Programme: EESD-2001
Key Action: City of Tomorrow
Task: 3.1

PLUME

PLanning and Urban Mobility in Europe

Synthesis Report: Urban Sustainability and its Appraisal

Project Contract No: EVK4-CT-2002-20011

CONTENTS

0 INTRODUCTION

This synthesis report discusses the theories, methods and problems related to the appraisal of sustainable urban policies. Much of the report simply reproduces (in edited form) text provided by Kari Lautso, based upon research from the SPARTACUS and PROPOLIS projects, and text from the PROSPECTS Methodological Guidebook (MG) (Minken et al, 2003). Also, text from the SPECTRUM project (SPECTRUM, 2003) is reproduced; this project further develops many of the concepts from PROSPECTS. The report commences with a discussion about the definition of sustainability in general and about urban sustainability in particular. The two predominant types of appraisal currently in use are then summarised: Multi Criteria Analysis (MCA) and Cost Benefit Analysis (CBA). MCA provides the basis for appraisal in PROPOLIS (where CBA is part of the overall appraisal), whilst "CBA within an MCA framework" provides the basis for appraisal in PROSPECTS. The description of these methods takes into account how they might incorporate the sustainability concepts outlined previously. A table is provided from SPECTRUM showing current national practice in European countries with respect to urban transport appraisal. Finally, the note briefly discusses the issues of justice and acceptability; this discussion provides a basis for thinking about how these issues might in future be incorporated into the appraisal process.

1 OVERVIEW OF KEY FINDINGS FOR POLITICIANS

Definitions of sustainability

The notion of each generation's duty to its successors is at the heart of the concept of sustainable development and was captured by the Brundtland Commission (World Commission on Environment and Development, 1987) in its report *Our Common Future*. The report defined sustainable development as "development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs". Since the publication of this report, a large number of other definitions of sustainability have been devised and are currently in use. In general, definitions distinguish between three different aspects of sustainability: environmental (or ecological); economic and social.

What do we mean by Appraisal and why do we need it?

Appraisal is the *ex-ante* process of deciding how well a scheme or strategy will perform and is a means of assisting the decision-maker with the tasks outlined below:

Roles of Appraisal

- deciding how serious the current or future problems are
- helping to identify possible strategies to solve these problems
- identifying gainers and losers from any proposed strategy
- determining whether the design for a proposed strategy could be improved
- choosing between alternative strategies and schemes

In the appraisal process, the likely impacts of a scheme or strategy are considered against a set of policy objectives: for a sustainable transport and land use system, these objectives will be based upon the type of sustainability concepts mentioned above. Two widely-used techniques are available to help with this process: Cost Benefit Analysis (CBA) and Multi Criteria Analysis (MCA).

CBA uses money as the comparator. Changes in amounts of travel, travel time, accidents and the environment are assigned money values, based on observation of the choices which people make. The net value of the expenditure less the benefits is calculated for each future year, and discounted to the present day to reflect the fact that expenditure in 10 years' time will cost less now than the same expenditure tomorrow. These are then summed over the appraisal period to give, as a single indicator of performance, a net present value of the benefits. The main weaknesses in this approach are the assumptions required to value attributes like noise and accidents, and the difficulty of distinguishing gainers and losers. **MCA** overcomes some of these problems by allowing the decision-maker to assess the weights to be assigned to different indicators, objectives and impact groups. In this way, differing views on the relative importance of, say, noise and accidents can be reflected.

Social justice and equity are issues that are not currently well-addressed in formal appraisal processes. An important reason for this is that there is a lack of clarity about what these concepts actually mean in practical day-to-day terms. More research is needed on the definition of operational concepts of social justice and equity, and how these might be included in an appraisal process.

2 ABOUT SUSTAINABILITY (FROM PROPOLIS)

2.1 General

The notion of each generation's duty to its successors is at the heart of the concept of sustainable development and was captured by the Brundtland Commission (World Commission on Environment and Development, 1987) in its report *Our Common Future*. The report defined sustainable development as "development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs".

From a purely semantic viewpoint, a sustainable system can be defined as a system that does not destroy the preconditions of its own existence. However, in practice it is rather a question of various degrees of transformation (e.g. global warming with its most uncertain consequences) of the system, not about a straightforward destruction. Thus, as no system is unchanging, it could be said that the definition of sustainability is dependent on what level of negative change is considered to be too much.

By definition, a city, as such, cannot be sustained unless all of its (relevant) components are sustainable. However, the evaluation of the sustainability of an urban system as a whole does not fit within the scope of the present context. The mere fact that we are not looking at the totality of the urban system but parts thereof does not allow us to measure its degree of absolute sustainability, even in principle. And, it would not seem to make sense to judge the absolute sustainability of any subsystems (e.g. land use and transport) because they will not be sustained if the rest of the system collapses.

In the wider context, it is similarly unclear whether urban sustainability - again in absolute terms - is a meaningful concept. This is because, by definition, the sustainability of a system which is dependent on an external system can not be evaluated without also examining the external system (which then loses its 'externality'). Despite these difficulties, the point of departure is that urban sustainability can and should be measured. As it is not possible in absolute terms, it must be done in relative terms. Using a set of pre-defined indicators, the impacts of urban policies on sustainability can be measured against targets set for the indicators, or policies can be compared against each other.

Many definitions have followed that of the Brundtland Commission. One common principle sees sustainable development as a situation in which future generations would be left with the same capacity for improving human well-being. Capacity is defined as the sum of all human, man-made and environmental assets. This definition allows trade-offs between different types of assets. But this concept may deflect attention from the degradation of important ecological assets. To take this into account, a notion of "strong sustainability" has been developed. This requires that the overall stock of capital is maintained, but also that special attention is paid to those essential ecological assets, which are deemed to constitute "critical natural capital". Often a distinction is drawn between major life or planet threatening concerns on the one hand and local concerns, which are more amenable to trade-offs, on the other (Report from the House of Lords Select Committee on Sustainable Development).

Broader definitions seek to extend the definition beyond environmental considerations and include issues of social equity and justice. Different weight is often also given to the

importance of economic growth. ICLEI has defined sustainable development as "development that delivers basic environmental, social and economic services to all residents of a community without threatening the viability of the natural, built and social systems upon which delivery of these systems depends" (quoted in European Commission, 1996).

2.2 Components of Sustainability

The above considerations show that sustainable development must be viewed as consisting of three interconnected components: ecological or environmental, social or human, and economic (e.g. Munasinghe, 1993; Alberti, 1995; Hannequart & Schamp, 1995; Gardner & Carlsen, 1996; World Bank, 1996). The following interpretations can be given (Munasinghe, 1993):

- The *economic* approach to sustainability is based on the Hicks-Lindahl concept of the maximum flow of income while at least maintaining the stock of assets or capital that yields these benefits (Solow, 1986; Maler, 1990). Interpretation problems arise with regard to the maintenance and mutual substitutability of the different kinds of capital (manufactured, human, natural etc.). Difficulties are also inherent in considerations of uncertainty, irreversibility and catastrophic collapse (Pearce and Turner, 1990).
- The *ecological* view of sustainability focuses on preserving the resilience and dynamic ability of biological and physical systems to adapt to change. These systems may be interpreted to include all aspects of the biosphere, including cities. Viability of subsystems critical to the global ecosystem (Perrings, 1991) and protection of biodiversity are of key importance.
- The *socio-cultural* concept involves both intra- and intergenerational equity. Elimination of poverty and defending the rights of future generations are of central importance. Maintaining the stability of social and cultural systems and reducing destructive conflicts are sought (UNEP et al., 1991).

2.3 Special Urban Characteristics

According to the European Environment Agency's (1995) survey on the state of the European environment, i.e. the Dobríš Assessment, the ecological aspect of urban sustainability can be expressed as meeting the inhabitants' needs "without imposing unsustainable demands on local, as well as global natural systems". It is clear that the total area required to sustain a modern European city is much larger than the city itself, and that the impacts of the functioning of the city are not confined to within its boundaries.

Five urban sustainability principles can be named (European Environment Agency, 1995):

1. *Environmental capacity*: Cities must be designed and managed within the limits imposed by the natural environment.
2. *Reversibility*: Planning interventions into the urban environment should be as reversible as much as possible so as not to endanger the ability of the city to adapt to new demands from changes in population and economic activities without impairing environmental capacity.
3. *Resilience*: A resilient city is able to recover from external stresses.

4. *Efficiency*: Obtaining the maximum economic benefit for each unit of resources used (environmental efficiency) and the greatest human benefit from each unit of economic activity (welfare efficiency).
5. *Equity*: Equal access for urban inhabitants to resources and services is important to modify unsustainable behaviour exacerbated by inequitable distribution of wealth.

The second and third principles seem to be special cases of the first one thus reducing the actual principles into the three components of sustainability discussed above: environmental, economic and social. Abiding by the above principles leads to achieving the following goals that are necessary in making cities sustainable (European Environment Agency, 1995):

- minimising the consumption of space and natural resources
- rationalising and efficiently managing urban flows
- protecting the health of the urban population
- ensuring equal access to resources and services
- maintaining cultural and social diversity

These principles are not easy to operationalise. For example, if 'minimising' is understood as making a quantity as small as possible, then questions arise regarding what is possible and whether it is sufficient.

Haughton and Hunter (1994) set out three basic principles for sustainable development:

- inter-generational equity: taking account of the ability of future generations to meet their needs
- social justice: because poverty causes degradation
- transfrontier responsibility: environmental costs of urban areas should not simply be transferred

3 OVERVIEW OF APPRAISAL (FROM PROSPECTS)

The main purpose of appraisal is to provide the participants in the decision making process with the information which they need to rank strategies, to select a single best strategy or a set of preferred strategies, or to retain a set of core strategies to be processed and discussed further by eliminating useless, unacceptable or dominated strategies. Thus appraisal will usually not be the last word in the decision making process. There will be differing political priorities and differing interests among the participants in the process. Appraisal, as we see it, will provide all of these parties with the information they need to make up their minds, conduct an informed discussion and understand the practical implications of their political differences and their ultimate decisions.

An appraisal framework is typically a matrix, with one row for each impact that is in some way relevant to the appraisal and one column for each alternative that is being considered. In principle, there is no reason why different rows in the framework might not present the same or overlapping information, although if this is done (e.g., to help different stakeholders appreciate an impact in the way they best associate with) then the dangers of explicit or implicit double-counting of impacts must be borne in mind.

In essence, the framework is simply a presentational device. Its main purpose is to overcome man's limited capacity as an intuitive processor of complex and unusual information, by ensuring that all data considered relevant to appraisal is explicitly set down and available. In doing so, it also ensures that all alternatives are assessed against the same set of criteria, something that cannot be guaranteed in the absence of some type of formalisation. At the same time, the very fact that all relevant data is in the open also acts as a deterrent against deliberate or sub-conscious misrepresentation of the impacts of alternatives, since all data is open to challenge. Information may be recorded numerically (on ratio, interval, ordinal or nominal scales) or verbally.

The framework and the choice of performance indicators to be included in the framework are the most critical steps of all in seeking good appraisal practice. To assess each project/-strategy explicitly against identical performance indicators for each alternative is the single most important contribution to sound appraisal. Next, choice of performance indicators to serve as the rows of the framework is also very important. Although duplication of information may be acceptable to a limited extent in frameworks, exclusion of significant impacts in general is not. All significant impacts that might realistically make a difference in preference between one alternative and another should be reflected in a row of the framework. The appraisal framework forms the basis for:

- Communication
- Initial informal understanding and assessment
- Possible revision or screening out of alternatives
- The application of cost-benefit analysis
- The application of multi-criteria analysis
- Possible iterations through the process to examine new or amended strategies

A further use of frameworks, if supported by further disaggregation, is to throw light on distributional questions. For example, it might be useful to understand how impacts are distributed between households, business, government, etc. – the winners and the losers.

However, this is not always practicable. Sometimes such information is constrained by data and modelling limitations. There are also challenges in the presentation of such information. Presented in a two-dimensional table, the level of detail could rapidly become unwieldy.

4 COST BENEFIT ANALYSIS (CBA)

4.1 Overview of CBA (from PROSPECTS)

A basic principle of CBA is to use the individuals' own valuations to measure the parts of the impacts of a strategy that they experience themselves. We seek the changes in their welfare expressed in money. So the question that must be asked and answered is what each individual herself would be willing to pay to get the benefits or avoid the costs of a strategy.

Next, we must somehow sum over all individuals in society to arrive at the value to *society* of implementing a strategy. In principle, society might attach a higher value to the welfare of some individuals than others, and this might be reflected in the ensuing social welfare function. In practice, this is seldom used in CBA. Instead, every individual's willingness-to-pay is counted the same. That way, if by some government intervention the winners could be made to pay compensation to the losers, so that losers are as well off with the strategy as without it and the winners still have some gain, the strategy is seen as an improvement to society as a whole (the Kaldor-Hicks criterion). The big problem with this point of view is that such compensations will not be made. Nevertheless, underlying CBA is the concept that government has the power to redistribute wealth so that any targeted wealth distribution could be reached. Efficiency and equity issues can be dealt with separately. If this is the case, any strategy with a potential to leave some individuals better off after compensation has been paid is an improvement in economic efficiency. Summing over all individuals, we arrive at the monetary value of this improvement.

CBA is well established in transport as a means of aggregating the impacts of competing transport proposals so as to get an overall ranking in terms of contribution to net social well-being. There are numerous texts and manuals outlining its theory and practice, see, for example, Pearce and Nash (1981), Sugden and Williams (1978).

As part of the recent EUNET project, an in-depth assessment of CBA in application at the trans-European network level of thinking has been undertaken. In particular, Deliverable 9 of EUNET (Nellthorp *et al.*, 1998) not only thoroughly assesses current appraisal practice and general appraisal issues, but also explores the specifics of appraisal not only of all the major direct impacts of transport projects that would typically be incorporated in a CBA, but also all of the environmental and indirect socio-economic impacts. See also Grant-Muller *et al.* (2001). These last two references, together with the references that they in turn include, provide up-to-date guidance on the state of the art in cost-benefit application within transport. In particular, they give guidance and sources on methods for appraising individual types of impact, such as noise, safety, etc.

Closely linked to CBA is the use of discounting procedures to allow costs and benefits that occur at different points in time to be aggregated into a single measure. This has a strong foundation in individual behaviour – individuals will prefer to consume now rather than later, and would require compensation in the form of interest to postpone consumption. Also, financial markets set the price of obtaining money now rather than later. However, when we appraise strategies with respect to sustainability, the issue is not just how individuals value benefits now compared to later. Sustainability involves very long term considerations, reaching well beyond single individual lives, and there is an important equity issue (inter-generational equity) involved. This may call for other approaches to discounting. In fact, faced with irreversible long-term impacts of strategies, CBA in its traditional form will be

inadequate and needs to be modified.

Since CBA concentrates solely on efficiency, it goes without saying that the distribution of impacts, socially and spatially, is not covered by CBA appraisal. It might be possible to derive the distribution of impacts from a CBA, but distributional aspects are certainly not *appraised* by the CBA. Thus CBA can be used to compute an overall indicator of economic efficiency, but the equity objectives must be tackled by other means.

Furthermore, CBA has difficulty in establishing money values for a number of crucial environmental and social impacts, either because the impacts are difficult to quantify or because the value per quantity varies considerably according to circumstances and across individuals. Even if accidents, air pollution and noise seem to be amenable to monetary valuation, the loss of natural habitats and cultural sites, the level of security and freedom of movement, liveable streets and neighbourhoods etc. pose much greater problems. For the impacts that can be quantified but not valued, separate non-monetised indicators need to be established. Since these indicators (and the indicators relating to equity) cannot be included in the CBA objective function, the CBA objective function will not perform a complete ranking of strategies. It may however perform a complete ranking of strategies that meet targets with respect to these indicators. This provides a way of incorporating environmental and social sustainability issues in a CBA setting, or conversely of taking care of economic efficiency issues in an Environmental Impact Assessment setting. Barbier et al (1990) is an example of how environmental sustainability can be incorporated in cost benefit analysis. Another alternative is to use multi-criteria analysis, which is the subject of Section 5 below.

4.2 The PROSPECTS "Sustainability Objective Function"

PROSPECTS has developed a *Sustainability Objective Function OF*, which can be used to measure social welfare under a CBA approach, whilst taking into account various features of sustainability. Its general mathematical form is:

$$OF = \sum_t a_t \left(b_t - c_t - I_t - g_t g_t\right) + \sum_{it} m_{it} y_{it}$$

where

$a_t = a \frac{1}{(1+r)^t}$ for all years between 0 and 30 except year t*, the last modelled year; r is a discount rate and a, the intergenerational equity constant, is a constant between 0 and 1, reflecting the relative importance of welfare at present as opposed to the welfare of future generations,

$a_{t^*} = a \frac{1}{(1+r)^{t^*}} + (1-a)$

b_t and c_t are benefits and costs in year t, including user benefits, producer surpluses, benefits to the government, and external costs. Investment I_t has been singled out as a special type of cost.

g_t is the shadow cost of CO_2 emission, reflecting national CO_2 targets for year t,

g_t is the amount of CO_2 emissions in year t,

m_{it} is the shadow cost of reaching the year t target for sub-objective i, or possibly a more subjectively set weight,

y_{it} is the level of indicator i in the year t.

The Sustainability Objective Function *OF* is in accordance with the definition of sustainability, because it involves the weighted sum of a CBA and the welfare of an undiscounted year (this is the first summed terms) plus penalties to assume that this last year stays within environmentally sustainable limits (this is the CO_2 term and the last summed terms).

5 MULTI CRITERIA ANALYSIS (MCA)

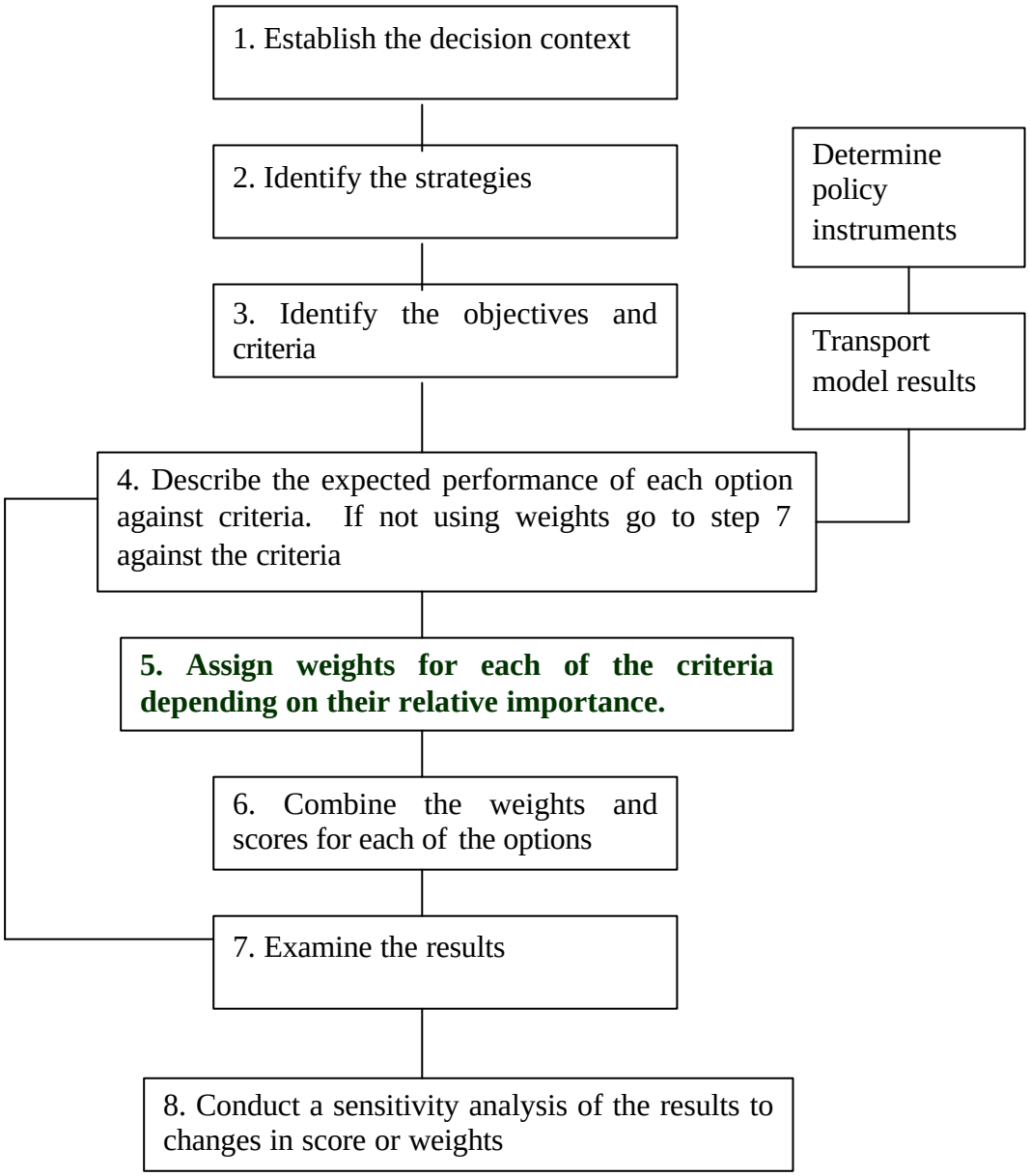
5.1 Overview of MCA (from SPECTRUM)

MCA methods reflect the subjective insights of decision makers. A wide variety of Multi Criteria analysis methods have been developed, many of which originated in the analysis of consumer choice. These include goals achievement matrix, regime analysis and analytical hierarchy process. These methods all aim to help decision makers to determine which strategy they should implement based on the known impacts and are particularly applicable for impacts that cannot be readily monetised and therefore not included in a traditional Cost Benefit Analysis. The MCA approach can be used as a stand-alone method or (as proposed in the flexible framework of the EUNET and PROPOLIS projects) combined into an overall framework that includes CBA.

A simple form of MCA contains just a performance matrix in which each row describes a strategy and each column the performance of the strategy against each criterion. The decision makers then decide which option best meets their objectives. This process can then be extended for more complicated techniques by converting the matrix into consistent numerical values by either using a weighting or scoring system. The guidance steps for a multi criteria analysis are provided in Figure 1.

The MCA process starts (as with the CBA) by defining the objectives and indicators (criteria). Transport models are then used to forecast the state of the transport system if these pre – defined economic and other policy instruments are implemented. The impacts of the policy instruments are then presented in a performance impact table, which describes whether the strategies met the criteria. If weights are not being used then the process goes directly to the stage where the decision makers will determine the appropriate strategy based upon whether the criteria have been met. Alternatively, using MCA techniques, weights can be applied to the performance table to determine the relative importance of each of the criteria. These weights can then be combined to determine which strategy should be chosen. The selection of the best strategy can take place within an iterative procedure between decision-maker and analysts (although there is also some literature regarding the decision-making power of the analyst).

Figure 5.1: Steps in a multi criteria analysis (adapted from DETR, 2000)



5.2 Building Sustainability Indices (From PROPOLIS)

The construction of indices in MCA proceeds in three steps: (1) generation of the 'raw' indicator values, (2) valuing and (3) weighting them. The theoretical bases of the two latter steps are discussed in the following subsections. Generation of the indicator values is based on land use and transport model runs.

The generation functions produce indicator values that do not have any common unit. They are both pressure and state indicators (e.g., emissions; the share of the population living in areas exceeding air quality standards). While it is possible to compare policies even without any further processing of the indicator values, this may have some drawbacks. The number of indicators to be taken into account may be unpractical and second, the value judgements on

which the results of the comparisons ultimately are based risk remaining implicit. Using indices avoids these problems by aggregating the results according to the values and weights explicitly given by the relevant people.

Each indicator must thus be assigned a weight that determines its importance in relation to the other indicators in order to determine the effect on the index value caused by a change in the indicator value. In addition, to enable the weighting to take place, the various incommensurable indicator values must be standardised onto a common scale using value functions.

5.3 Valuation (from PROPOLIS)

5.3.1 Principles

Below, some of the basic issues of value measurement are discussed. For a fuller account with useful references to basic literature, the reader is directed to von Winterfeldt and Edwards (1986) upon which the following is mainly based.

A value function has to answer the question, what are the relative strengths of preference of any two 'raw' indicator values x, i.e. what are the corresponding values of the value function. Figure 5.2 shows an example of a value function $v = v(x)$, where $v(x)$ is the value of the function and x is the indicator value.

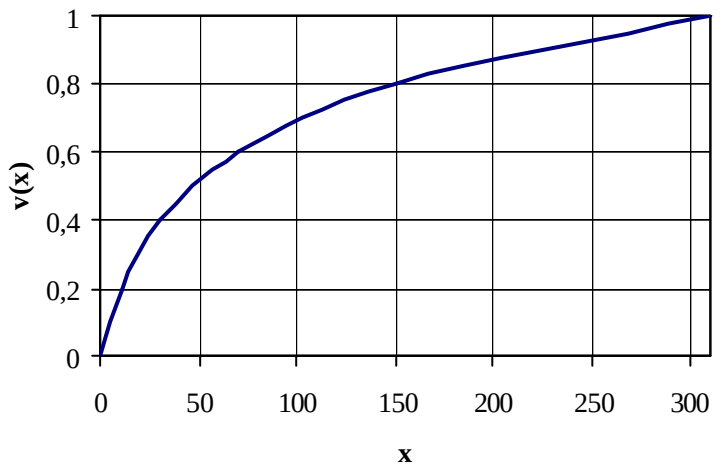


Figure 5.2: An example of a value function.

A value function must fulfil this basic condition: if the preference of a value x_1 over x_2 is at least as strong as that of x_3 over x_4, then

$$v(x_1) - v(x_2) \geq v(x_3) - v(x_4)$$

The most important assumptions that must hold for the above condition to be fulfilled are:

Connectivity: A judgement on the preference of two x values must be able to be made in the first place.

Transitivity: If x_1 is preferred or equal to x_2, and x_2 to x_3, then x_1 is preferred or equal to x_3.

Summation: If x_1 is preferred or equal to x_2 and x_2 to x_3, then $v(x_3) - v(x_1)$ must be greater than either of the two differences $v(x_2) - v(x_1)$ and $v(x_3) - v(x_2)$.

Solvability: All equations concerning strengths of preference must have a solution.

Archimedean: There must not be values of x that would require an extremely large positive or negative value of v in comparison with other x values.

5.3.2 Value measurement

In the following, two main techniques, with some variations, for obtaining the values of $v(x)$ needed for constructing the value function are introduced:

- ***Direct rating:*** First, the worst and best x values are defined and assigned the minimum and maximum values of the value functions (e.g. zero and unity, respectively). However, the best and worst 'raw' indicator values are not usually known beforehand. Still, the basic condition for value functions mentioned above must be satisfied. Thus, should x values outside the predefined range occur there are two alternatives:
    1. Extrapolation. In cases where value functions are used for standardisation purposes, this is not feasible as it could result in $v(x)$ values outside the standard range (e.g. [0…1]).
    2. Redefining the value function so that the new value(s) are included in the x range.
- ***Indifference methods:*** These are based on determining equal differences in the strengths of preference. One can start from equally spaced $v(x)$ values and estimate which x values they correspond to. These x values are called a standard sequence and the method the *difference standard sequence technique*. Another indifference method is the *bisection method* in which x_is that correspond to $v(x) = 0$ and $v(x) = 1$ (or whatever the maximum) are first defined. Subsequently, the x_i whose $v(x)$ value is halfway between the extremes is sought. Further subdivisions of the scale lead to a refinement of the value function.

5.4 Weighting (from PROPOLIS)

Nijkamp et al. (1990) present a good summary of different kinds of weighting methods. The presentation below draws to a large extent on their book.
The general formula for the sustainability indices (SI) applied can be an additive one:

$$SI = \sum_{i=1}^{n} w_i \cdot v_i(x_i),$$

where n is the number of indicators;
w_i are the weights of the indicators, $\Sigma w = 1$;
v_i are the indicator-specific value functions (see section 1.6.2); and
x_i are the 'raw' indicator values.

In the following, five types of method for obtaining the weights are presented:

- ***Trade-off methods:*** All the ratios between the weights (i.e., in the case of three indicators, w_1/w_2, w_2/w_3, w_1/w_3) are estimated pair-wise using a question like "How large should the value of the ratio w_1/w_2 be in order that a change of one unit of x_1 is equally significant as an improvement of w_1/w_2 units of x_2?"
- ***Rating methods:*** A constant number of points (e.g. 100) are distributed among the indicators to directly reflect their importance.
- ***Ranking methods:*** First, the indicators are ranked in relation to each other on an ordinal scale. In the case of three indicators, the result is thus e.g., $w_1 \leq w_2 \leq w_3$. It is assumed that $\Sigma w = 1$ and $w_i \geq 0$ for all i. In a three-dimensional space where each axis represents the weight of one of the indicators, these relationships form a surface. The three co-ordinate values of the points belonging to this surface are the possible weight combinations. A range of methods not explained here can thereafter be applied in order to arrive at the weights of the individual indicators.

- ***Verbal statements:*** A seven- of five-point scale may be used for deriving qualitative descriptions of the weights. The outcome can then be transformed into quantitative weights using some form of standardisation.
- ***Pair-wise comparison (Analytical Hierarchy Process):*** The AHP method developed by Saaty (1977) is a three-stage process: building the hierarchy, weighting the attributes locally and globally, and calculating the final values for the alternatives. All the indicators for which it holds that their $\Sigma w = 1$, are compared pair-wise. The respondent presents his/her views using the scale presented in Table 5.1.

Table 5.1: Scale of relative preference (after Saaty, 1977).

Intensity of relative importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Weak importance of one over another	Experience and judgement slightly favour one activity over another
5	Essential or strong	Experience and judgement strongly favour one activity over another
7	Very strong importance	An activity is strongly favoured and its dominance is demonstrated in practice
9	Absolute importance	The evidence favouring one activity over another is of the highest possible order of affirmation
2, 4, 6, 8	Intermediate values between the two adjacent judgements	When compromise is needed
Reciprocals of above non-zero numbers	If activity *i* has one of the above non-zero numbers assigned to it when compared with activity *j,* then *j* has the reciprocal value when compared to *i*.	

6 APPROACHING JUSTICE AND ACCEPTABILITY (FROM PROPOLIS)

The justice implications of the policies can be approached via the concept of equity. The term usually refers to the ethical desirability of distributing benefits or wealth between groups and individuals and to the corresponding injustice caused by substantial uncompensated losses (Lichfield et al., 1975). According to Miller (1976), at least three principles of justice can be used to distinguish right from wrong in the context of distributing benefits: to each according to his rights, to each according to his deserts and to each according to his needs. Being based on different things, these may well be in conflict: rights derive from laws or other rules or established practices, deserts from a person's capabilities, moral virtue etc., and needs range from those to food and shelter to higher social and cultural ones.

6.1 Theories of Justice

Khisty (1996) presents six chosen theories of justice and defines them as attempts to answer certain questions about justice itself. According to Gunn and Vesilind (1987) they can be used as *input in the development of decision making procedures*. The six theories are described in the following.

- **Equal shares**
  This theory is followed for example in democratic elections: one person, one vote. According to Miller (1976), this theory is not motivated by striving towards an undifferentiated society as sometimes suggested by critics, but it is a rough and ready way of achieving equal level of well-being, if scales of well-being cannot be relied upon.
- **Utilitarian approach**
  According to this theory, justice is done when the amount of utility is maximised, regardless of its distribution. Underlying is the idea that differences in well-being are quantitative, not qualitative, and that a common measure adequately trading off benefits and costs can be derived.
- **Maximisation of average net benefits with a minimum floor benefit**
  The objective of maximising the average benefit is constrained by defining a minimum amount that certain individuals or groups, notably the less well-off, should receive.
- **Maximisation of average net benefits with a benefit range**
  This approach aims at limiting the contribution of a policy to the widening of the differences in well-being between groups or individuals. For example, it might be prescribed that the differences between the benefits to the higher income group must not exceed those to the lower group with more than X units.
- **Egalitarianism**
  The point of departure for this theory is that all human beings are equal and should be treated equally in all respects. The objective is to level any unevenness in the distribution of well-being. Any policy delivering more benefits to the less advantaged would be regarded as egalitarian.
- **The Difference Principle**
  Rawls' theory of justice consists of three principles (Rawls 1971):
  1. Each person is to have an equal right to the most extensive total system of equal basic liberties compatible with a similar system of liberty for all.
  2. Social and economic inequalities are to be arranged so that they are both:

- (2a) to the greatest benefit of the least advantaged, consistent with the just savings principle, and
- (2b) attached to offices and positions open to all under conditions of fair equality of opportunity

Principle 1 shall be satisfied before 2 and 2b before 2a. In the present context, the principle 2a—also known as the Difference Principle—is of most interest. The basic assumption behind it is that everyone can be better off if some inequalities are allowed. For example, if more productive individuals are able to earn more, that will increase the total production leading to increase in the total wealth of the economy and hence the wealth of the less well-off. The Difference Principle is not anti-egalitarian as such. It is concerned most about the absolute position of the least advantaged group rather than their relative position, and if strict egalitarian distribution of wealth maximises the absolute wealth of the least advantaged, then that is what the Principle advocates (Zalta).

There are practical examples for applying the justice theories in practise. In Belgium the Flemish Parliament has passed a law in 2001 stating the minimum level of service to be provided by public transport operators (public or private) on each day of the week. Maps cover the entire territory and indicate the accessibility required (500 m. minimum in urban areas, 750 m. in rural villages). This law has already strongly increased the level of service and actual modal choice by citizens (STEVAERT 2003). A summary of the pending issues may be found in the conclusions of the book « Rights and Mobility » (LACONTE 2003).

6.2 Acceptability

Regarding the assessment of the justice implications of urban policies, one may ask if the measurement of justice of individual issues, such as exposure to noise or pollutants is relevant at all. It can be argued that unjust distribution of any individual effect should be allowed as long as care is taken to maintain an *overall* progress towards greater justice in society.

The answer to the question is that the measurement of justice of the distributions of individual impacts is relevant in any case from the point of view of the acceptability of a policy. A good policy where the distribution of negative (or positive) effects is very unjust is more likely to be disapproved by the public and vice versa: if the distribution of the effects is just the policy is more likely to be accepted. Naturally, also the extent of the net benefits affects the public reaction; it could even be maintained that the net benefits alone should reflect the acceptability, for those that gain will surely be in favour of and those who lose against a policy. However, as long as the net *social* benefits are concerned, this is not accurate, as the social benefits can not be identified with the sum of private benefits.
Although making only popular decisions should not be understood as the sole aim of the political system, information on the acceptability of policies does have its value in assisting the search for policies that are both sustainable and acceptable. Thus, it can be said that the theories of justice can be used for *aiding the assessment of the acceptability of a policy*. This is a relevant issue even if one thinks that the justice of individual distributions of the effects of a policy is irrelevant from the point of view of overall justice in society.

7 CURRENT PRACTICE IN EUROPE FOR URBAN TRANSPORT APPRAISAL

Table 7.1 summarises current national practice in Europe concerning on the appraisal of urban transport, as found by the SPECTRUM project (SPECTRUM, 2003). It can be seen that there is a general consistency between countries in using CBA for the appraisal of: capital costs; recurring financial costs; time savings and safety. On the other hand, there is wide variation between countries on the appraisal of other impacts.

Table 7.1: Transport appraisal approaches used in Europe (SPECTRUM Consortium partners, 2003)

Direct Impacts	POL	UK	FRA	GER	NRL	IRL (Dublin)	NOR	HUN	SWE	FIN	ITA	DEN (Road)
Capital												
Construction costs					M							
Disruption costs			*									
Land and property costs												
Recurring												
Maintenance costs					M							
Operating costs					M							
Vehicle operating costs					M							
Revenues												
Passenger cost Savings												
Time savings					M							
Safety					M			M				
Service level								M				
Information												
Enforcement												
Financing/taxation												
Environmental Impacts												
Noise		M									*	
Vibration							*			*		
Air pollution-local		M									*	
Air pollution-global		M			M							
Severance	*	M	*		*		*			*		
Visual intrusion	*						*					
Loss of important sites	*	*M	*	*	*		*		*	*	*	
Resources consumption				*			*		*		*	
Landscape	*	*M		*			*		*	*		
Ground/water pollution		*M		*	*		*		*			
light pollution												

Socio-economic impacts

Land use		*M	*		*M		*	*				
Economic development	*	*M	*		M			*	*		*	
Employment								*				
Economic and social cohesion		*M					*	M				
International traffic								*				
Interoperability							*	M				
Regional policy	*	*M			*		*	M		*		
Conformity to sector plans		*M	*					*M		*	*	
Peripherality / distribution			*				*	*M				
Liveable streets		*M					*	*M				
inter generational equity								*M				

Others

Biodiversity/geology		M									
Physical fitness (health promoting/damaging)		*M									
Personal security		*M									
Grant/subsidy											
Journey reliability											
Option "mode choice"		*M									

Key : * - descriptive treatment of impacts, -

- CBA(monetised),

- measured impacts (non monetised), M - included in MCA.

8 PRACTICAL EXAMPLE (FROM PROPOLIS)

The appraisal framework - including the environmental, social and economic dimensions of sustainability, the themes under each dimension and the indicators under each theme – is illustrated in Table 8.1. Each dimension ends with an index summarising the state of that dimension after the weighting and valuation processes.

The economic index, although expressed as the net present value of the savings per inhabitant, represents the CBA part of the approach. Note that the indices for the different dimensions are not commensurable.

Figure 8.1 illustrates how the environmental index and its various themes behave when different policy options are implemented. The first column presents the current situation and the next column the situation in the base reference scenario in 2021. The target for any policy could be to perform better than the base scenario and - in the best case – to maintain or even improve the current level.

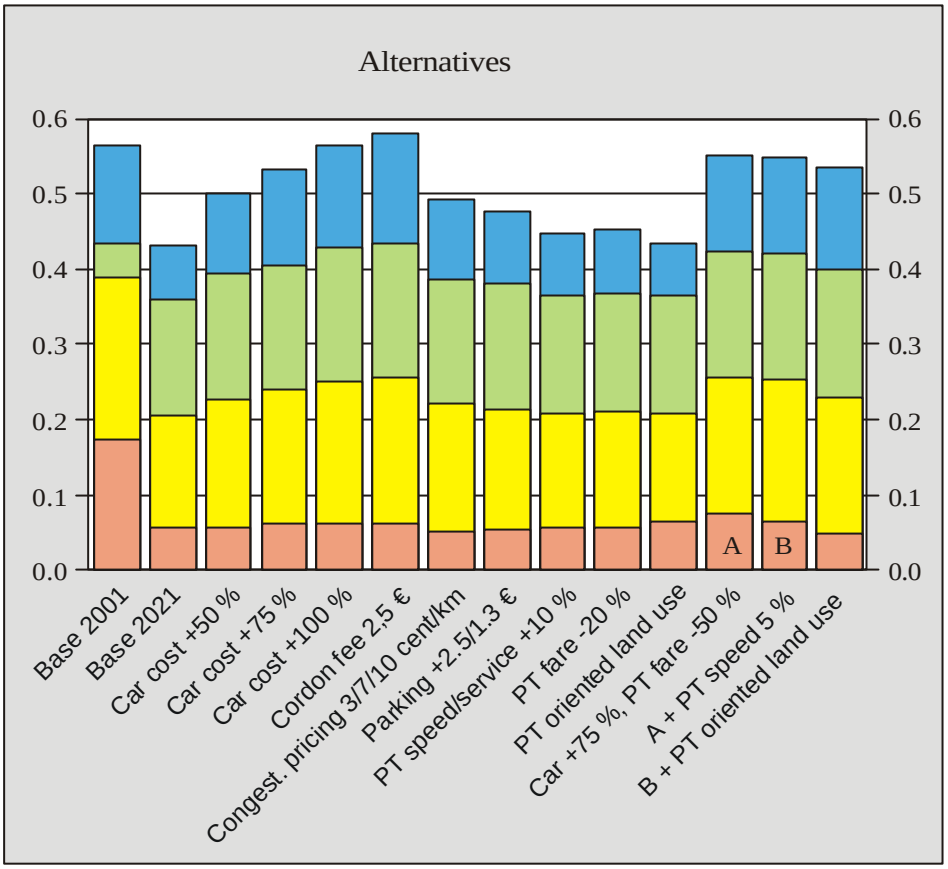
The social and economic indices can be presented in the same way for the same policies. An ideal policy is able to simultaneously improve all the dimensions of sustainability.

In addition to indicators a set of background variables are available for the decision-maker. These variables illustrate the behaviour of the policy in terms that are easy to understand but are not directly related to sustainability (e.g. modal share or average trip speeds and lengths).

Table 8.1: List of PROPOLIS indicators

THEME	INDICATOR	UNIT	WEIGHT %
ENVIRONMENTAL DIMENSION			
Global climate change			[21.6]
	Greenhouse gases from transport	CO2 eq./1000 inh. / year.	21.6
Air pollution			[22,5]
	Acidifying gases from transport	acid eq./1000 inh. / year.	13.2
	Volatile organic compounds from transport	tons /1000 inh. / year.	9.3
Consumption of natural sources			[34,3]
	Consumption of mineral oil products, transport	tons /1000 inh. / year.	14.7
	Land coverage	percent of area	11.1
	Need for new construction	annual growth in %	8.5
Environmental quality			[21,6]
	Fragmentation of open space	index	13.4
	Quality of open space	index	8.2
Environmental index			
SOCIAL DIMENSION			
Health			[37.6]
	Exposure to particulate matter from transport in the living environment	percentage of population	7.5
	Exposure to nitrogen dioxide from transport in the living environment	percentage of population	5.9
	Exposure to traffic noise	percentage of population	6.7
	Traffic deaths	deaths/1000000 inh./year	10.6
	Traffic injuries	injured/1000000 inh/year	7.0
Equity			[23,0]
	Justice of distribution of economic benefits	justice index	5.1
	Justice to exposure to particulates	justice index	4.4
	Justice of exposure to nitrogen dioxides	justice index	4.3
	Justice of exposure to noise	justice index	4.2
	Segregation	GINI-index	5.0
Opportunities			[16.4]
	Housing standard	% of overcrowded househ.	4.8
	Vitality of city centre	index	3.1
	Vitality of surrounding region	index	3.1
	Productivity gain from land use	percent / year	5.4
Accessibility and traffic			[23.0]
	Total time spent in traffic	hours/inhabitants/year	4.6
	Level of service of PT and slow modes	minutes/trip	5.8
	Accessibility to city centre	minutes/trip	4.0
	Accessibility to services	minutes/trip	4.6
	Accessibility to open space	minutes/trip	4.1
Social index			
ECONOMIC DIMENSION			
	Investment costs	Euro/capita	
	Transport user benefits	Euro/capita	
	Transport operator benefits	Euro/capita	
	Government benefits from transport	Euro/capita	
	Transport external accident costs	Euro/capita	
	Transport external emissions cost	Euro/capita	
	Transport external greenhouse gases	Euro/capita	
	Transport external noise costs	Euro/capita	
Economic index, total net benefit from transport		Euro/capita	

Figure 8.1: Illustration of the use of the environmental appraisal: the Environmental index in different policy scenarios



9 TECHNICAL SUMMARY

Definitions of sustainability

There are a large number of definitions of sustainability. In general though, three aspects of sustainability can typically be identified: environmental (or ecological); economic and social. Of these three aspects, the least well-defined is social sustainability, which could possibly cover a wide number of specific areas, but at a minimum concerns issues such as social justice, social inclusion, intragenerational equity, and reduction in poverty. On a high level of generality, progress in any of these areas is uncontroversial; i.e. no politician would ever claim to desire an unjust society or want to increase poverty. However, there are difficult political questions on how to create practical day-to-day operational concepts concerning social sustainability which can be used in the planning process. Research is required on developing such operational concepts, probably mapping them on to specific political ideologies (of the type that would be disputed in elections by political parties) as well as on to the actual practice of particular cities with respect to these issues.

Forms of appraisal

The two main forms of appraisal in current use are **Cost Benefit Analysis (CBA)** and **Multi Criteria Analysis (MCA)**. A survey of current practice in Europe has shown that there is a general consistency between countries in using CBA for the appraisal of: capital costs; recurring financial costs; time savings and safety. On the other hand, there is wide variation between countries on the appraisal of other impacts such as those concerning the environment. A basic problem with traditional CBA is that it explicitly gives more weight to the needs to the current generation than to future generations (through the practice of discounting future benefits and costs). Thus traditional CBA has limited value as a tool for appraising sustainability (which must, by any definition, place emphasis upon the needs of future generations. However, state-of-the-art methods have been devised to overcome this problem by developing a CBA approach which gives equal (if not more) importance to the needs of future generations to the needs of the current generation, thus ensuring **intergenerational equity**. A second problem with CBA is that many impacts can simply not be monetised in any uncontroversial manner. This points towards the benefits of using MCA in which the importance attached to particular impacts is formally decided by the policy maker in a (hopefully) transparent manner. Whilst it is not likely that the differences between hard-line advocates of CBA and MCA will be easily resolved (especially given the different ideological roots of the two approaches, reflecting modernism and post-modernism respectively), it is possible that the positive features of the two approaches might be combined in a manner that is helpful to practical decision-makers. In particular, the concept of "CBA within a generalised MCA" framework, as currently being developed in a number of research projects, would be likely to generate wide support.

Including social justice and equity within appraisal methods

Given the lack of clarity concerning social sustainability (as discussed above) and the consequent lack of operational concepts, it is not surprising that issues of social sustainability are not well included in formal appraisal processes. More research is required on how appraisal might be adapted to take more account of social justice and intragenerational equity.

Such research needs to be pursued in conjunction with the research suggested above on how to define operational concepts.

10 REFERENCES

Alberti, M. (1995) "Towards Urban Sustainability Indicators" in: J. Jäger, A. Liberatore and K. Grundlach (Eds.). *Global environmental change and sustainable development in Europe.* European Commission, Directorate-General for Science, Research and Development. Brussels.

Barbier, E.B., A. Markandya and D.W. Pearce (1990) Environmental sustainability and cost benefit analysis. *Environment and Planning A* **22**, 1259-1266.

Breheny, M (1990) "Strategic Planning and Urban Sustainability" *Proceedings of the 1990 Town and Country Planning Association Annual Conference*. TCPA, London.

European Commission (1996) *European Sustainable Cities.* EU Expert Group on the Urban Environment, DG XI. Brussels.

European Environment Agency (1995) *Europe's Environment: The Dobříš Assessment.* Edited by Stanners David & Bourdeau Philippe. Copenhagen.

Gardner, K. and J. Carlsen (1996) "Performance Indicators for Sustainable Transport in London." *Proceedings of the 24th European Transport Forum*. London Planning Advisory Committee. London, 2 to 6 September 1996.

Grant-Muller, S. M.; P.J. Mackie; J. Nellthorp and A.D. Pearman (2001) Economic appraisal of European transport projects: the state-of-the-art revisited. *Transport Reviews* **21**, pp.237 – 261.

Hannequart, J-P. and E. Schamp, Eric (1995) "Bruxelles et le developpement durable" *Les cahiers de l'institute bruxellois pour la gestion de l'environnement* 11.

Haughton, G. and C. Hunter (1994). Sustainable Cities. ISBN 1-85302-234-9

ICLEI (International Council for Local Environmental Initiatives) (1993) *The local agenda 21 initiative. ICLEI guidelines for local and national LA21 campaigns*. Toronto.

Khisty, C. J. (1996) "Operationalising Concepts of Equity for Public Project Investment" *Proceedings of the 75th Meeting of the Transportation Research Board, January 7-11, 1996.* TRB, Washington, D.C.

LACONTE, P. (2003) « Conclusions générales: Droit à la mobilité ou droit à l'automobilité ? » in : Droit et Mobilité, Namur : Presses universitaires de Namur 2003

Lichfield N., P. Kettle, and M. Whitbread (1975) *Evaluation in the planning process*. Pergamon Press, Oxford. Quoted by Khisty.

Maler, K. G. (1990) "Economic Theory and Environmental Degradation: A Survey of Some Problems" *Revista de Analisis Economico*, Vol. 5, No. 2, pp. 7-17. Quoted by Munasinghe.

Miller, D. (1976) *Social justice*. Clarendon Press, Oxford. Quoted by Khisty.

Minken, H., D. Jonsson, S. Shepherd, T. Järvi, T. May, M. Page, A. Pearman, P. Pfaffenbichler, P. Timms and A. Vold (2003). PROSPECTS; Developing Sustainable Land Use and Transport Strategies: A Methodological Guidebook. DG TREN, 5th FP.

Munasinghe, M. (1993) "Environmental Economics and Sustainable Development" *World Bank Environment Paper* No. 3. World Bank, Washington, D.C.

Nellthorp, J., Mackie, P.J. and Bristow, A.L. (1998) *Measurement and valuation of the impacts of transport initiatives.* EUNET Deliverable 9, ITS Leeds.

Pearce, D.W. and Nash, C.A. *The Social Appraisal of Projects*, MacMillan, London, 1981

Pearce, D. W. and R. K. Turner, (1990). *The Use of Benefits Estimates in Environmental Decisionmaking, report to the Environment Directorate.* OECD, Paris. Quoted by Munasinghe.

"Report from the House of Lords Select Committee on Sustainable Development, Volume 1-Report", *HL Paper* 72, HMSO. London.

Saaty, T. L. (1980) *The Analytic Hierarchy Process.* McGraw Hill Company, New York.

Solow, R. (1986). "On the Intergenerational Allocation of Natural Resources" *Scandinavian Journal of Economics*, vol. 88, no.1, pp. 141-149. Quoted by Munasinghe.

SPECTRUM (2003). Outline specification of a high level framework for transport instrument pacakages. Deliverable D5 of the SPECTRUM project. DG TREN, 5th FP.

STEVAERT, S. « Le décret du Gouvernement flamand sur la mobilité de base par transport public et le réseau des gares », in : Laconte P. (Ed.) La Gare et la Ville, Brussels : Fondation pour l'environnement urbain (2003)

Sugden, R. and A. Williams (1978) *The Principles of Practical Cost-Benefit Analysis.* Oxford University Press.

UNEP, IUCN, and WWF (1991). *Caring for the Earth.* Quoted by Munasinghe.

von Winterfeldt D. and W. Edwards (1986) *Decision analysis and behavioural research.* Cambridge University Press. New York.

World Bank (1996). "Sustainable Transport: Priorities for Policy Reform" *Development in Practice Series*. Washington, D.C.

World Commission on Environment and Development (1987) *Our Common Future*. Oxford University Press. Oxford and New York.

Zalta, E. N. (Ed.) *Stanford Encyclopedia of Philosophy*. A publication of the Center for the Study of Language and Information. http://plato.stanford.edu/