A Survey of Methods for Sustainable City Planning and Cultural Heritage Management

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A SURVEY OF METHODS FOR SUSTAINABLE CITY PLANNING AND CULTURAL HERITAGE MANAGEMENT

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1. Emerging Issues in Managing the Urban Cultural Stock

Modern cities are action centres of economic activity and culture. As a consequence, they find themselves in an ambivalent position. On the one hand, they are the vehicles of Schumpeterian entrepreneurship and hence the carriers of innovation and economic growth. On the other hand, they are the trustees of cultural heritage and sustainable city life and hence the carriers of socio-cultural identity. This ambiguity is particularly present in a European setting. As European countries move towards unification, the issue of cultural identity becomes more urgent for policy makers at all levels: European, national, regional and local. Besides, a great variety of cultures has always been a particular characteristic and strength of Europe. The issue of preserving cultural diversity and identity concerns not only European societies but also the rest of the world, as wider socio-economic forces influence styles and modes of living (see Coccossis and Nijkamp, 1995).

Cultural identity is based on heritage which is a broad concept including values, attitudes, customs, historical memory, language, literature, art, architecture, etc. A very important and visible part of heritage consists of the built environment, the context of urban living. Many countries have pursued conservation policies, as conserving the past offers a source for cultural identity and a basis of reference for the future. Conservation policy has usually been approached in an eclectic way focusing on the unique and outstanding. Recent attitudes towards conservation bring forward the issue of protecting more and more aspects of heritage. Selection and assessment become therefore priority concerns. Such changes call for a reorientation of conservation policy. New analytical tools and concepts are thus required which would enrich and expand the conventional methods utilized and which would ensure sustainability of cultural heritage in an urban setting (cf. Archibugi 1992).

The aim of this paper is to present practical methods for urban sustainability policy analysis, with a particular view to finding a balance between the need for sustainable development (with a view to environmental and cultural goods) and sound economic progress. The paper tries to comply with the quality conditions for human settlements set forth by Kevin Lynch who claimed, *"So that settlement is a good which enhances the continuity of a culture and the survival of its people, increases a sense of connection in time and space, and permits or spurs individual growth: development, within continuity, via openness and connection"* (Lynch, 1981). We take for granted here that an intrinsic element of cities is formed by its cultural heritage, i.e., that part of the present which is drawn from the past. To a large extent present values, attitudes, customs, lifestyles, etc. are deeply rooted in the past. Heritage is that part of culture which is transmitted from one generation to the next. To some extent a society's identity is based on its heritage. This is the reason for which many societies, in both he developed and developing world, attach great value to heritage. Clearly, the meaning of the term 'heritage' is quite broad and encompasses a great many attributes.

Part of our heritage is visible, in the sense that it has a physical existence. It consists of various artifacts created by man in the past. Often this type of heritage is part of our everyday living environment: monuments, buildings, gardens, landscapes, etc. An important characteristic of the built heritage is its presence in time and space, and often these artifacts are integrated in our everyday lives and serve as shells for our activities. Yet, they go through a long-term life cycle in terms of physical condition and quality, Then society has to face the choice between development and conservation, based on rational planning methods(cf. Greffe 1997).

Over the years, substantial experience has been accumulated in conservation planning. In this context many - mainly descriptive - contributions have been made to the analysis of prevailing policies, strategies and measures in policy situations marked by conflict between development and conservation. In spite of the widely acknowledged value of conserving our built cultural heritage, relatively little effort has been invested in developing appropriate analytical tools for integrating conservation in to development planning.

The cultural conservation issue - or, perhaps more properly, the management of cultural heritage - has become especially important within the framework of urban planning (e.g., urban renewal, redevelopment, renovation, restructuring or urban areas), as here the conflict between 'high tech' versus 'high touch' developments is at stake. For instance, in various cities the threat of urban degradation requires a physical and economic restructuring which very often is to the detriment of the historico-cultural heritage of the city. Despite many debates in this field, so far no uniformly acceptable urban development planning paradigm has emerged. Although various successful interventions exist around the world, there is little margin to transfer this experience to other areas, as the socio-economic and cultural context is different from one place to another. In spite of the progress in architectural and urban design and in successful interventions which respect the heritage of a place, this experience is not directly susceptible to generalization. Each case is bounded by its particularities. In addition, as the size of the area increases and the number of options expand, it is always necessary to make decisions about the value of things to preserve or to be allowed to change in the near or distant future.

Urban development means the creation of new assets in terms of physical, social and economic structures, but it is at the same time worth noting that each development process often also destroys traditional physical, social and cultural assets derived from our common heritage. Clearly, although not always immediately computable, all cultural assets represent an economic value - or at least an option value - which has to be taken into consideration in any urban transformation process. In most cases, however, the evaluation of such assets in the planning process cannot be left to the market mechanism, as most urban historico-cultural assets represent 'unpriced goods' characterized by external effects which are not included in the conventional "measuring rod of money'. Thus the development of appropriate evaluation methods is of paramount importance here, as otherwise a careful and balanced nurturing of cultural assets will never be realized in the context of an urban sustainability policy.

Despite much progress, the operational assessment of the socio-economic and historico-cultural value of monuments - or the impacts of monument policy - is still fraught with many difficulties. Monuments represent part of the historical, architectural, and cultural heritage of a country or city, and usually do not offer a direct productive contribution to the economy. Clearly, tourist revenues may sometimes reflect part of the interest of society in monument conservation and/or restoration, but in many cases this implies a biased and incomplete measure, so that monument policy can hardly be based on tourist values. On the contrary, in various places one may observe a situation in which large-scale tourism (sometimes marked by congestion) even affects the quality of a cultural heritage (Venice of Florence, for example). Thus, there is a need for evaluation and assessment methods which form a balance between priced and unpriced 'goods'. This is especially relevant, because in the current period of budgetary constraints there is a risk that budget cuts in the public sector will affect first the 'less productive' or 'soft' sectors such as monument conservation, arts, and so forth. Therefore, it is necessary to pay due attention to the socio-economic and historico-cultural significance of our heritage, in the interest of the notion of sustainable cities (cf. Lichfield 1996).

There has been a strong tendency among many economists to adopt the narrow conventional economic viewpoint that the meaning of a certain good can be derived in a proper way from the revealed preferences of economic agents who express their desires in an often artificial market. It is however, increasingly recognized that the socio-economic and historico-artistic value of a cultural good is a multidimensional (or compound) indicator which often cannot be reduced to one common denominator (such as the 'measuring rod of money'). From a planning viewpoint, more interest is needed into the 'complex social value' of cultural resources (Fusco Girard 1987). This implies that the meaning of historical and cultural resources is not in the first place dependent on its absolute quantities, but on its constituent qualitative (sometimes even symbolic) attributes or features (such as age, uniqueness, historical meaning, visual beauty, physical condition, artistic value, etc.). For instance, cities like Venice, Florence, Sienna or Padua would never have received an international reputation without the presence of intangible values inherent in their cultural monuments. Symbolism and synergy are two key factors here.

To clarify the meaning of the multidimensional approach proposed, some general background observations on the preservation or our cultural heritage will first be given. The 1960s and 1970s showed a strong dominance of economic evaluation tools in public planning (for example, cost-benefit analysis, cost-effectiveness analysis). It was a widely held belief that a systematic application of rigorous economic thinking in evaluating and selecting public projects or plans would be a major instrument in improving the performance of the public sector (for instance, see Little and Mirrlees, 1974).

This conventional economic appraisal methodology found its basis mainly in welfare economies and was originally normative and prescriptive in nature, but it also implied various restrictive value judgments, such as the emphasis on efficiency and the repression of equity. Besides, the use of 'fictitious' shadow prices to assess benefits foregone was a major source of uncertainty in such project evaluations. The aim to transform all relevant impacts into one common denominator, i.e., the 'measuring rod of money', has especially become a source of major criticism and skepticism.

Clearly, a compound evaluation of collective goods - and especially public capital goods such as churches, palaces, parks, landscapes, 'cityscapes', etc. - is far from easy and cannot be undertaken by the exclusive consideration of the tourist and recreation sector (see also Lichfield 1989). Especially in the Anglo-Saxon literature the expenditures made in visiting recreational destinations are often used a proxy value for assessing the financial or economic meanings of natural parks, palaces, museums, etc. A geographically complicating problem here is the fact that such recreational commodities and the various users are distributed unequally over space. This means that recreational expenditures are co-determined by distance frictions, so that the evaluation of recreation or tourist opportunities has to take into account the transportation costs inherent in recreational and tourist visits. Consequently, the socio-economic value of such recreational opportunities depends both on their indigenous attractiveness and on their location in geographic space. Therefore, increase of accessibility might then become an instrument in enhancing the socio-economic value of cultural heritage, even though the indigenous historico-cultural value of monuments is invariant with respect to geographical location (apart from the scale economies emanating from a 'sociocultural complex'). Thus, we are still left with the problem of a compound evaluation in policy analysis for a sustainable urban cultural stock.

Modern policy analysis aims to offer an assessment and evaluation framework for compound, often unpriced goods in the public sector. In this sector decisions are usually to be made without a clear reliance on the market system. And it is indeed increasingly recognized that market forces alone do not necessarily lead to optimal results. Structural market failures as well as sudden external factors may require a balanced policy mechanism that is able to influence the actual economic developments within a community or society. The initiation of policies or the implementation of corrective measures may take place on several organizational levels, ranging from local to supranational. Urban decision-makers usually face complex decision problems in which many factors play a significant role: each policy alternative may lead to desirable as well as undesirable consequences in a long chain of interconnected activities. To obtain insight into the complexity of the decision-making process, it is necessary to undertake thorough studies in order to collect knowledge or to learn from previous experiences or experiences elsewhere.

In the past decades, several assessment techniques were developed and used as a basis for decision-making in many countries. These methods ranged from cost-benefit or cost-effectiveness studies to financial accounting systems and market studies. Despite their intrinsic value, these types of assessment techniques have a limited range of application and they cannot take into account the rich variety of - often very diverse - factors underlying a decision-making procedure. Consequently, in the 1980s and 1990s new classes of multi-dimensional assessment and evaluation methods (such as multicriteria analysis) have emerged which aimed to take into consideration unpriced, intangible or qualitative aspects of complex decision problems (see for an extensive overview Beinat and Nijkamp 1998, and Nijkamp and Blaas 1995). These methods may be seen as a meaningful complement to traditional evaluation methods such as cost-benefit analysis. They do certainly not replace cost-benefit analysis, but offer a wider complementary perspective.

The features of cost-benefit analysis are well-known, not only in neo-classical welfare economics but also in decision-making procedures which incorporate social aspects (see Janssen 1992). As a further addition to cost-benefit analysis, a multi-dimensional assessment approach tries to merge and feature the different aspects which intervene during a decision-making process. The gradual shift from conventional assessment techniques such as cost-benefit analysis toward multi-dimensional assessment approaches and the systematic comparison of all these studies require an enormous study effort, and induce, as a consequence, a significant cost. In this context, it should be noted that over the past two decades a new set of research techniques has been developed which makes a rigorous analysis of study findings possible: meta-analysis. Meta-analysis aims to summarize results from previous studies in a quantitative way to allow also for transferability of findings (see for details also Van den Bergh et *al.,* 1997). As a result, a synthesizing process becomes more manageable and less vulnerable to subjective elements due to a more rigorous examination of earlier research. For example, by means of meta-analysis a great variety of similar studies can be taken into consideration, while the impact of the researcher on the study findings be reduced via the use of quantitative methods which make a rigorous synthesis possible. These recent scientific developments allow also to establish a new type of assessment methodology in order to address multi-dimensional decision problems in a proper way. We will now present several assessment methods in more detail.

2 Assessment Methods and Decision Support for Urban Planning

In order to reach a satisfactory policy in a complex environment a careful process of decision-making is required which takes time and can be costly (see Ackoff 198 1, Banister 1997, Mintzberg 1979, and Simon 1960). The problems faced in a decision-making process may be subdivided into the following components:

- the information or data available always contain an element of uncertainty;
- the data or information may be stored in different data bases that may be difficult to access, manipulate, compare and study;
- a large set of - often conflicting - objectives or targets has to be taken into account;
- the decision-making process itself might be influenced by power relations or selfish motivations;
- a decision-making process has to take place within the shortest time possible to avoid countervailing effects.

This means that the best alternative or policy has to be determined. In fact, a decision-maker has to deal with an optimization procedure where from a set of alternatives the optimal alternative is to be found given the objectives and underlying conditions and constraints (cf. Stead and Banister 1996). Making decisions based on uncertain or imprecise information is a problem which has attracted the attention of many scientists; see, for example, Leung (1997), and Nijkamp and Scholten (1993). A wide range of support systems - with the aim of handling incomplete knowledge concerning real-world phenomena - is nowadays available, e.g. Decision Support Systems, Computer Information Systems and Expert Systems (see, for example, Jackson 1990). According to Kacprzyk and Yager (1990), these systems are built upon mathematical research techniques and aim to yield new knowledge via a proper treatment of data and/or information. However, in many situations uncertainty is not the only complicating factor in the decision-making process.

Most decisions can be typified as choice experiments based on multiple objective or multicriteria features. This means that an optimal alternative from a set of alternatives is to be determined which best satisfies a number of - often conflicting - objectives. Next, another complicating factor is that in a policy setting - beside a set of quantitative criteria - also qualitative criteria have to be taken into account in a decision-making process. In the past, several attempts have been made to apply cost benefit analysis (CBA) to the appraisal of urban sustainability projects. However, as mentioned above, CBA shows several severe shortcomings when it comes to an operationalization (see METAPOL 1996). Especially the assessment of environmental - or, in general, unpriced - impacts of economic activities via CBA turned out to be troublesome, since in CBA all criterion scores have to be transformed into a common monetary unit. Hence, qualitative and unpriced criteria cannot be included in the decision-making procedure based on a CBA. Another problem is that in a CBA, the value priorities are reflected in the (corrected) market prices or through the willingness-to-pay of the individuals (see Janssen 1992), which does not necessarily lead to meaningful political priorities. Hence, a decision-making process which is better able to handle qualitative information in a more sophisticated way seems to be desirable. We will now present in Sections 3 to 8 a concise overview of some important and operational assessment techniques. All sections will follow the same systematic structure so as to allow for a mutual comparison.

3 Benchmarking

3.1 Introduction

Benchmarking has up to now mainly been applied as a management tool within companies. The history of benchmarking began in the 1960s and 1970s when Japanese visitors investigated many European and American firms, organizations, exchanges, etc. However, hardly anyone expected the way they started to produce their products after this 'learning period': they sold products for prices which were below even the production costs of their Western competitors.

One of the organizations facing these problems was Rank Xerox, which had been very successful in producing inter alia photo-copiers. Now, Japanese copiers were sold at even lower prices than Xerox's production costs. In order to analyse how this was possible, Xerox began a project which they called 'benchmarking'. This project aimed to provide insight into the way these large productivity differences were caused and to suggest solutions for their own productivity improvements. The benchmarking project was apparently very successful (Camp, 1989). Since the success of the Xerox project, benchmarking has gained much attention in the 1980s as a new management instrument. Greater numbers of organizations have applied this tool with more or less success. In the meantime, benchmarking has become a kind of 'fashion' in economic research, especially as a management tool for improving the productivity and the competitive position of organizations. In this context many research methods and projects are called 'benchmarking'.

3.2 Description of the method

As mentioned above, benchmarking is mainly applied as a management tool. Its aim is to compare the performance of a company with the performance of other companies, and to analyse why these changes occur. In this way it can be analysed why a company is more successful than another company. It is important that not in the first place products and financial figures are compared, but merely underlying processes which cause the differences. As a result also an analysis why differences occur is presented, and eventually indications how a company may perform better. In a benchmarking project, activities are split up in small activities (e.g. invoicing, maintenance), so that the analysis takes place at a rather detailed level. When successful, this leads to the most interesting information, but it should be acknowledged that such an analysis takes a lot of efforts and time. There is a lot of data necessary, but also insights in the contents of data (every organisation may have different definition for a certain activity).

As mentioned before, benchmarking is more than simply comparing ratios or achievements of targets. Its aim is to learn where improvements in policies may occur. The best performing country in the benchmark study may then provide a future target value, to which a organization should aim (see Figure 1). For one country the current value (t_1) of the benchmark item (say CO_2 emissions) is A, while the best performing country/region regarding CO_2 emissions starts at point B, which is higher. Both countries are supposed to have an autonomous increase in their benchmark value until t_2, the first country of AC, the best performing country of BD. It is clear that for the first country an extra effort is needed to 'jump' at least towards point D, for example by the **'benchmark path'** indicated. To indicate how this may be achieved, the differences in policies should be analysed and proposals on how to adapt the policy of the least performing country should be made.

It may be clear that in this case not only the objective should be determined, but that also the **underlying processes** have to be analysed, in order to investigate how such an objective should be reached. In this respect also cultural, spatial, economic and institutional differences between countries have to be analysed to identify the reasons for the differences between the various countries. Policy packages may then also include differences in these fields.

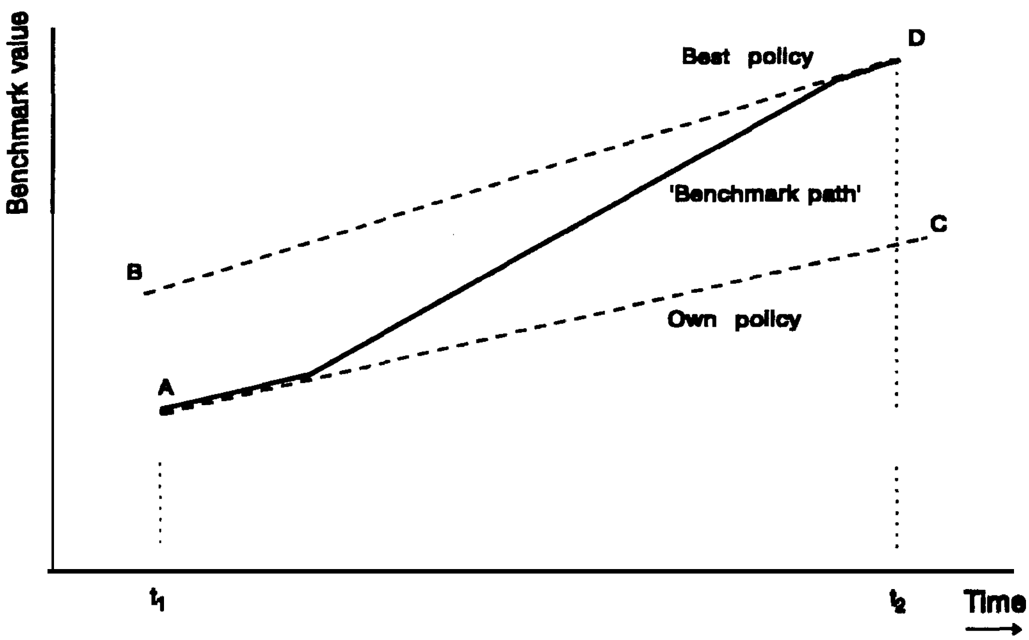

Figure 1 The benchmark path

It may be clear anyway that for carrying out a bench-marking study, there is quite some data necessary while there should also be a lot of insight in the underlying processes. This not only holds for data regarding the developments of the targets, but also regarding the underlying processes. in international studies especially the latter causes problems, because each country has his own specific reasons to implement a certain policy. This widens the scope of the analysis to a large extent, but makes at the other hand the study very complex. The end results however, may be presented in a user friendly way by means of the benchmark path discussed above.

For carrying out a benchmarking study many data are needed on all targets and other determinants of the transport sector. In addition, much information is necessary on underlying processes as well as on the specific definitions used in the data sets of the various countries and regions. As shown in the Rienstra and Nijkamp (1995) study, this requires much discussion and data search.

When the data are available, one may think of various ways of visualizing the outcomes. An example may be a presentation with the benchmark path for each of the targets. The type of data however, may also result in other ways of visualizing the outcomes of policy packages.

4 Spider Model

4.1 Introduction

The future is a complex field of research and there are many thinkable futures and scenarios. To analyse these futures it is necessary to develop a kind of model in which it is decided which factors are internal or external in a scenario or analysis (POSSUM, 1997). External factors can be considered as fixed in the analysis; an example may be demographic developments. Whether a factor is internal or external depends also on the time frame: in the long-run more factors may be internal than in the short-run. Internal factors are variable in a scenario analysis: they change according to the assumptions made during the construction of the scenarios. To keep an analysis manageable however, there should not be too many internal factors,

A way to analyse, assess and visualize internal factors in a scenario is the so-called Spider model. In this paper its usefulness for assessing scenarios is discussed. First, we will discuss shortly the methodology.

4.2 Description of the Method

The most important future developments may be studied by using a simple, qualitative multi-criteria analysis, which is visualized by means of a Spider model (see, for example, Figure 2). Multi-criteria analysis is a method to grasp, classify and analyse different scenarios by means of explicitly formulated criteria (which are put on the axes of the spider). The advantage of this analysis is that the individual assessment criteria do not have to be measured in a single quantitative unit; they may be qualitative in nature (e.g., rank order). The Spider model has up to now been used as a means to present the contents of scenarios in a user friendly way; it has been applied to various types of transport studies. Its aim is both to analyse, and to visualize scenarios for the future.

In the model, it is first necessary to identify the main four fields of building blocks within the scenario. These four fields are internal factors within the scenario analysis. In Figure 2 for example, the main fields identified are the spatial, institutional, economic and socio-psychological field. These four fields are presented in each of the quadrants. Next, the main developments, factors or policies within these fields have to be identified and put on these axes. In this way, the analysis is structured which makes it easy to compare various scenarios. This stage is very important, as the ordinal ranking of the outcomes of future scenarios on the axes of the spider allows one to make normative judgements - in a comparative sense - on the desirability of the various images. This makes the spider approach more practical than just a visualization method.

A policy initiative can now be represented and assessed by a combination of 8 points on the successive axes of the spider model. This is a meaningful visualisation of the main characteristics and driving forces of such a system as a confrontation of different 'spiders' (concerned with different driving forces) will immediately pinpoint the most important underlying factors. It should be recognized that the size of the area formed by linking the 8 points on all axes has no meaning, as

* the information on the axes has only a qualitative (and not a cardinal) meaning;
* the size of the resulting area is also dependent on the order in which the axes are positioned in the spider.

It should be noted that the extreme points on each axis have only a qualitative meaning; they do not represent numerical information, but only a rank order (in terms of more or less). This is also important for scenario design, as the axes present underlying

forces which are more or less likely, but not precise assessments of all consequences of such options.
The outer points of the spider present rather extreme developments. In Figure 3 for example, the outer points present a liberalized environment, while the inner points present a situation in which government intervention is assumed. It is possible - or even likely - that in practice the future developments will be less extreme. In that case a shrinkage of the axes may take place in order to describe such actual developments. Clearly, the second and fourth point represent developments which are closer to the extremes, whereas the central point (3) indicates an intermediate (neutral) development.

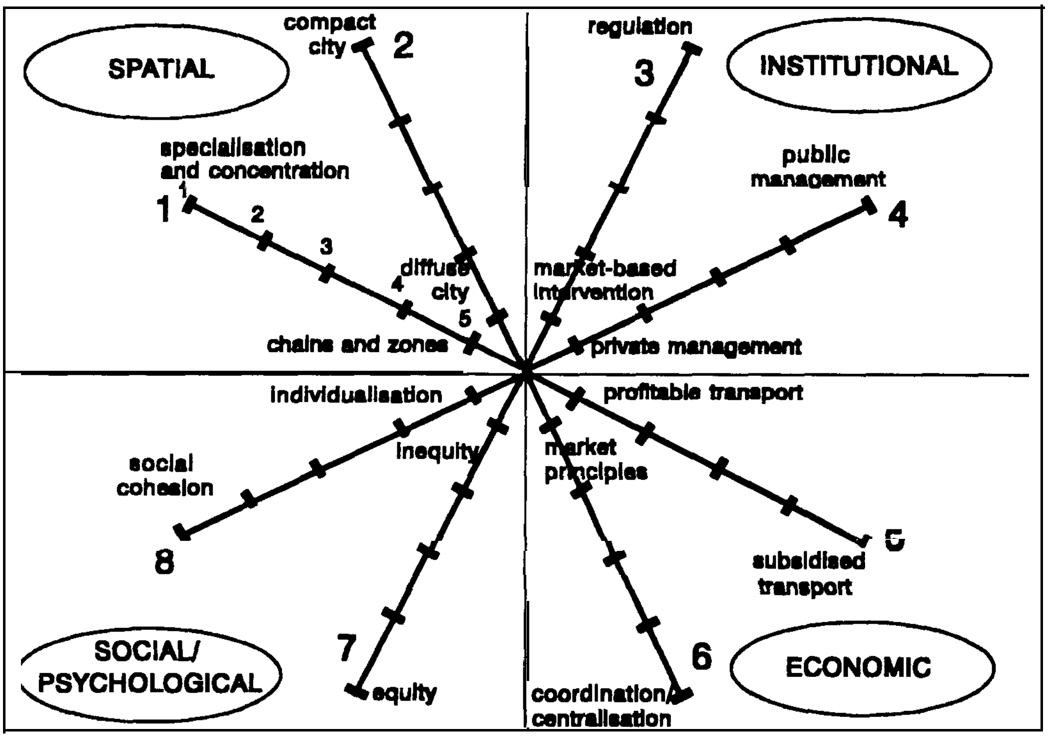

Figure 2 An example of a spider model for depicting the driving forces of future urban transport systems

Compound scenarios can now be composed, by taking a point on every axis and linking these points, In this way a great many of scenarios can in theory be designed. The reference scenarios are constructed in such a way that they form the inner and outer circle of the spider. They mainly serve as a frame of reference. For more details we refer to Nijkamp et *al.* (1998), and Rienstra *et al.* (1996).

For this model scores have to be given on the several axes. Up to now this has been done via expert opinions (questionnaire survey) and logical reasoning. In this way the data requirements are limited and can be based on qualitative scores, but e.g. some way of expert judgement is necessary. Nevertheless, the data requirements are limited and can be of any type.

Although this method has not yet been combined with other methods, but this can easily be done. As mentioned above, the spider can be seen as a rank-order visualization of a multi-criteria type of analysis. When an evaluation type of analysis is applied, the scores need to be interpreted normatively. In this respect, one should for example be able to say that the inner circle is more desirable than the outer circle. In the above mentioned studies, this is not possible so that the combination could not be made. However, in principle a combination with multi-criteria (e.g., regime) analysis is possible. The combination possibilities with other methods are smaller, although when there is a quantitative background (e.g., via a questionnaire) other types of analysis like rough set analysis may be applied. These possibilities depend largely on the approach with which the scenarios are constructed.

The method is a visualization method in itself, and provides an attractive presentation for policy makers.

5 Meta-Regression Analysis

5.1 Introduction

The meta-approach or meta-analysis was introduced by social study researchers in the early 1970s to overcome common problems such as the lack of large data sets in order to induce general results and the problem of uncertainty of information and of data values. Meta-analysis is a systematic framework which synthesizes and compares past studies and extends and reexamines the results of the available data to reach more general results than earlier attempts had been able to do.

The meta-analysis approach thus offers a series of techniques that permit a quantitative aggregation of results across studies. In so doing, it helps to more clearly provide defined valuations of the economic costs and benefits from the available data. It can also act as a supplement to more common literary-type approaches when reviewing the usefulness of parameters derived from prior studies and help direct new research to areas where there is greater need.

5.2 Description of the method

The introduction of meta-analysis as a formal procedure for analyzing problems has emerged from the necessity to summarize and induce general results from studies already developed on similar problems. Meta-analysis is therefore concerned with the synthesis of results and findings from scientific studies. Glass, who in 1976 coined the term meta-analysis, provides a simple definition of this approach: "*meta-analysis refers to the statistical analysis of a large collection of results from individual studies for the purpose of integrating the findings. It connotes a rigorous alternative to the casual, narrative discussions of research studies which typify our attempts to make sense of the rapidly expanding research literature*".

In our specific examination which is a review of assessment methods, we will concentrate on meta-regression analysis. Such a statistical technique has been widely applied in biometrics and sociometrics with very successful results. Since we use a statistical tool, the input data must be quantitative data. The primary methodology characteristics of a meta-regression analysis are the same as those used in regression analysis, i.e. we want to estimate one of the variables (the dependent variable) by means of another variable (the independent variable),

Let us consider a number of studies which have addressed our problem but in different contexts and with different data. For instance, say that we want to address the problem of transport congestion. We consider studies on transport congestion which have been conducted in various countries at different times and with a different sample. In general, the application of meta-analysis methodology is used when there are small case studies in which a general conclusion is difficult to obtain. Therefore, we combine different studies on the same topic in order to reach a universal conclusion. So in a figurative way, we can compare meta-analysis to a puzzle where each piece does not give the idea of the entire figure, but altogether, the pieces make a cohesive picture. In an assessment problem, meta-analysis is applied to reach a decision in the present based upon decisions made in the past. To do so, this approach tries to define the relationship between cause and effect in the problem. The genera1 form which our problem encompasses will be as follows:

$$Y = f(P, X, R, T, L) + Error$$

where:

Y is the variable we want to study which has been the results of the studies under scrutiny;

P is what we consider to be the cause of the outcome Y;

X represents the characteristics of the set of objects under examination affected by P in order to determine the outcome Y;

R represents the characteristics of the research methods used in each study, (e.g. econometric or survey), and the data (e.g. time series or cross-sectional);

T indicates the time covered by each study in order to examine dynamic effects;

L expresses the location where each study has been carried out.

In relation to the types of studies that we are developing, all of these variables will have a relative importance in our analysis. For instance, in the field of medical studies where the majority of the works are experiments in a closed system with the same methodology, attention is mainly focused on variables P and X.

The application of a meta-regression analysis can then define the results we want to achieve in our assessment analysis. However, standard precautions in the regression analysis need to be taken so as to obtain valuable results.

After having estimated the regression, we must evaluate various tests that can verify the correctness of our result. Such tests generally try to assess the effect sizes in the examined study and the accuracy of the results. For instance, we can test how the indicator, chosen to reveal the effects of the problem under scrutiny, depends upon the design of the examination, or how different estimates can be combined into one estimate of the effect size. The most frequently used tests are the following:

(1) estimation of individual effect sizes: is an examination of the correlation of the 'policy' applied and the observed effect;
(2) vote-counting: is a procedure which assesses whether a specific effect does or does not exist;
(3) combined significance: this test reaches a conclusion concerning the existence of the effect under scrutiny;
(4) combining effect sizes and the test of homoeeneitv: in this test, attention is given to the question of how different estimates can be combined into one estimate of the effect size;
(5) analysing effect sizes: in this test, the variations among the estimated effect sizes is calculated.

After having calculated these tests, not only will we have a response to the assessment problem upon which we are focusing, but we will also have a more comprehensive understanding of the characteristics and limitations of the adopted methodology.

In the case of meta-regression analysis the data that needs to be collected must be quantitative data, Given this condition, a general guideline for deciding whether or not a particular study should be considered in the meta-analytical formulation is based on commonality in research issues. Therefore, a meta-regression analysis rests upon the following rules: the study that may be included must focus on the same phenomenon; it must use the same outcome measure and the same population characteristics and finally, it must have a similar research objective. The problem of the selection of the studies is closely linked to the selection criteria that we will define in order to select the studies. With regard to this criteria for the selection, particular care must be taken to ensure similarity among the studies, Moreover, we need to verify uniformity and standardization in order to minimize possible errors in the calculation. To avoid this problem it may be necessary to conduct further experiments or simulations or carry out new elaborations and estimations of the data presented in the individual studies (Van den Bergh *et al.*, 1997)

Due to its specific summarizing feature, a meta-analysis approach may substitute for the most standard literature review. Therefore, it can assume a relevant role in an initial phase of a study because such a technique has the capacity to pin-point aspects of a problem not immediately evident from a cursory examination of data.

With this technique the visualizing output we obtain are tables and charts that depict the results and summarize the considered variables and studies which have been examined.

6 Regime Analysis

6.1 Introduction

In the literature we find a rich variety of multi-assessment methods, (sometimes under the name of multi-criteria methods or multiple objective evaluation methods). By setting aside the different labels, we can observe that these methods have one common element: the existence of multiple judgment or evaluation criteria. By considering such a clarification, we can make a general distinction among multi-assessment methods (see Figure 3)

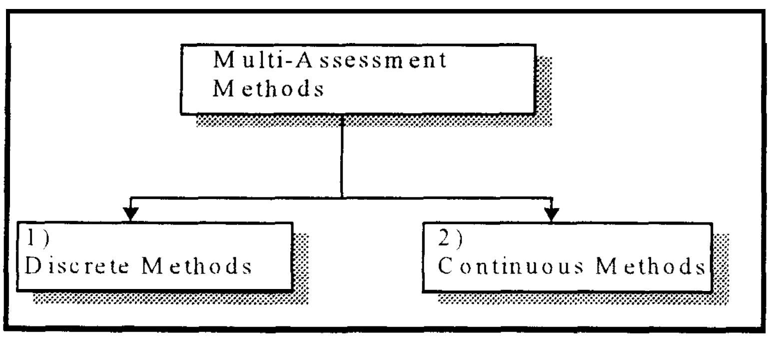

Figure 3 Classification of Multi-Assessment Methods

On the one hand, the discrete multiple assessment methods are structured to examine a finite number of feasible choices, The continuous multiple assessment methods consider, on the other hand, an infinite number of choices in the decision-making process. The multi-assessment method we now examine is the regime analysis. Regime analysis is a discrete multi-assessment method that is suitable due to its flexibility in assessing projects as well as policies, and due to its capacity to analyse quantitative as well as ordinal data.

6.2 Description of the method

The fundamental framework of multi-criteria methods is based upon two kinds of input data: an evaluation matrix and a set of political weights. The evaluation matrix is composed of elements which measure the effect of each considered alternative in relation to each considered criterion. The set of weights gives us information concerning the relative importance of the criteria we want to examine. Regime analysis is a discrete multiple criteria method, and in particular, it is a generalized case of concordance analysis. Regime analysis is a generalization of pair-wise comparison methods able to examine quantitative as well as qualitative data (see for details Hinloopen *et al.* 1983, and Nijkamp *et al.* 1990). In order to gain a better understanding of regime analysis, let us reiterate the basic components of the concordance analysis.

The concordance analysis is an evaluation method in which the basic idea is to rank a set of alternatives by means of their pair-wise comparisons in relation to the chosen criteria. For instance, we consider a problem where we have a set of alternatives and a set of criteria. We begin our examination by comparing alternative i with alternative j in relation to all criteria. After having done this, we select all the criteria for which alternative i performs better than, or equal to, alternative j. This class of criteria we will call a “concordance set”. Similarly, we define the class of criteria for which alternative i performs worse than, or equal to, alternative j. This set of criteria we will call a “discordance set”.

We now need to rank the alternatives. In order to do so, we introduce the concordance index. The concordance index indicates the weight of the chosen alternative in the concordance set. It is defined by the sum of the weights of the criteria according to which, for example, alternative i is more attractive than alternative j. Certainly. the higher the value of the concordance index, the more attractive is one alternative above another. As might be expected, we need to define a discordance index which indicates the maximum difference of scores for the alternatives When we search for the best alternative as a solution for a problem, we must regard the alternatives that have higher values for the concordance indices, and low values for the discordance indices.

The strength of regime analysis is that it is able to deal with binary, ordinal, categorical and cardinal (ratio and interval data), while it is also possible to use mixed data. This applies to both the effects and the weights in the policy analysis.

In regime analysis, like in the concordance analysis, we compare the alternatives in relation to all the criteria in order to define the concordance index. Let us consider, for example, the comparison between alternative i and k. The concordance index will be the sum of the weights which are related to the criteria for which i is better than k. Let us call this sum. c_{ik}. Then we calculate the concordance index for the same alternatives, but by considering the criteria for which k is better than i, i.e., c_{ki}.

After having calculated these two sums, we subtract these two values in order to obtain the index: $\mu_{ik}=c_{ik}-c_{ki}$.

Because we have ordinal information about the weights, our interest is focused on the sign of the index μ_{ik}. If the sign is positive, this will indicate that alternative i is more attractive than alternative k; if negative, it will imply vice versa. We will therefore be able to rank our alternatives. We must note that due to the ordinal nature of the information in the indicator μ no attention is given to the size of the difference between the alternatives; it is only the sign of the difference that is important.

We may also solve the complication that we may not be able to determine an unambiguous result, i.e. rank the alternatives. This is because we confront the problem of ambiguity with the sign of the index μ. In order to solve this problem we introduce a certain probability p_{ij} for the dominance of criteria i with respect to criteria j as follows:

$$p_{ij} = prob \quad (\mu_{ij} > 0)$$

and we define an aggregate probability measure which indicates the success score as follows:

$$p_i = \frac{1}{I - 1} \sum_{j \neq i} p_{ij}$$

where I is the number of chosen alternatives,

The problem here is to assess the value of p_{ij} and of p_i We will assume a specific probability distribution of the set of feasible weights. This assumption is based upon the criterion of Laplace in the case of decision-making under uncertainty. In the case of probability distribution of qualitative information, it is sufficient to mention that in principle, the use of stochastic analysis, which is consistent with an originally ordinal data set, may help overcome the methodological problem we can encounter by trying a numerical operation on qualitative data.

From the viewpoint of numerical analysis, the regime method then identifies the feasible area in which values of the feasible weights w_i must fall in order to be compatible with the condition imposed by their probability value. By means of a random generator, numerous values of weights can be calculated. This allow us at the end to calculate the probability score (or success score) p_i for each alternative i. We can then determine an unambiguous solution and rank the alternatives,

Regime analysis can examine both quantitative and cardinal data. In the case where we confront problems with qualitative data, we first need to transform the qualitative data into cardinal data and then apply the regime method. Due to this necessity, regime analysis is classified as an indirect method for qualitative data. This is an important positive feature. When we apply the cardinalization of qualitative data through indirect methods such as regime analysis, we do not lose information like in direct methods; this is due to the fact that in the direct methods only the ordinal content of the available quantitative information is used.

Regime analysis can be combined with other methods to enhance its results. To do so, we have to consider the combination of the regime method with all the methods that determine the cardinalization of the qualitative data for example, multi-dimensional scaling models (Keller and Wansbeek 1983). We can also consider the methods that determine the classification of the data that can then be examined by the regime analysis. Of such methods, the rough set method and the flag model are of the classification type.

The method is developed to be transparent in each of the different steps of the assessment process. We can visualize the impact matrix and the rank all the alternatives. In particular, the impact matrix can be adjusted during the assessment process by simplification of the impact classes through the use of the visualized impact matrix.

7 Flag Model

7.1 Introduction

The flag model is a methodology that has been developed to offer a broad framework for decision support for regional sustainable development. A major issue in sustainability policy is the question of how to determine a normative definition of sustainability. The flag mode1 has the objective to operationalize the concept of sustainability by defining a multi-criteria approach in which the indicators are represented through ranges of values by using the normative concept of critical threshold values.

7.2 Description of the method

In order to define a normative approach of the concept of sustainability one requires a framework of analysis and of expert judgment which should be able to test actual and future states of the economy and the ecology against a set of reference values, The Flag mode1 has been defined to assess the degree of sustainability of values of policy alternatives (Nijkamp 1998). The model develops an operational description and definition of the concept of sustainable development. There are three important components of the model:

1. identifying a set of measurable sustainability indicators;
2. establishing a set of normative reference values;
3. developing a practical methodology for assessing future development.

The input of the program is an impact matrix with a number n of variables; the matrix is formed by the values that the variables assume for each considered scenario. Such values are defined by non-partisan experts. The main purpose of the model is to analyze whether one or more scenarios can be classified as sustainable or not; such an evaluation is based upon the indicators. The methodology therefore requires the identification and definition of policy relevant indicators (OECD 1993), which are suitable for further empirical treatment in the assessment procedure.

The choice of indicators corresponds to the problem that we decide to address; in general. the indicators must expose the problem under scrutiny as well as consider the objectives that such a problem must tackle. One significant dilemma that we can encounter when defining the indicators is the likelihood that the number of indicators always tends to grow; and, to complicate matters, some indicators are encompassed within other indicators, In order to avoid the complication of a large number of indicators which would thus be difficult to examine and which are often minor and unnecessary, a helpful methodology is to use a hierarchical approach based on a tree-like structure. Such an approach corresponds to the idea of aggregation and disaggregation of the indicators that we deem fundamental to our examination. For instance, we can make distinctions among macro, meso and micro indicators, or distinguish by means of relevant time or geographical scales. Such indicators in the program have two formal attributes: class and type. There are three classes of indicators which correspond to the main dimensions of the sustainability analysis: (1) biophysical, (2) social, and (3) economic. The second attribute, type, relates to the point that some indicators such as water quality, have high scores showing a sustainable situation; while for others such as the pollution indicator, we have low scores that are sustainable as well. This difference is captured in the attribute type of the indicator; the first types are defined as *good* ***indicators,*** the second types are ***bad indicators.***

For each sustainable indicator we have to define the critical threshold values (see Figure 4). These values represent the reference system for judging actual states or future outcomes of scenario experiments. Since in certain areas and under certain circumstances experts and decision-makers will have conflicting views on the precise level of the acceptable threshold values, we estimate a band of values of the thresholds ranging from a maximum value (CTV,,,) to a minimum value (CTV_{min}). This can be represented as follows:

CTV_{min} CTV **CTV_{max}**

0 **A** **B** **c** **D**

Section A	**Green** Flag	no reason for specific concern
Section B	**Orange** Flag	be very alert
Section C	Red **Flag**	reverse trends
Section D	**Black Flag**	stop further growth

Figure 4 Thresholds values

The third component of the model, the impact assessment, provides a number of instruments for the analysis of the sustainability issue. This analysis can be carried out in two ways. The first is an inspection of a single strategy. The second is the comparison of two scenarios. In the former procedure we decide whether the scenario is sustainable or not. In the latter case by comparing the scenarios, we decide which scenario scores best wherever this question is centered around the sustainability issue. This option may be interpreted as a basic form of multi-criteria analysis.

The input of the program consists of the definition of an impact matrix. Thus, each indicator is given its values for each of the considered scenarios. Additionally, for each indicator we have to identify the class, the type and the range of its threshold values. The model considers only quantitative data.

The flag model can operate both as a classification procedure and as a visualizing method. In the former case, for example, in combination with the regime analysis, the flag model can determine the acceptable alternatives according to the examined policy that then will be ranked by the regime method. In the latter case, we can utilize the flag model in order to better visualize the results obtained for example, from the regime method or the rough set procedure.

One of the major aspects of the flag model is its representation module. There are three approaches to the representation: a qualitative, a quantitative and a hybrid approach. The idea of having three possible levels of result representation is based upon the necessity for the program to be flexible to the requirements of its users. Rather than to be used as substitutions, the three modes of analysis are complementary to each other. The qualitative approach only takes into account the colours of the flags. This entails flag counts and cross tabulation. This approach merely displays in various representative ways the results obtained by the evaluation. The quantitative approach defines the values of the indicators that may be acceptable or not. To achieve such results, we need to standardize the indicators which, because they refer to different aspects, are then expressed by different scales of measure. Finally, the hybrid form regards the existence of both qualitative and quantitative aspects. For example, let us suppose that for a cost indicator CTV = 100, CTV_{max} = 120, and for the three scenarios the indicator values are 114, 119 and 121, respectively. The hybrid form then shows that the first two indicators lead to red flags, while the third indicator is black-flagged (qualitative results). It will also reveal that the outcomes for the second and third indicators are extremely close, while the score for the first is the best (quantitative results).

8 Rough Set Analysis

8.1 Introduction

Rough set analysis has been developed within the areas of artificial intelligence; its main emphases are how to define knowledge and the learning process through induction or deduction mechanisms, and how to differentiate between imprecision and vagueness. In rough set analysis we examine how to draw out conclusions, e.g. decisions from imprecise data and how to determine correlation and relationship among data. We can summarize by saying that the aim of the rough set analysis is to recognize possible cause-effect relationships between the available data and to underline the importance and the strategic role of some data and the irrelevance of other data (Pawlak 1986, 1991, Wong *et al.* 1986). The approach focuses on regularities in the data in order to draw aspects and relationships from them which are less evident, but which can be useful in analyses and policy-making.

For this reason rough set analysis overlaps other mathematical ideas developed to deal with imprecision and vagueness, such as fuzzy logic theory, the theory of evidence, and the discriminant analysis. Other comparative analyses have discussed the links among these different mathematical concepts and pointed out the intrinsic relationships of these methods with rough set analysis.

It appears evident how rough set analysis optimally has been applied as an assessment policy method, where imprecise information are classified and reduced to determine a coherent policy choice.

8.2 Description of the method

Often the choice among different alternatives of a problem can become very puzzling because of a vague and inaccurate description of the reality we need to examine. The aim of rough set analysis is to reduce the cumbersome character of fuzzy input when we analyse decision situations. More precisely, this approach is designed to discover possible cause-effect relationships between the data available, to underline the importance and the strategic role of some data, and to differentiate between irrelevant and relevant data. The intrinsic attribute of rough set analysis is its ability to manage quantitative as well as qualitative data.

Let us consider a finite universe of objects which we would like to examine and classify. For each object we can define a number n of attributes in order to create a significant basis for the required characterization of the object. If the attribute is quantitative, it will be easy to define its domain. If the attribute is qualitative, we divide its domain into sub-intervals so as to obtain an accurate description of the object. We have classified our objects with the attributes, and thus, for each object we associate a vector of attributes. The table containing all this organized information will be called the *information table*. From the table of information, we can immediately observe which objects share the same types of attributes. Two objects that are not the same object have an indiscernibility relation when they have the same descriptive attributes. Such a binary relation is reflexive, symmetric and transitive.

We can now introduce a fundamental concept in the rough set analysis procedure. Let us imagine that Q is the set of attributes that describe the set of objects U. Let P represent a sub-set of the set of attributes Q, and X represent a sub-set of the set of objects U. We define as a sub-set of X those objects which all have the attributes belonging to set P. Such a set is the P-lower approximation of X set, and it is denoted as P_LX. We then define as P-upper approximation of X, denoted as P_UX, the sub-set of U having as its elements all objects belonging to the P set of attributes and which has at least one element in common with set X.

The definition of the upper and lower approximation sets assumes an important role in the rough set methodology. Through these sets we can classify and examine the load of uncertain information which we have collected. Consequently, this approach could lead to an imprecise representation of reality by reducing the information specific sets. Such an objection to this methodology might be better understood when we remember that the capacity to manipulate uncertain information and the consequent capability of reaching conclusions is one of the most essential assets of the human mind in obtaining knowledge. Therefore, the representation of reality by means of rough set analysis is indeed a reduction of the perceived real phenomena, but it is done in such a way as to enable us to classify, distinguish, and express judgments about it.

Until now, we have focused our attention on the classification of uncertain data. Let us now examine the case where we want to express a choice among different alternatives; this is most assured when we confront an assessment problem. We have previously described the *information table,* and in this table in the instance of an assessment problem, we can distinguish two classes from the set of attributes: a class of condition attributes and a class of decision attributes.

The class of condition attributes are those which describe the object following the procedure that we have depicted above. The class of decision attributes is defined by all the attributes which the object must have in order to be selected as an acceptable alternative. For instance, a set of objects can be described by values of condition attributes, while classifications of experts are represented by values of decision attributes.

At this point, we must define a decision rule as an implication relation between the description of a condition class and the description of a decision class. The decision rule can be exact or deterministic when the class of decision is contained in the set of conditions, i.e. all the decision attributes belong to the class of the condition attributes. We have an approximate rule when more than one value of the decision attributes corresponds to the same combination of values of the condition attributes. Therefore, an exact rule offers a sufficient condition for belonging to a decision class; an approximate rule admits the possibility of this.

The decision rules and the table of information are the basic elements needed to solve multi-attribute choice and ranking problems. The binary preference relations between the decision rules and the description of the objects by means of the condition attributes determine a set of potentially acceptable actions. In order to rank such alternatives, we need to conduct a final binary comparison among the potential actions. This procedure will define the most acceptable action or alternative.

One of the most important features of this approach is the capacity to examine quantitative as well as qualitative data. Such data can define vague information and uncertain knowledge that will then be manipulated by the model in the approximation of the data set.

The model in its version for Windows '95 is potentially able to visualize the obtained results in a user friendly environment.

9 Comparison of the Methods

We have described through seven points of view the chosen assessment methods which have in common a multiple objective assessment approach. This feature however does not classify these multi-assessment methods as opposite to the cost and benefit analysis (CBA). In general, the methods we have reviewed can function in a complementary way with CBA and therefore define additional information to the decision process. Before comparing the six methods let us summarize some of their properties and limits.

The benchmarking approach compares various alternatives in order to reach those with the best performance. Such a method, although having wide applications in the management field, does not have a methodological framework able to develop an assessment procedure for policies. The spider model is a simplified version of a multi-criteria analysis able to examine quantitative and qualitative data. Meta-regression analysis may be used to summarize and classify large data sets of numerous case studies that singularly cannot depict general results. Regime analysis is a powerful tool among the assessment methods, since it is able to analyse ordinal as well as cardinal data, and therefore within a multi-objective framework, it can manage a large variety of assessment problems. In the flag model we have shown the possibility of expressing 'fuzzy' and overlapping ranges of values for the decision processes, as well as the capacity to represent the results with various devices, thus giving a friendly structure to the program. Rough set analysis, finally, has the unique quality of being able to synthesize, classify and order the information available for the decision-makers.

The six methods can tackle a wide range of assessment problems, but important questions remain. When is one method preferable to another? How can we combine different methods to reach a better result? What kind of results can we achieve? An important consideration is the type of data that each method can analyze (see Table 1). In urban policy decisions the type of data are often qualitative or mixed, i.e. qualitative as well as quantitative; from this perspective benchmarking and meta-regression analysis are the only methods unable to examine qualitative or mixed data. These two methods also have in common the methodology to reach an assessment conclusion through past experience. This can be seen as an advantage when we have a small data base or when we want to summarize various studies on a similar topic in a general conclusion. However, as we have pointed out earlier, these two methods may not be able to determine new information and thus different decisions from the past ones. This implies that the spider model, regime analysis, flag model and rough set analysis have the capacity to define the decision rules. By decision rules we mean the possibility for the decision-maker to identify the type of rules the decision process must examine to reach the choice. An example is given by the definition of the weights in the regime analysis or the threshold values in the flag model. The capacity to determine the decision rules is fundamental when we examine our methods according to the "transparency" criteria stated in section 2. Certainly, the methods which can define and modify the decision rules have such a transparency feature since the decision-maker can intervene in the assessment process, i.e. in the choice. Due to this fact, these previous methods can also satisfy the condition of accountability since the decision-maker, through the determination of the decision rules, will agree and readily support the decision that it has made. The simplicity of the methods is related to the capacity to clarify the assessment process and then allow a friendly use of the method. This last aspect remains under-examined in the definition of the software package of the methods and therefore only benchmarking, the spider model and the flag model can been considered user friendly systems. If we examine the type of results we can obtain, we observe that only regime analysis and rough set analysis are able to conduct a full assessment process of urban policies. The other methods find their best application in combination with other methods, e.g. CBA,

Methods	Mixed Data	Quantitative Data	Definition of Decision Rules	Transparency	Account-ability	User Friendly System
Bench-marking		✓				✓
Spider Model	✓	✓	✓	✓	✓	✓
Meta-regression Analysis		✓				
Regime Analysis	✓	✓	✓	✓	✓	
Flag Model	✓	✓	✓	✓	✓	✓
Rough Set Analysis	✓	✓	✓	✓	✓	

Table 1 Comparative examination of assessment methodologies

With these simple elements in mind, it is evident that each assessment tool is chosen in relation to the specific necessity of decision-makers and of the data available to them, Nevertheless, due to the flexibility and compatibility of these six assessment methods, we can interpret them in a compound way where one model may counterbalance the limits of another one. Thus, by considering these six approaches as complementary rather than supplementary, we may achieve more satisfactory results in the assessment process. An example can been shown by the combined use of regime analysis, the flag model and rough set analysis. With the flag model we can identify the acceptable list of alternatives which satisfies the threshold values, then through the regime analysis we can operate the assessment process of the chosen alternatives. In parallel we may run the rough set analysis with the complete set of alternatives, i.e. before the selection made by the flag model, in order to compare the consistency of the results.

10 Conclusion

In our daily lives we are often confronted with the problem of how to assess choice options and thus to take decisions in the presence of alternatives. Such decisions, however, are often not entirely well-defined and rational. In particular, assessing policy alternatives is a highly complex process, since it includes and compares economic, environmental, social, political, and technological aspects. It is principally a communicative process where transparency, simplicity and accountability for the decision-makers are of utmost importance to the success of the decision process.

Assessment methods try to cope with the problems of decision situations by trying to define a logical structure based upon rationality and objectivity. Since reality can be defined as a complex system, there are different methods which address the problem of classifying and then making decisions. These methods build upon the principles of cost-benefit analysis, but are also complements and generalizations. Keeping in mind this observation, this paper reviews six assessment methods: benchmarking, spider model, the meta-regression analysis, regime analysis, the flag model and rough set analysis. These six methods have been chosen, since they give a representative overview on the question of how to approach a multi-objective assessment problem. In a decision situation we encounter various obstacles such as the characterization of alternatives, or the definition of the relative weights among the relevant decision attributes. In this context, these six methods can operate separately according to the problem encountered, but they can also operate in a sequential way. By this we mean that certain problems can sometimes be better tackled by a given specific method, while next the assessment problem can be carried out with another approach. Therefore, these six approaches may be thought of as complementary.

Clearly, these methods may be applicable to a wide range of urban planning problems. The flexible scope of these methods renders them also appropriate for sustainability issues in the context of the management of urban cultural heritage.

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