

# **Inclusion of social benefits in road transport planning**

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## **1) Comparing traditional and proposed approaches**

The proposal of methodological procedures for the analysis of road transport impacts and benefits has to rely on several assumptions. These assumptions have been changing in the last decades, as the planning process was applied and faced reality. Some of the most important changes and the corresponding proposals are discussed below.

Transport has in the last decades been subjected to a predominantly technical treatment, as an area that was seen as 'naturally' inclined to physics, mathematics and economy. This traditional approach has been under increasing criticism, and alternative approaches have been proposed. The first phase of systematic transport analysis in the 50's was characterised by the use of sophisticated mathematical techniques and forecasting methods known as the "four-step modelling process". The supposed neutrality and technicality of the methodology began to be challenged by reality in the 60's, as confidence in the market as an appropriate signal and provider of needs and the neglect of social and environmental impacts became were challenged. Cost-benefit analysis started to include social and environmental impacts, and political participation in the decision-making process was formalised. The distributive and equity effects of transport policies began to be investigated, in contrast with economic efficiency. At a micro level, the analysis of travel patterns was altered, as most planners became aware of the disconnection between manifested demand and actual needs: if other conditions were present, other trips would have been registered. It also became clear that the daily activities of individuals in a household were constrained by both personal and family limits, along with limits imposed by the environment and transport supply. Finally, the whole set of models were challenged in their supposed ability to represent actual behaviour and forecast the future (Dimitriou, 1990).

These criticisms opened the way to a social and political approach, which should not just complement the traditional one but rather replace it, without minimising the importance of competent technical treatment in specific phases of the analytical process. Such social and political approach is able to take care in a more appropriate way of the complex chain of factors lying behind the use of space by people and hence of the relationship between transport, development and poverty reduction.

## **2) Main social and economic proposed assumptions**

The social impacts of transport

Transport is an essential element for ensuring the social and economic reproduction of all people. In large urban or in rural areas, public transport is essential for most, once access to motorised private transport is limited to few. In addition to macroeconomic and social functions, transport it also a vital asset for fuelling society social and cultural life. To damage or restrain the access to transport may threaten the continuity of the social system. The lack of adequate transport or the deficient access to it may therefore be seen as a form of social exclusion, that helps perpetuate continued poverty.

Therefore better access to school, health care, social gathering, information and working opportunities help alleviate poverty and reduce inequities. However, it has been widely agreed that investments on transport have to be followed by investments in other areas, that are found to be relevant for the social and economy reproduction of people. Transport investments have also to be co-ordinated with other related policies, worked out by clearly defined agents, with priorities and goals. Transport alone is useless unless people may use it to have access to activities. Although several factors may be mentioned as relevant, the positive relation between scholarship, access to information and healthy living conditions on one side and income/quality of life on the other side seems to be the prime one. The main question is therefore how transport may contribute to such virtuous circle.

Poverty, culture and transport

The concept of poverty is relative and complex and varies in time and space. In addition, in rural areas wealth (or the lack of) is based on monetary and non-monetary goods, in a combination that vary according to specific circumstances. Second, poverty is not homogeneously distributed and differences amongst the poor

preclude a general policy towards poverty and transport (Diaz Olvera et al, 1997). This also means that in poor communities there may be large economic differences among people, that in the event of a new road or transport service may translate into different forms of mobility, with negative impacts: this is the case of those that will have access to motorised means such as trucks, cars and motorcycles as compared to those that will remain using non motorised means.

Third, differences between poverty and deprivation have to be clarified. While the former may be seen more in quantitative terms, relating to lack of material resources (including money) the former is more qualitative and relates to lack of access to economic opportunities, social services and interaction; that is why the concept of poverty generated in wealthy countries cannot be used in poor ones, in face of radically different conditions concerning infrastructure and accessibility, and the role of informal markets as well. If we take the standard definition of mobility – the number of trips made per person on a certain period of time – it may be seen as directly related to individual and family characteristics, such as income, age, gender, level of education and household division of tasks. However, such simple idea of mobility cannot cope with the attempt to understand the reproduction process within society, once it lacks the analysis of what people can make in the available time with the available resources. The concept of accessibility may fill this gap. And accessibility turns out to be influenced by external factors such as physical location of public services, the hours of operation (e.g., the school hours) and the transport means that provide access to them. We may then associate poverty to mobility impairment and deprivation with accessibility impairment. Therefore, the agenda for transport investment has to properly address both concepts and also decide how to cope with both the physical reproduction of people and the needs related to ensuring social and economic relations. Transport investments may affect both however in different ways: subsidies to bus fares may improve mobility however they will be useless if there are no schools or jobs available or if the opening hours of public services are incompatible to the work-constrained time schedule of people.

Cultural factors may play a key role in defining what is positive or negative; this is the case of the use of bicycles by women or of girls seen as less needed for schooling or socialising. Religious factors may also play a key role in defining what is positive or negative, as with girls not allowed to attend schools with male teachers or having fellows from other religious group.

#### Non-motorised transport, informal transport and the economy

In every society there are several transport means that are used or owned by people according to their characteristics. In poor societies, most poor people either are able to own just non-motorised means or rely on the services provided by others who own such vehicles. A similar condition occurs with the supply of informal public transport. When a new transport system is organised, impacts on existing systems may be large: increase in motorization rates are threatening labour-intensive forms of transport, which provide employment opportunities to people (Etherington and Simon, 1996). Therefore, there are social and economic reasons for considering non-motorised and informal public transport in the any analysis.

The opposition between motorised and non-motorised and ‘formal’ and ‘informal’ activities permeate the debate and infuse discussions on allowing motorised transport to replace non-motorised vehicles and/or freeing informal public transport to operate. The issue concerns comparing macroeconomic results of alternative transport policies. While non-motorised transport provides a large number of direct and indirect jobs, motorised transport is expected to raise overall productivity and may have diversified impacts on the economy as a whole. With productivity, the higher average speeds provided by motorised transport has been argued as beneficial, however, they are not necessarily ‘better’ (at the society scale) and in fact generate several negative impacts. With the overall economic impact on economy, there can be no denying of the motor industry’s large chaining effect; however the extent to which such impacts compensate for the loss of jobs in the existent informal economy is not clear.

With the provision of public transport, experience shows that the peculiar nature of public transport renders both radical regulation and deregulation ineffective in social terms: both end up with serious supply problems, either in quality or in spatial/time coverage, with direct impacts on the most poor or geographically isolated. The most attractive solution appears to be the mixing of the public regulatory and surveillance roles with the private operating and marketing efficiency, with public and private roles defined according to specific conditions of each particular situation. High economic differences among social strata, as well as low density settlements may command special attention to ensure the provision of non-profitable services. And external financial support or subsidies may have to be used to ensure that social objectives are met.

## Equity and transport

The political acceptance of the right to transport varies according to the characteristics of each society and its understanding of equity and welfare. Equity is a complex concept, that bears several meanings. It is different from equality, which represents the mere equalisation of a right. Equality occurs for instance when equal spatial and time coverage of bus services in a neighbourhood is ensured or when equal rights to vote is granted for all, regardless of their individual conditions. Conversely, equity implies considering the specific characteristics of people when deciding how they should participate in the distribution of rights and duties within society and in using public resources. Using the same aforementioned examples, the spatial and time coverage of bus services may be equal but not equitable, once individual differences among people – age, gender, income, physical conditions – may interfere in their actual ability to use such services; the mere existence of places for voting (such as public schools) may be equal but not equitable, if for instance handicapped people can not access such places. Therefore, inequitable conditions may end up denying the access to formally equal rights. In isolated, rural communities, such negative effects may be severe. Accordingly, the discussion of the right to transport implies the discussion of the access to transport services. The first approach, within the liberal perspective, is that of access having to be limited to solvent demand. Such approach is at the centre of all recent proposals of transport privatisation and deregulation. The second approach postulates that transport conditions should be equally distributed, regardless of individual characteristics. Such proposal is just apparently equal, once it conveniently hides deep exclusion impacts, as with the aforementioned example of bus services. The third approach is that access should be provided according to needs. Such approach is closer to the concept of equity however raises important questions of deciding what is a ‘need’ and to which extent unsatisfied needs should be attended. Answering these questions require making a careful analysis of transport demand, identifying both manifested and suppressed demand, using for instance travel budget analysis. The most important consideration at the highest policy level is that the prevailing market paradigm, which leaves all decisions to the market as a superior tool for allocating resources, must be replaced by a social paradigm, in which transport is an essential tool for ensuring the right to access and the achievement of broader social goals. The proposal does not imply neglecting efficiency but rather approaching it by a different perspective, that of replacing the concept of economic efficiency with that of social efficiency, when costs to provide socially accorded objectives are addressed. Hence, policies should not limit proposals to manifested demand but should instead investigate the suppressed demand and also the differences in accessibility within social groups and classes. Both normative views of accessibility (minimum levels) and comparative views (differential accessibility) may be taken.

## The sustainability issue

When including the sustainability issue, care must be taken to avoid some misleading assumptions. The concentration on ‘ecological sustainability’ as the only goal of sustainable development – focusing either on sustaining the resource base or limiting human activities that disrupt global cycles – tends to forget the poverty dimension of the problem. Such critical thinking on development has come out from the questioning of the ‘trickle down’ assumption and is also grounded on a different view of development and its impacts. Although very important for understanding current development inequities and for guiding developing countries in searching for alternative forms of development, such approach has to be complemented by broader, macro-economic views of what should be done to face poverty, deprivation and inequity. Development demands social changes, not ‘sustainability in the sense of keeping them going continuously’ (Mitlin and Satterthwaite, 1996, p27). Sustainable development in developing countries cannot be achieved until poverty and inequality are addressed. To the aforementioned question about what is to be sustained, one should add a vital question for developing countries: we should provide sustainability for whom? If this question is not asked, we will behave as if everybody affected by environmental problems were equal and as if general sustainability targets such as ‘economic sustainability’ would be equally beneficial or relevant to all people. Therefore one has to ask whose sustainability has to be pursued, which implies analysing the relative transport conditions faced by different social groups and classes.

## Outline for a sociological approach

While a standard social research is limited to the accountability of social impacts, the sociological approach is characterised by the analysis of travel patterns given social, political, economic and institutional constraints.

This means that while descriptive social research accepts the trips as a *given*, the sociological research asks the basic question about *why* and *how* trips are made. Also, a sociological approach differs from a social one in the sense that it analyses the transport and traffic related social data in respect to the relative economic and political assets of social groups and classes, as well as their conflicting (or merging) interests, and may imply a more profound analysis of the whole chain of effects on both users and non-users, capturing the impacts on a macro-economic scale: this will be the case of case of road investments in isolated rural areas, when the analysis would have to take care of the long and complex chain of social and economic changes that could be prompted of accelerated.

This proposition also assumes that the central issue for transport and traffic policies are:

- how access is distributed in space;
- how do different social classes and groups use the space;
- what are the related conditions of equity, safety, comfort, efficiency, environment and cost.

The proposition also implies that circulation is a physical necessity related to the reproduction needs of social groups and classes, which in turn are constrained by economic, social, cultural and political conditions varying from one society to another.

Basic differences among the three main approaches are summarised on table 1, for two examples – urban transport quality and rural road provision.

Table 1: Differences among prevailing and proposed approaches to transport.

Approach	Typical factors considered in the analysis (examples)	
	Transport quality	Rural road provision
Technical	Vehicle traffic conditions (volume, speed, density)	Traffic volume and speed
Social	Vehicle traffic conditions and quantity of people involved	Traffic volume and speed, and number of people using vehicles
Sociological	Vehicle traffic conditions and quantity of people involved, analysed in face of their social and economic characteristics and their access to different transport means	People using vehicles and non-motorised transport; influence of their social and economic characteristics on accessibility and mobility; differences in economic and social benefits; differences in the generation and bearing of externalities

Table 2: Essential differences among the three approaches

Approach	Data used (nature)	Preferred elements for analysis	Preferred focus of explanation	Preferred elements of evaluation
Technical	Quantitative	Vehicles	Individuals	Economic efficiency (cost-benefit analysis)
Social	Quantitative and qualitative	'People' in general	Individuals	Economic efficiency, with social analyses
Sociological	Quantitative and qualitative	Political beings and their roles in traffic <sup>1</sup>	Individuals, family, social groups and classes	Economic and social efficiency; equity analysis

(1) pedestrian, cyclist, bus user, driver etc.

### 3) Social costs and benefits to consider

Costs and benefits have been used extensively to yield decisions on investments. Their common use in appraisal efforts is not free from difficulties. Costs may be classified according to their nature (direct/indirect, internal/external to the user) or to be or not represented in market transactions (marketed/non-marketed). Benefits may be tangible (reduction in travel time) or intangible (increase in comfort), and may be translated or not in monetary terms. Ultimately, most benefits may be translated into “reduced” costs.

In the case of road investments in rural areas, costs and benefits are explored below. To better analyse the issue, the positive/negative impacts of the project are summarised on tables 3 and 4. There is a certain level of subjectivity in placing a factor as having a “positive” or “negative” potential impact, such as accidents (they might increase or decrease with the new project). Also, some factors may have a double entry, in the sense of how people see them: the increase in access may be seen as positive *per se* by most and negative by those who fear for instance an increase in violence or in the exposure to illnesses; the increase in the value of land that may be seen as positive by owners who may profit from this and negative by owners who may be forced to sell their land.

Table 3: Possible positive impacts

Area	Impact
Social	Access to gathering; celebrations; religious activities; leisure
Education	Access to school
	Access to training
	Access to information via transport services: newspaper, books; mail
Goods	Access to alternative food, water, furniture, tools, clothes
Public Services	Access to new/renewed services: electricity; phone
Health	Access to regional and local health services
Economic	Workers: Access to working alternatives
	Producers: Access to alternative markets; lower average production costs; potential increase in production (or totally new items)
	Land: expected increase in value
Traffic (alternate routes)	Traffic conditions in alternate routes may become more safe and comfortable

Table 4: Possible negative impacts

Area	Impact
Social Environment	Accidents
	Pedestrian and NMT accidents x motor vehicles
	Barrier effect: Disruption of social relations (crossing of communities) Reduced mobility for the fragile (pedestrians, cyclists, elderly, handicapped)
	Use of road space Inequitable space consumption by mode and social group
Natural resources	Land taken for road infrastructure
	Vegetation taken for road infrastructure
	Killing of animals by motor vehicles
	Energy consumption
Physical Environment	Water pollution
	Air and noise pollution from motor vehicles
	Vibration from motor vehicles
	Dust
Economic	Reduction in employment/activity opportunities for the poor
	Increase in the cost of land for the poor

#### 4) Appraisal procedures

##### General procedures

Irrespective of which costs and benefits to consider, it is important to adopt general procedures, explained below.

- a) Impact area: the area to be affected by the project may be divided, for instance, into immediate, intermediate and external, according to the feeling of those involved and/or to any geographical or legal limitation. Such decision may have to be adjusted after the inauguration of the new infrastructure or service, in face of a different dynamics in respect to what had been imagined.
- b) Terms: impacts shall be estimated according to different time horizons, for instance short, medium and long. This has to be made according to the specific characteristics of each cost and benefit. Some projects may require just short to middle terms. Extreme care must be taken when forecasting variables.
- c) Agents: they shall be separated according to their public and private nature, organisational assets, legal power, leverage power and interests and needs related to the project.
- d) Users: they shall be separated according to their main social/economic characteristics (income, age), their roles played in traffic, their most used transport modes, their relation to the production process (consumers/suppliers) and their supposed or surveyed interest or needs in respect to the project. The current household travelling activity and space and money budgets shall be identified as detailed as possible.
- e) New demand: expected demand shall be split into diverted (from other routes/services) and generated (new)
- f) Tangible/intangible impacts: impacts should be split into those two categories, using available knowledge and the expertise beliefs
- g) Net results: all computations should consider that the objective is to arrive to the net results of the project.

This implies avoiding double-counting of impacts and not forgetting to include “double signed” impacts (e.g., increase and decrease in job opportunities).

##### Costs to be considered

Tables 5A and 5B summarise the proposed costs items to consider. Table 5A gives the infrastructure and transport operation costs for the new road. Table 5B gives the “impact” costs, as those that the new infrastructure might cause.

Table 5A: Infrastructure and transport operating costs

Area	Costs	Computation
Land	Land cost for construction	Direct cost
Human settlements	Re-location: new site, transport from actual to new site, temporary compensation	Direct costs
Existing business	Temporary or definite compensation	Direct costs
Transport Infrastructure	Project Construction Maintenance	Direct cost Direct cost Direct cost, per year
Transport activities		
Private	Operating (fixed and variable) x income x mobility	Cost, per km or pass-km
Public	Purchasing (new) Operating (fixed and variable) Monitoring Difference between revenues and costs Costs to users (fares) x income x mobility	Direct cost Cost, per km or pass-km Direct cost, per year Direct cost Direct cost
Traffic management	Surveillance and enforcement	Direct cost, per year

Table 5B: Impact costs

Area	Impact	Indicators	Costs
Social Environment	Accidents Pedestrian and NMT accidents x motor vehicles Vehicle crashes	New pattern of traffic conflicts; potential dangers; profile and quantity of people involved, with focus on the most vulnerable	Cost of accidents (vehicle-only, injury-only; fatal), split by transport mode (NMT, light motor, heavy motor)
	Barrier effect: Disruption of social relations (crossing of communities) Reduced mobility for the fragile (pedestrians, cyclists, elderly, handicapped)	Before-after relational network by social group Before-after mobility by social group	Not suitable to sound monetisation; alternative is hedonic pricing Losses in income; Increase in in-door leisure cost, at home or in paid spaces
	Use of road space Space consumption by mode and social group	Before- after spatial use by transport modes	Cost of construction and maintenance of road, per m <sup>2</sup> , per person-trip, per mode
	Travel time to activities	Before – after travel time by mode and by social group	Cost of time or qualitative approach
Natural resources	Land taken for road infrastructure	Current use and economic relevance (jobs, income); potential impacts	Lost production
	Vegetation taken for road infrastructure	Type, quantity, potential damage; environmental relevance;	Cost of substitution
	Killing of animals by motor vehicles Energy consumption	Before-after animal routes Before-after energy use on transport	Not suitable to sound monetisation B-A cost of energy used
Physical Environment	Water pollution	Potential impacts	Cost of cleaning the water
	Air and noise pollution from motor vehicles	Before-after conditions	Cost of morbidity and mortality
	Vibration from motor vehicles	Before-after conditions	Cost of recovering structures
	Dust	Before-after conditions	Cost of cleaning, of decreased crops and of related health effects
Economic	Reduction in employment/activities for the poor	Before-after jobs/income	Social security costs; direct income lost
	Increase in the cost of land for the poor	Before-after costs	Lost welfare

NMT – nonmotorised transport, B-A: before-after

## Benefits to be considered

Table 6: Benefits

Area	Impact	Indicators	Value (monetisation)
Social	Gathering; celebrations; religious activities; leisure	Access: TP services time coverage; average WT and TT, comfort, safety, security; cost; reliability	Not suitable to monetisation
Education	Access to school Access to training	Average WT and TT; pick-up and delivery times for young children; comfort, safety, security; cost; reliability Potential cultural impacts in face of current community relations All items x diversity of educational opportunities + training/recycling	Not suitable to monetisation,; long term effects may be monetised through schooling-income data from similar communities
	Access to information via transport services: newspaper, books; mail	Delivery services: frequency and reliability	Not suitable to direct monetisation; may be linked to increased household productivity
Goods	Access to alternative food, water, tools, clothes, medicines	Access: TP services time coverage; average WT and TT, comfort, safety, security; cost; reliability	Savings in time (replaced trips); may be linked to increased household productivity
Public Services	Access to new/renewed services: electricity; phone	Repairing services: reliability of access	Not suitable to direct monetisation; may be linked to increased household productivity
Health	Access to regional and local health services	TP services available: in (ambulances), out (public transport; cost; safety, security; reliability All items x diversity of medical services available	Impact on productivity/quality of life
Economic	Workers: Access to working alternatives	TP services available; cost; safety; security; reliability (in and out) All items x diversity of employment opportunities	B-A income levels
	Producers: Access to alternative markets; lower average production costs; potential increase in production (or totally new items)	TP services available; cost; reliability (in and out) All items x diversity of potential markets + credits + suppliers + technical information	B-A production net revenues
	Land: expected increase in value	Current x expected value	B-A land value
Traffic (other routes)	Traffic conditions in alternate routes, that become more safe and comfortable	Convenience, cost and safety for non-motorised or motorised transport	B-A Travel time and safety costs

TP: transport; WT: waiting time; TT: travel time; B-A : before-after

## Specific appraisal problems

- a) With safety, the cost of a human life – the “value of a statistical life”, captured mostly by enquiring the willingness to pay for a reduction in risk - is very difficult to estimate and highly controversial as well.
- b) The estimate of lost future production of a person that dies (gross or net earnings, after taking expenses out) may, in the case of elderly people or jobless people yield negative results and be counted as a benefit.
- c) Costs of injuries are not that controversial however are very difficult to estimate in developing countries, in face of difficulties in having reliable data. In addition, a large portion of injuries become permanent disabilities, when the cost is again very difficult to estimate.
- d) With pollution, similar problems arise: how should we value people’s health? Few developing countries have consistent data on transport-related environmental impacts such as air pollution, noise and natural resources depletion. Further, there are few – and often unreliable – data on the health effects of such environmental impacts. Therefore, the initial errors in estimating quantitative impacts are exacerbated by the difficulty in attributing monetary values to such impacts.
- e) With travel time, initially the computation itself is subjected to considerable errors, especially in face of the new traffic that may be attracted to the new facility or service. Secondly, in the case of developing countries traffic conditions are very different from those in developed ones, with a complex mix of vehicles that make conventional speed-volume computations of before-after travel times difficult to use. Finally, the attempt to estimate travel time savings at any cost leads to weird conclusions, such as signal timing settings which save a few seconds per vehicle and that are proven “viable” because they yield numerically large annual travel time savings. Another problem is the attempt to place money values on time. Time is valued directly – according to some relationship to people’s wage as workers – or indirectly, using the values people seemingly place on their time (by revealed or stated preference surveys). There are three main problems. First, in some cases of very poor environments in developing countries, the very notion of the value of time may be meaningless in practice. Second, the value of time varies considerably with income, gender, level of education and trip purpose; specific social, cultural, religious and economic conditions introduce unusual factors as constraints to people’s behaviour that are far from well known. Third, the assumption that only the time involved in ‘productive’ trips (such as travelling to work or to make business) should be considered disregard the value implicit on the whole chain of interrelated activities as essential to social and economic reproduction. Forth, the use of different wages across social groups deeply impact appraisal results and often leads to the conclusion that the benefits to higher income groups are always worthy the investment (it is very difficult to justify investment in public transport in face of the very low income of users). For policy purposes, appraisal cannot be based on such strict economic computations related to market opportunities and relations, but has to be based instead on how public resources are distributed within society.
- f) Forecasting: In developing countries it is difficult, or even impossible, to make sound and reliable forecasts, either due to the lack of appropriate data or to the unstable socio-economic environments. The most important data used – population, employment, school enrolments, average individual and household income, and auto ownership – either do not exist or are highly inaccurate. Unstable socio-economic environments are also quite common in developing countries, related to rural-urban migration, intra-urban migration, inflation, unlawful land occupation and changes in job market structure and size. Problems are also related to the continuing inflation and the sudden and constant changes in actual people’s income, with a significant effect on their travel activities and habits. It is important to emphasise that such changes may affect both low income people walking or using public transport and middle class people using private transport means. The comparison between predicted and actual demand figures demonstrates that long-term studies are not faithful in developing countries and represent an irresponsible practice when treated as decisive inputs to modelling. From a practical point of view they should be used just to devise theoretical ‘ceiling’ limits, along with prospective scenarios.

## Estimate of costs

- a) Infrastructure and transport operation

Land: the direct cost is the cost of the land that will be taken to build the road and the indirect (long term) is the value of agricultural/commercial lost production. Beware of double counting between both costs  
Human settlements: People may have to be displaced to free space for the road. Estimate cost for providing a new site, plus transport cost for the new site and probable temporary economic support for those forced to

move.

Existing business: construction may interfere with existing business activities, that may have to be compensated for lost revenues.

Infrastructure: estimate costs to project, implement and maintain the new road.

Transport

Private: operating costs for running private vehicles such as bicycles, carts, motorcycles, tractors, trucks, automobiles

Public transport:

Suppliers: costs for running and monitoring public transport services; revenue/cost ratio

Users: cost per trip (fares), according to social group; depict existing fare discounts x social group

Public services (e.g., garbage collection): costs for running such services

Traffic management: costs to manage traffic (surveillance and enforcement)

b) Impact costs

b1) Social environment

Accidents: Traffic accidents are a complex phenomenon, related to a large set of tangible and intangible factors. The number and diversity of motorised and non-motorised vehicles using roads in developing countries preclude the use of traditional techniques to understand the problem. The most direct measure of the problem is the number of dead or injured people caused by traffic accidents. As the latter is often underreported (or even unknown) the former is used as a standard measure of the gravity of the problem.

Indirect measures relate the number of accidents to some form of underlying cause or exposure to traffic conflicts – usually in the form of accidents per 100,000 people or the rate of fatalities per 10,000 vehicles.

The number of accidents per person is misleading because it does not take into account the actual physical exposure of people on the streets and sidewalks, related to the mobility level in each condition (for example, the number and extension of trips made by people). The number of accidents per vehicle (usually by automobiles) is also misleading, once it does not take into account the nature and composition of different vehicles using the streets and of the pattern of traffic conflicts as well. One way of improving the analysis is to adopt as a rate the number of accidents or fatalities per vehicle or person kilometre. Although much more consistent, it is rarely used in developing countries, once in most cases there are no data available on the distances travelled by people.

How to measure: collect data on accidents divided by type (vehicle-pedestrian, vehicles only), consequence (no victims, with injuries, with fatalities), site, time and day of occurrence. Relate all data to vehicle or person –km, if available. Identify possible safety impacts of the project and the most probable negative situations (in space and in time). Compare to the analysis of the barrier effect. Suitable to economic evaluations concerning decrease in morbidity and mortality. Beware with the accident “migration” effect (accidents being just transferred to nearby places).

Barrier effect and segregation: People’s relations may be severely affected by new, unfavourable traffic conditions – the “barrier effect”. Main consequences are the reduction in social interaction and in the use of public spaces (Appleyard, 1981) and the need to define strategies for reducing the risk of accidents (Hillman, 1988). Children and youngsters are especially affected by such externality while socialising. The volume, composition and speed of traffic are prime impact factors. The effect is very severe when a new road crosses a pedestrian environment. Speeding drivers force children, cyclists and elderly out of the road. Trucks, for their dimensions and engine power, often cause large nuisances and building vibration. Buses, when organised in heavy trafficked routes also may cause negative impacts in respect to concentrated pollution and visual annoyance.

How to measure: Draw a map of current social networks that use road space, according to mode, role played and socio-economic characteristics (age, gender, income). Compare with expected impacts on such networks, identifying the most undesirable conditions and the most vulnerable users. Qualify impacts using a scale such as “light, moderate, severe” and weight it with the number of people affected, by social group. Not suitable to direct economic evaluation. Hedonic pricing may be used in some cases, by comparing the effect of similar nuisances on the price of land or buildings in a similar site.

Road space: The space occupied by a person while using the public road is dependent on the transport mode, its speed while moving and the time it remains parked, in the case of a vehicle. The analysis of the relative use of roads by people in different transport modes reflect how such public assets are being divided among people. The use of roads is highly dependent on social and economic characteristics of people. When the daily space consumption of families (space budget) is computed for several income levels, large differences appear, with the higher income families using much more space. When linear distances are multiplied by the specific personal space correspondent to each motorised mode, differences between income levels become even more pronounced. The most important conclusion for policy purposes is that road public assets are not equally distributed among people and that treating road investments as democratic and 'equitable' is a myth. How to measure: compute the 'shadow' area of the typical vehicle of each mode and divide it by the average daily (or peak-hour) occupancy of each vehicle, yielding the average space used by a person on such mode. Then multiply such individual spaces by linear distances travelled on such mode and compare data among the different income strata. Data may also be worked out to specific trip purpose such as working or schooling trips. Suitable to economic evaluation, by applying construction and maintenance costs for road space. Beware of double counting in respect of pure road construction costs (first phase).

Travel time: The framework available for travel time analysis, developed in the industrialised countries, is automobile-centred. Its use in the case of developing countries has to face other traffic conditions, especially the extensive use of non-motorised and public transport modes.

How to measure: for each transport mode, compare to actual and predicted travel times. Estimate the difference per person-trip, per peak hour or per day. The drawing of isochronal curves is also helpful, to identify how long it is possible to travel to reach a certain area or a number of specific destination points (e.g. jobs, schools). Suitable to economic evaluations concerning changes in travel time and related costs. Use average wages as a basis when a stable paid labour market exists and there are sound data. When there are no data, work with percentage changes in time, per income level and social group. Analyse possible changes in household travel budget, identifying the time surplus (time released to alternative activities). Beware of double counting in respect to increase in land value.

## b2) Natural resources

Agricultural land: the land to be used for transport purposes may be currently used for agricultural purposes. Estimate the value of lost agricultural output. Beware of double counting in respect to the price of land taken for infrastructure.

Vegetation: estimate the cost of substitution of lost vegetation

Killing of animals: motor transport has a negative impact on the killing of animals that will cross the road. Locate current animal habits and routes and estimate their number, along with the potential number of killed animals per year. Not suitable to sound monetisation.

Energy: the energy spent by a transport mode is of particular relevance to developing countries, be it from fossil fuels (diesel, petrol) or from hydroelectric origin.

How to measure: Use standard energy parameters to compute specific energy consumption by each transport mode, according to the specific source, electric or from petroleum (trains, buses, autos and motorcycles). Compute the units of energy per distance travelled and weight it by the number of people using the mode, to yield a comparative figure among different modes, for current and future conditions. Suitable to economic evaluations concerning changes in expenses with energy. Beware of double counting in respect to vehicle operation costs.

## b3) Physical environment

Water pollution: the road infrastructure may cross and damage waterways and transport vehicles may pollute such waterways. Identify danger points and their magnitude. Economic impact may be expressed as the cost to keep waterways clean.

Air pollution from motor vehicles: An important distinction is between pollutants that have a direct effect on the Earth's health (leading to the "green" agenda for action) and those that have a strong effect on people's health (the "brown" agenda). In the first case are CO<sub>2</sub> and other pollutants and in the second case SPM, HC, NOX and SO<sub>2</sub> (and CO above certain levels). Most of the air pollution is produced by private transport (automobiles and motorcycles) although trucks and buses also play an important role, especially related to the use of diesel. Most pollutant emissions increase exponentially with decreasing speeds.

How to measure: use standard emission tables per vehicle/mode and the number of trips per mode to estimate average emission per person-trip, per peak-hour or per day. Separate between "green agenda pollutants" and "brown agenda pollutants". Consider the impact of vehicle speed on emissions if available. Compare impacts for each mode, for before and after conditions. Suitable to economic evaluations concerning decrease in morbidity and mortality.

Noise, vibration and dust: Traffic volume and composition have an important effect on noise and vibration. In gravel roads, dust may be produced in large quantities. Heavy vehicles such as trucks and buses, and motorcycles as well, are major contributors to noise, while trucks and buses produce most of the dust. The way vehicles are driven and the speed are also important factors. Severe negative effects may also be caused by railways in urban areas. Effects of noise on human's health depend on the level of exposure. They can be significant, affecting concentration and productivity and causing health damaging tensions. The same may be said of long exposures to dust.

How to measure: use standard noise production tables per vehicle/mode and the number of trips per mode to estimate average noise emission change per person-trip, per peak-hour or per day. Compare impacts for each mode. With vibration, measure before and after vibration levels on the most important structures along the road (such as schools, medical centres or households). Noise and dust impacts are suitable to economic evaluations concerning decrease in morbidity. Vibration impacts are suitable to economic evaluations concerning potential damage to structures.

#### b4) Economic

Reduction in employment/activities for the poor: the project may reduce employment for the poor, especially those in low-paid agricultural jobs or in informal transport services.

How to measure: estimate the potential loss compared to current conditions. Beware of double counting in respect to estimate of impacts of transport services made elsewhere.

Increase in the cost of land for the poor: the project may rise the cost of land/services and force the poor to move

How to measure: use the estimate of the increase in the price of land to estimate the number of poor landowners that could be forced to move.

### **Estimate of Benefits**

#### a) Specific analyses

General accessibility: estimate the potential demand that may be served by the project. Separate into diverted demand from other routes or services and generated demand. In several cases, simple estimations based on standard information and the expertise experience yield results with an adequate accuracy. When most accurate estimates or more detailed data are needed (by link, for instance), modelling mathematical procedures may be used.

Access to schools: estimate potential access opportunities classified by type and diversity, according to each income, age and gender groups; include range in time/cost etc. Suitable to economic evaluations concerning expected income increase (long term). Suggestion: compare potential future earnings using twin areas where transport is available or using data relating scholarship to income in similar areas. Beware of double counting in respect to positive outcomes of better access to jobs.

Access to information: the same as with access to schools; suggestion: include as part of the economic evaluation of schooling.

Access to health care: estimate potential access opportunities classified by type and diversity, according to each income, age and gender groups; include range in time/cost etc. Suitable to economic evaluations concerning decrease in morbidity and mortality.

Access to goods: estimate potential access opportunities classified by type and diversity, according to each income, age and gender groups; include range in time/cost etc. May be valued analysing savings in travel time (replaced trips) or as part of a general household productivity model.

Access to public services: estimate potential access opportunities classified by type and diversity, according to each income, age and gender groups; include range in time/cost etc. Suitable to economic evaluations concerning the indirect impact of some services (e.g, phone, electricity) in household production and income. Beware of double counting in respect to positive outcomes of better access to jobs and markets (producers).

Access to social activities: estimate potential access opportunities classified by type and diversity, according to each income, age and gender groups; include range in time/cost etc. Not suitable to economic evaluation

Access to the job market: estimate potential access opportunities classified by type and diversity, according to each income, age and gender groups; include range in time/cost etc. Suitable to economic evaluations concerning expected income increase (middle to long terms). Suggestion: compare potential future earnings using twin areas where transport is available. Beware of double counting in respect to positive outcomes of better education.

Access to training: the same with the job market

Access to markets (producers): estimate potential opportunities classified by type and diversity, according to each income, age and gender groups; include range in time/cost etc. Suitable to economic evaluations concerning expected income increase (short to long terms). Suggestion: a) compare potential future earnings using twin areas where transport is available b) estimate decrease in average production cost (and consequent profit increase) in face of a new scale of production and the access to tools and supplies (short to long terms).

### **Integrated analysis**

Costs and benefits should be considered since the beginning of the appraisal and should be treated according to a mixed quantitative and qualitative analysis. Three phases are suggested:

Phase 1: Strategic analysis

Perform strategic analysis to explore the overall sustainability of the proposal. Suggested steps:

- a) Costs: do people want to invest on such project? Is there money available? Is there an alternative, better use for such money? In the case of a loan, it will be possible to pay for it and what is the expected impact on national/regional debts?
- b) Environmental: are there politically unacceptable negative environmental impacts caused by the project?
- c) Institutional: are there institutional and legal capabilities to implement the project?
- d) Technological: are there technological means of adequately implementing the project?
- e) Technical: will be adequate maintenance means to keep the new infrastructure and services running adequately?
- f) Managing: is there personnel and expertise to take care of the new infrastructure and services?
- g) Sustainability: is the whole project sustainable in economic, environmental and technical terms?

Phase 2: Equity analysis

Integrate all (or most) specific accessibility analysis into before-after activity networks of households (split by income) or social groups (split by type: e.g., gender, age, occupation). Compare first potential differences in mobility and accessibility, computing also the time "surplus" for each social group or household type (time saved to perform other activities). Second, compare potential differences in space, time and money budgets brought by the project. Clarify equity differences in all cases and take a special attention on the impact on the poor. Third, using data from the impact costs, compare future production and enduring of negative externalities (accidents, pollution, barrier effect and consumption of energy and road space) among social groups or household classes.

### Phase 3: Final analysis

Work to reach a balance between efficiency and equity objectives, according to the initial political assumptions. Use public hearings or other sort of community input to the process. Compute all direct and impact costs (tables 5A and 5B). Compute benefits (table 6). Compare the tangible items first, yielding a first estimate. Then introduce the intangible through any type of qualitative evaluation and weighting, yielding a second evaluation. Finally, introduce the main findings of the equity analysis to provide a final decision.

### Other questions

a) Do donors' objectives assist or interfere with identification of social benefits and costs?

They do both things. For instance, the World Bank has accumulated a large experience in evaluating transport projects and assists with this identification however specific conditions often lead to interference. Such interference may be related to the BIRD interests and to interests and needs of the public agency in charge of the investment. Dispute may arise within a conflicting policy environment, where there are opposing interests related to the provision of new infrastructure or services. Donors may want to interfere both in face of internal procedures and technical culture of the agencies in charge of planning and in face of economic interests such as the opening of new business opportunities or the increase in land value that may be associated with the project.

b) Can social benefits and costs be pre-defined?

Yes, but reality may lead to a reassessment of benefits and costs.

With costs, especially in developing countries, it is difficult to accurately anticipate some costs, like soil transport and drainage costs, in face of deficient topographic information. Also, unexpected cost items may arise, such as compensating for the displacement of people or for the interruption of existing informal means of transport. With benefits, some impacts may be overstated and others may be understated in the initial phase. In addition, infrastructure and services may be used by target social groups in different ways than it was expected, forcing the reassessment of benefits or the withdrawal from initial beliefs. Also, different social groups may enter the scene and use the infrastructure or services, in a positive or negative way. Finally, the size of the impact areas (immediate, intermediate or external) may change in face of a different dynamics from what was expected

c) Are assumptions and procedures deployed for identification of social costs and benefits in other sectors (e.g. water, health, education) relevant to the transport sector?

Yes, using the concept of accessibility and health impacts. Studies on school supply provide important assumptions and procedures for analysing the accessibility to schools according to transport modes available (especially in rural areas). The same happens with studies of health service supply. Studies on water supply include procedures for analysing the positive health impacts and therefore have implicit (or explicit) analysis of the "value of a statistical life".

### References

- Appleyard, D (1981) *Livable Streets*, University of California Press, U.S.
- Diaz Olvera, L, Plat, D and Pochet, P (1997) 'Les mobilités quotidiennes de deux pauvres à Bamako et Ouagadougou' in *Mobilité et politiques de transport dans les villes en développement*, INRETS, Paris, pp119–134.
- Dimitriou, H (1990) 'Transport problems of the third world', in Banjo G.A. and Dimitriou H T (eds) (1990), *Transport planning for Third world cities*, Routledge, US, pp 50 – 83.
- Etherington, K and Simon, D (1996) 'Paratransit and employment in Phnom Penh: the dynamics and development potential of cyclo riding', *Journal of Transport Geography*, Vol. 4, No. 12, pp. 37-53
- Hillman, M (1988) 'Foul play for children: a price of mobility', *Town and Country Planning*, October, pp 331-332
- Howe, John (1994) *Enhancing Non-motorized transport use in Africa- changing the policy climate , working paper IP-6*, IHE Delft, Netherlands.
- Mitlin, D and Satterthwaite, D (1996) 'Sustainable development in cities', in Pugh, C (ed) *Sustainability, environment and urbanisation*, Earthscan, UK, pp 23 –62.

Vasconcellos, E A (2000) Urban transport, environment and equity: the case for developing countries, Earthscan, UK.