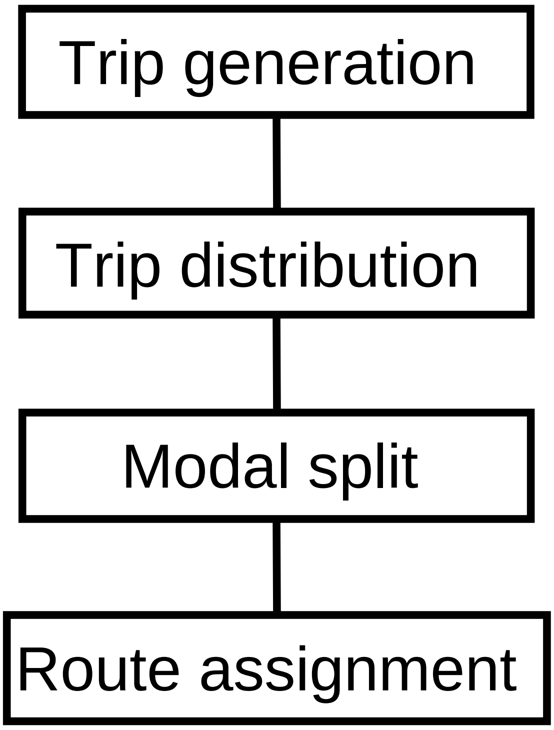
The sustainable development literature and its emphasis on the environmental impacts of economic development have also had its impact on transport modeling and cost-benefit analysis. Both tools have been adapted so as to better address the environmental impacts of the transport sector (see below). In contrast, the rising attention for justice and transport has hardly resounded in the discussions around transport modeling and cost-benefit analysis. Below we suggest various ways to insert social justice considerations into transport modeling and cost-benefit analysis. Along the way, we also show that explicit attention for the social justice dimension is prone to lead to transport policies and investment decisions that avoid environmental degradation related to the transport sector.

3. Transport modeling

The fundamentals of transport modeling were developed in the USA during the 1950s, in the context of the pioneering Detroit and Chicago Transportation Studies (Bates 2000). Since then, the tool gained widespread use in the industrialized world and is now an integral part of transport planning in virtually all motorized countries.

The first generation of transport models largely encompasses variations on the four-stage model. While widely criticized as outdated and irrelevant, the model is still in common use in most industrialized countries, among which the USA (Bates 2000; McNally 2000). The model forecasts future transport demand in four steps (see e.g. de Dios Ortuzar and Willumsen 2001; McNally 2000; McNally 2000). The first step, trip generation, estimates the number of trips on the level of transport activity zones, using data on the number and characteristics of households and activities located in each zone. In the second step, trip distribution, the total number of trips of a specific activity zone is distributed spatially over other zones, based on the estimated attraction of each zone and estimates of travel impedance. In the third step, mode choice, the distribution of trips over the available modes (typically car and public transport) is estimated. Finally in the fourth step, traffic assignment, the data on origins and destination and travel mode are assigned to mode-specific transport networks. In some cases, steps 2-4 are carried out in a different order (Figure 2). The four-step model ultimately results in a forecast of future travel demand, which data in turn can be used to asses the future performance of the existing transport system, to identify transport links in the region that lack sufficient capacity (roads, railways, etc.), and to assess the impact of various transport investments on the performance of the system.

Figure 2 The four-stage model



The growing concern for the environment since the late 1980s has played an important role in the development of a new generation of transport models under the banner of the activity-based approach (e.g. Ettema and Timmermans 1997). The sustainability agenda resulted in a need to assess the potential impacts of measures like parking fees and congestion charges as alternatives for ongoing extension of road capacity. Since the four-stage model was unable to deal with these policy issues (McNally 2000), the activity-based approach was pushed forward as a feasible alternative. The key difference with the four-stage model is the focus on activity patterns rather than trips. Where the four-stage model takes trips as the basic unit of analysis, the activity-based approach starts from patterns of behavior and thus links trips to activities as well as to social, spatial, temporal, and interpersonal interdependencies and constraints. The key similarity with the four-step model lies in the goal of the activity-based transport models: like the former the various activity-based models have been developed to forecast future travel demand using data on current travel patterns. Where the four-stage model starts from rather simple data on trip rates, the activity-based approach uses more complex data on travel behavior. The number of working activity-based transport models is still limited and the models are only applied sporadically in practice. The most well-known example of a partly activity-based transport model is TRANSIMS, which has been developed for the USA Department of Transportation and the Environmental Protection Agency. Other countries, like the Netherlands and Israel, are also developing activity-based models to complement or possibly replace the four-stage transport model.

From a social justice perspective, the four-stage model and the activity-based approach are comparable in one crucial respect: both aim to forecast future travel *demand*. As Sheppard 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 other, which in turn suggests that the observed pattern of trips [on which modeling efforts are based – KM] represents the best possible set of actions that individuals could have taken given their preferences and the spatial structure of the city’ (Sheppard 1995, 101). However, as the activity-based approach rightfully stresses, current travel demand is as much the result of constraint as it is of choice. This implies that transport modeling that starts from current travel patterns may actually reinforce the current differences in mobility and accessibility levels between various population groups.

A further analysis of the four-stage model can strengthen 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 levels, 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 obviously translate into the results of the transport model and, ultimately, into suggestions for major transport capacity improvements.

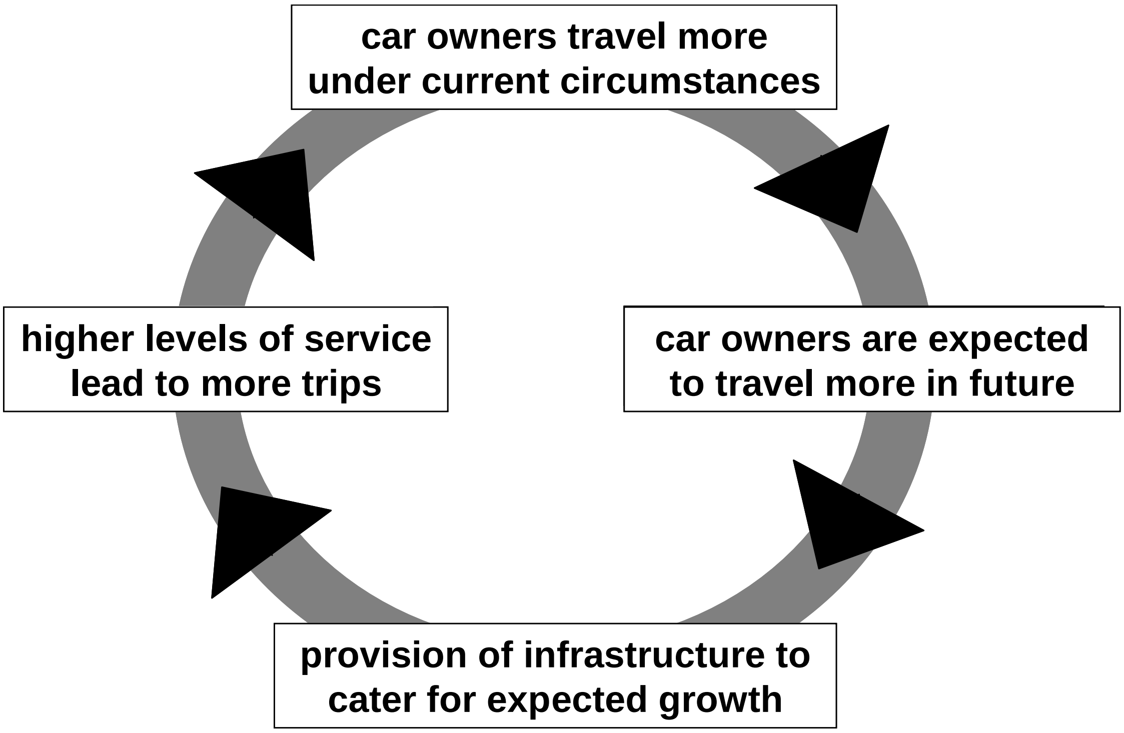
Table 1 Typical example of trip rates used in transport modeling

	Car ownership level		
Household size	0 car	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.

What is ignored in the four-stage model, but also in activity-based models, is that current travel patterns are a reflection of the way in which transport (roads, parking, public transport, etc.) has been distributed in the past. By using current travel patterns as the starting point, these modeling approaches actually strengthen the position of those who have received transport facilities in the past and are thus more likely to travel (typically the car owner given the extensive road building over the past decades), and weaken the position of those who did not receive many facilities and are thus limited in their possibilities to travel (typically the car-less given the reduction in public transport during the same period). In this way, the transport models actually create a vicious circle: they start with the current high trip rates among car owners, then predict high trip levels among car owners in the future, subsequently suggest ways to cater for this growth through improved services for car owners (road building or high quality public transport services), which in turn results in higher trip rates among car owners. From here on, the circle starts again (Figure 3).

Figure 3 The vicious circle underlying transport modeling



This analysis can also be translated into social justice terms. The fact that both the four-stage model and activity-based models aim to forecast future travel demand suggests that both approaches implicitly define demand as the *just* principle to distribute new transport facilities. After all, the forecast of future travel demand is the basis for generating suggestions with regard to future transport infrastructure provision. While it may seem obvious to focus on demand from the perspective of a transport planner, it hardly is from the perspective of social justice. Demand is not the only criterion that can be used to decide on how to distribute key transport services, over population groups, neighborhoods, regions, or generations. Transport investments could just as well be distributed according to other criteria, such as rights or needs. There is no ex ante justification for using demand as *the* distributive criterion in the field of transport. The choice for the criterion of demand should follow from an ethical discussion on what is just in the field of transport, as well as from a proper understanding of the consequences of each of the distributional criteria, including the criterion of demand. The criterion of demand is defined as distribution of a good according to wants backed by a *willingness* and an *ability* to pay (Hay and Trinder 1991). Given the superiority of the car in terms of travel speeds and comfort on most links, the choice for demand as the distributive principle will strengthen those population groups with the willingness and ability to buy and operate a car. This comes at the expense of groups that have lower levels of access to a car, such a low income groups, women, the young, as well as ethnic minorities.

The importance of mobility and accessibility in contemporary lifestyles make a 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 ‘explosion’ of the urban space that has gone hand in hand with the increase in car ownership has made motorized mobility a necessity rather than a luxury. This suggests that *need* rather than demand would be a just principle to distribute key transport facilities. The literature on basic needs strengthens this argument. While key authors like Braybrooke (1987), Thomson (1987) or Doyal and Gough (1991) do not explicitly recognize mobility or accessibility as a basic need or only discuss it in the margins, a large share of the needs that they do recognize require motorized transport in order to be fulfilled simultaneously in contemporary society. This line of reasoning suggests that current transport demand models will have to be replaced by a whole new generation of transport models based on the criterion of need. Such need-based models would start from the needs for transport among various population groups, rather than from trip rates or current activity patterns, and assess to what extent the existing and future transport system can provide for the needs of all.

4. 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). Like CBA methodologies used in other policy fields, the type of analysis generally used in the transport sector is characterized by three key features. First, the analysis generates an overview of costs and benefits related to an investment project. Second, it translates these costs and benefits to three summary measures: cost-benefit ratio (C/B ratio), Net Present Value (NPV), and Internal Rate of Return (IRR). Third, it is a *social* cost-benefit analyses in the sense that it encompasses costs and benefits for all individuals in a society and not just those for the parties directly involved (the consumers and producers of a project) (Brent 1996).

While the last characteristic suggests a broad approach, early types of cost-benefit analysis applied in the transport sector have generally included only a limited number of benefits and costs. Typically, the focus has been on construction and maintenance costs of infrastructures on the one hand, and on travel time savings, reductions in vehicle operating costs, and – to some extent – improvements in road safety on the other hand. Furthermore, in some cases CBA was first applied to road projects and was only later used to evaluate other transport modes (Quinet 2000). 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).

While the theoretical foundations of CBA lie in welfare economics and the focus is thus on the total costs and benefits rather than on the distribution of those costs and benefits over population groups, social justice considerations have played a role in the development of the CBA tool for the transport field. The reason lies in the key importance of travel time savings. Travel time savings typically account for the vast majority of benefits related to a transport investment. The way in which the monetary value of these savings is calculated is thus 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 to use 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, Fowkes et al. 2003). In case market-based values would be used, transport investments that generate a lot of benefits for higher income groups would score substantially better in cost-benefit analysis than alternatives that would serve poor population groups, ceteris paribus. In order to solve this problem, the so-called equity value of travel time was introduced in virtually all cost-benefit analysis used around the world, including the USA (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 analysis also use equity values for the calculation of the benefits related to improvements in traffic safety and a reduction in (road) casualties.

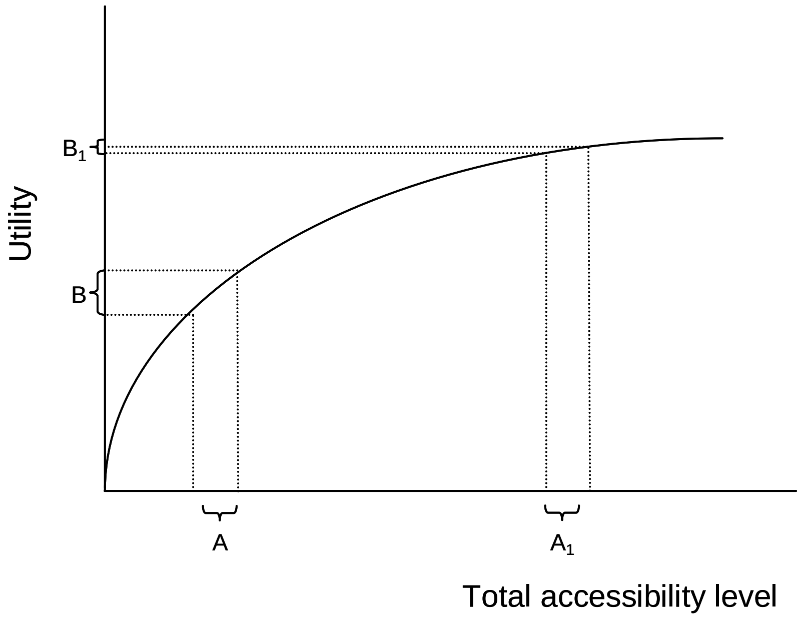
While the use of equity values is certainly in the benefit of weaker groups in society, the focus on these values hides another, even more powerful, distributional mechanism at work in cost-benefit analysis. This mechanism concerns the link between the total number of trips and the total benefits generated 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 segregated societies like the USA, where spatial segregation of population groups is to some extent replicated in the use of particular infrastructures (e.g. Hodge 1995). 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.

The link between trip rates and benefit levels may come as no surprise, as cost-benefit analyses are fed by data generated by transport models that are based on the distributive principle of demand. This direct link implies that cost-benefit analysis, too, is implicitly supporting the distribution of transport improvements according to (travel) demand.

There are two possible ways to correct this situation. Both are linked to a reassessment of the benefits that are related to a transport improvement. Current cost-benefit analysis defines travel time savings as the key user benefit generated by improvements in the transport network. The emphasis on travel 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 (e.g. Levinson and Kumar 1994; Whitelegg 1997; Harris, Lewis et al. 2004; Mokhtarian and Chen 2004; Noland and Lem 2002). 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 analysis suggests that the monetary value attached to travel time savings should not be based on the travel time savings themselves, but on the *accessibility gains* that these savings enable. This has profound consequences for the value attached to travel time savings. The value can no longer be based on the (average) wage level, but will have to be linked to the value of an increase in accessibility. The value attached to these accessibility gains will, in turn, depend on a number of factors. Most importantly, the value of an additional destination that comes within reach due to an improvement in the transport network 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, ceteris paribus (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).



The analysis above suggests two ways to correct the distributional flaw in current cost-benefit analysis. The first option centers around the monetary value attached to travel time savings. The argument here would be that travel time savings as such are of limited importance to travelers, implying that the value of travel time savings should not be based simply on the value of the time. Rather, the value ascribed to a certain unit of travel time savings should be based on the possible accessibility gains it brings about. Furthermore, following the principle of diminishing marginal utility, 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. In other words, accessibility gains for the mobility-poor should receive higher monetary value in the evaluation of transport projects than the accessibility gains for the mobility-rich, simply because a person with a limited choice set will value an extra destination higher than a person with an extensive choice set, ceteris paribus (Figure 4). Translated to cost-benefit analysis, it means that travel 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 basis of welfare theory.

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 number of trips, time saving per trip, and 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-in in cost-benefit analysis.

The second option would be to disconnect total trip numbers and total benefits all together. The argument here would be that transport improvements only result in travel time savings in the short term, but are used for accessibility gains in the longer term. Since the longer term is of key importance in cost-benefit calculations, the calculations should be based on the valuation of the accessibility gains themselves, rather than on the travel time savings that make them possible. In contrast to travel time savings, accessibility gains do not only depend on the number of trips. Rather, it is an 'option value'. Having accessibility to a wide number of jobs, shops, medical services or educational facilities is a value in itself, as it increases choice and thus future options. 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 of 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).

5. 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 the classic four-stage transport model to assess the impacts of 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, has come at the expense of 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-in in both tools.

The analysis in this paper suggests that both transport modeling and cost-benefit analysis are driven by distributive principles that serve the highly mobile groups, most notably car users, at the expense of the 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 the 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, the paper suggests to base transport modeling on the distributive principle of need rather than demand. This would turn transport modeling into a tool to secure a minimal level of transport service for all population groups.

The criticism on cost-benefit analysis is comparable. Like transport modeling, cost-benefit analysis has a built-in distributive mechanism that structurally favors transport improvements for mobility-rich. The direct link between total trip numbers, travel time savings, and total benefits in cost-benefit analysis has as a consequence that transport investments that serve highly mobile groups automatically perform better in cost-benefit calculations than transport improvements that primarily serve less mobile groups. The paper suggests replacing travel time savings by the concept of accessibility gains. This 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 some deep-rooted beliefs of the goals of transport planning, most notably the goal to provide for future travel demand. So far, the sustainable agenda has not been able to do so. 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 on 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.

Acknowledgements
The paper is the result of a larger research project into justice and transport funded by the Volvo Research and Educational Foundations. Parts of the ideas of the paper are the result of an inquiry into the equity aspects of cost-benefit analysis on behalf of the Israeli Ministry of Transport.

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