Cost-benefit analysis in interactive planning processes; an interactive instrument in an integrated approach

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Abstract

Increasing pressure on space demands careful assessment between competing functions in a planning process. Especially, in metropolitan landscapes, space is in short supply and hence expensive. Housing, industrial sites and office parks, and infrastructure are strong drivers of landscape change, often dominating nature and landscape which represent values with a more collective good character. Nevertheless, in The Netherlands, nature is becoming an important force in spatial planning.

This assessment between competing functions, requires interactive planning and appropriate instruments. In the usual planning process, the costs and benefits of the development plans to society are only computed in the final stage of the process. We argue in this paper for integration of a social cost-benefit analysis (SCBA) in interactive regional planning processes. Firstly, it avoids time and money being spent on elaborating a plan, which is not beneficial to society. Secondly, it helps to prevent unwarranted enthusiasm for inauspicious plans among participants.

From earlier studies, we learned that in the application of SCBA the discussion between researchers, clients and other participants should focus on two or three clearly distinctive models. Too much detail should be avoided. On the other hand, key indicators used in calculating effects have to be available and well documented. The summation of the costs and benefits provides a first impression of the financial and social feasibility of the plan. In a first planning session, therefore, a common understanding of the mechanisms underlying the assessment of the plan will be built up. This improves the support for SCBA of the final project. It also provides the stakeholders and shareholders with information about the feasibility of the plan at an early stage. Another advantage is that SCBA focuses on the benefits to society as a whole.

Recently, we have spent much effort in the development of an interactive tool that is both relevant and user friendly. Relevant means that it takes into account the essential values of different types of land use and their interaction. At the moment we focus on spatial interaction and incorporating ecological network values. A prototype of the interactive integrated model is available for demonstration.

1 Introduction: the whys and wherefores of this paper

an integrated approach

Pressure on space is increasing incessantly. Especially in areas such as metropolitan deltas, which are both physically vulnerable and attractive for development, the demand for space exceeds supply. The need for multiple use of space is therefore growing. This requires interactive planning.

Much has been written about how to hold landscape dialogues with stakeholders in the region concerned. However, mostly the costs and benefits of the development plans to society are only computed in the final stage of the planning process. We argue in this paper for integration of a cost-benefit analysis (SCBA) in interactive (regional) planning processes.

SCBA should be an essential part of the planning process. Firstly, it avoids time and money being spent on elaborating a plan, which is not beneficial to society. Secondly, it helps to prevent unwarranted enthusiasm for inauspicious plans among participants in the landscape dialogues. This will frustrate public support for the rest of the process and for similar processes in future. We already have some experience in integrating SCBA in regional-planning processes. These now are the ingredients in the processes we propose in this paper; combining SCBA and interactive planning.

structure of the paper

The next section of this paper discusses the growing demand for space and the need for interactive planning. The third section considers the whys and wherefores of methods to assess the feasibility of plans. Available instruments and models are discussed in terms of their usefulness to regional development. Next, we report on the first steps of applying SCBA in regional planning processes. This is based on the experiences of LEI in some regional projects. Case studies illustrate the proposed integration between interactive planning and SCBA. In section 5 we describe the work in progress on combining SCBA and interactive planning. Finally, conclusions are put forward.

2 Background

the growing demand for space

Let us illustrate the growing demand for space in view of the situation in the Netherlands. In a sense the Netherlands form a single metropolitan delta. It is also one of the most densely populated countries in the world. The first half of the 20th century was characterised by a rapid population growth. In 1900 the country counted about five million inhabitants. Only 50 years later this number was doubled. Now more than 16 million people live on the 34.000 square kilometres

land of the Netherlands; this means some 480 per square kilometre, far more than the 150 of a hundred years ago. This increase becomes even more impressive if one realises that the land area itself has grown by 6% since 1900, due to land reclamation.

multiple use of space as a solution

All these people want to live, work and recreate. At the same time, people demand more space for themselves (a big home with a garden) than in the past. Moreover, it is not only the growing quantitative demand for space that needs attention. More and more, the qualitative aspects of space become important. For example, people attach a growing value to a living environment that is diverse and ecologically sustainable.

This changing demand is closely connected to the increased prosperity in the past decades, which has also led to more time for leisure activities. In this light there is also a growing demand for space for outdoor and nature-related activities, which affects the value of the functions of space and therewith land-use patterns.

It is clear that due to this growing and increasingly diverse demand for space, the allocation of space becomes more complex.

interactive instead of a hierarchical planning

The growing demand for space requires a more interactive and regional type of planning than traditional spatial planning with its strongly top-down approach. This doesn't imply, however, that the *process* needs no leading actor. One actor (preferably at regional level) should be responsible for the process. This role has to be accepted by the other actors, who focus on the content of the planning process.

Earlier we mentioned the need for a more interactive and regional type of planning. A top-down planning method, which dominated spatial planning in the Netherlands especially in the decades after World War II, is no longer satisfactory. The advice of the Netherlands Scientific Council for Government Policy (WRR, 1998) about 'strengthening integral planning and the forming of social coalitions on a regional scale' is included as an assumption in the Dutch National Spatial Strategy (Nota Ruimte, VROM, 2006), where it reads "this complies with the growing demand for regional tailor-made solutions and a more interactive development oriented planning process [supported] by all stakeholders in a region" (VROM, 2006, p36).

3 Research on the feasibility of plans

insight in consequences of spatial decisions

Space can be used in many ways. We distinguish production space on behalf of economic development, living space and the strategic stock of nature and landscape (Reinhard et al, 2003). These three elements are related to each other. Development in one element (for example industrial production) has inevitably consequences for

the other elements (for example landscape). In policymaking the various forms of spatial utilization must be considered carefully. Therefore, it is necessary to gain insight into social and other consequences of certain decisions. In other words: the costs and benefits of the decisions must be clarified ex ante, through a process known as appraisal. The following section discusses several methods and models to support this process. Next, the experience of LEI in applying social cost-benefit analysis in regional planning processes is described. This will take place by means of two case studies. The methods and experiences presented are the beginning of a first attempt at integration between interactive planning and cost-benefit analysis. This attempt is described in the last section of this third part of the paper. Which combination of methods seems the best? In the next and last part of this paper the exercise will be further developed.

appraisal theory

This section briefly describes three methods of integral appraisal. We pay attention to the method of multi-criteria analysis, social cost-benefit analysis and finally, cost-effectiveness analysis. Social cost-benefit analysis values effects in monetary units, whereas the other two do not.

Other appraisal methods are also frequently used. Most of them focus just on certain aspects. For example in the Netherlands an environmental impact assessment (EIA) is a requirement for projects that affect the environment. In the EIA the proposed project has to be compared to the alternative that least affects the environment.

Multi-criteria analysis (MCA) is a general method to approach problems of choice. The aim of MCA is to investigate a number of alternative choices in the light of multiple criteria and conflicting objectives. A ranking of the alternatives can be made on the basis of their suitability. MCA starts from different, explicit criteria of judgment. It is also possible to give one criterion more importance than another.

There are three different approaches in MCA: cardinal methods (use of quantitative criteria scores), qualitative methods (use of qualitative scores) and mixed data methods (use of quantitative and qualitative scores). The basis of these methods is the same. The following steps can be distinguished: 1) determine the set of alternatives; 2) formulate the criteria on which the alternatives are judged; 3) determine the scores of the alternatives on the criteria (these are called the criteria scores); 4) standardize the criteria scores (value between zero and one); 5) determine the importance of the criteria (assign weights); 6) link the criteria scores to the weights; 7) from a large amount of scores, formulate an overall mark.

As with all models, MCA has some disadvantages: there is a risk that certain aspects are expressed by multiple criteria, while other aspects are not specified, thus introducing hidden weights. Moreover, the importance of the criteria can vary from one person to another and it can change in time.

Social cost-benefit analysis is based on welfare economics (in contrast to MCA). It estimates the project's contribution to welfare. In any SCBA, several stages must

be considered. The social benefits of a project consist of the extra benefits the project yields with regard to the original situation. 'Benefit' is a concept from economic theory and can be described as 'that which individuals experience during the use of goods and services and what they try to maximize' (Eijgenraam *et al.*, 2000). The essential steps are: defining the project, identifying impacts which are economically relevant, quantifying physical impacts, calculating a monetary valuation, discounting, weighting and sensitivity analysis. Focusing on society as a whole makes is possible to select a project on the basis of his contribution to social goals.
A second difference with MCA is that it is expressed in terms of money. This enables weighing of the different effects. These two points are the most important arguments for choosing to integrate SCBA (and not another integral method like MCA) in planning processes on a regional scale. MCA has the advantage that policy makers can more easily understand it, because this method can be explained quickly. A SCBA is more expensive than a MCA. The distribution of the costs and benefits over the population is not incorporated in a SCBA, while income distribution might be a policy objective. For a comparison of MCA and SCBA the reader is referred to Reinhard et al. (2003). For infrastructure projects the so-called OEI (Overview of Effects of Infrastructure Projects) guidelines have been developed. Since April 2000 the Netherlands government declared these guidelines compulsory for projects with a spatial dimension of national importance.

In *cost effectiveness analysis* (CEA) different projects (measures) are compared that generate the same outcome. Because the result of the projects that are being compared is identical the project with least costs for society is preferred. These social costs are computed according the social cost benefit analysis. The main difference with SCBA is the fact that benefits related to the objective of the plan are not expressed in monetary values.

In the first part of the paper we mentioned the growing demand for nature and recreation facilities as a result of increased prosperity. The benefits of land use such as recreation and nature for example, must be incorporated in the social cost-benefit analysis. The services provided by recreation facilities, landscape and nature are not traded in a market: they are external effects and therefore the valuation of these land uses is more complicated. In case of multiple use of space the costs can be computed easily but the benefits are mostly not a simple summation of the benefits of the underlying functions. In the SCBA these problems have to be solved. In the case of nature development, for example, it deals with an increase of enjoyment in living and recreation and income from the timber sale. Some goods can be traded in the market, and can therefore easily be assigned a price. However, if that is not the case (like nature and clean air), the benefits must be estimated by means of valuation methods. Often external effects are treated as p.m. (pro memory) in the costs benefit balance.

4. Integrating SCBA and interactive planning

We also have experience with processes where SCBA is integrated in the planning process in one way or another. We focus on two case studies to illustrate possible ways of applying SCBA in interactive planning processes.

The case of *reopening the Apeldoorn Canal* illustrates the interactive use of SCBA in designing alternative development models. The Apeldoorn Canal is an early 19th century waterway in the centre of the Netherlands that once opened up the eastern rim of the Veluwe region for economic development. Due to several reasons, the connection fell into disuse and finally in 1972 the canal was closed completely for navigation.

In recent years however, local authorities, leisure investors, nature conservators, water companies and protectors of industrial heritage became aware of the high potential value of the Apeldoorn Canal, albeit from different perspectives. Many studies, surveys, models and development plans were published. The central issue was reopening the canal for navigation, in particular for recreation vessels.

It was evident that interests diverged and a simple solution was not easy to be found. Only a balanced combination of functions attributed to the canal and its immediate surroundings could possibly lead to a sustainable solution with increased social welfare. In this case SCBA was applied in an interactive process to facilitate the discussion about an optimal mix of functions.

The process consisted of seven steps. In the first step the researchers defined two preliminary alternative models, based on elements mentioned in the available studies of the Apeldoorn canal. In the second step, the most dominant effects of both models were identified and those effects that could be assessed in monetary terms were calculated. In other words: in this stage a first and quick SCBA based on rough data was done. These results were given feedback to the advisory group of the study. The discussions in the advisory group then gave rise to amendments on both models.

In the third step, we reformulated the two models by changing the amount of several elements or by adding or deleting certain elements completely. With this input, we recalculated the effects in order to have a more realistic SCBA than in the second step.

The fourth step of the interactive process consisted of a creative session in the form of a workshop with a group of about 20 specialists in the functions concerned, like recreation businessmen, forest managers, water-board managers, consultants for tourism, Chamber of Commerce, etc. The participants were invited as private persons, not as representatives of an organisation. The objective of this workshop was to see if new elements could be added to increase the social cost-benefit balance of the respective models. Besides, we expected to find out whether elements from both models could be combined in order to construct a new, third model. Among other things, the output of the second SCBA was used as input. The

result of the session was that a surprisingly large common basis of both extreme models could be defined.
Following the workshop, we again performed an SCBA starting from the once again reformulated models. Although this was intended to be the fifth and last step of the project, the interactive process did not stop. Even the draft report of the study containing the results of this SCBA stimulated the parties involved to reconsider the functions and in particular the volume of some of the elements.
One lesson from this study is the need for frequent feedback between researchers, clients and other participants. Another conclusion is that the position of SCBA as a facilitator of the process must be clear beforehand to all parties involved. None of the regional authorities was the direct commissioner for the project, which was presented and carried out as a methodological (but not theoretical!) study. This fact greatly enhanced the involvement of the participants in the workshop.

The case of the *inundation of the Horstermeer Polder* is an illustration of the use of SCBA identifying an optimal development model and facilitating the process of finding new alternatives of spatial design. The Horstermeer is a polder in the vicinity of Amsterdam. Due to its low position in comparison to the neighbouring hills, groundwater flows into the polder. This water has to be pumped away permanently in order to have the place habitable and to make it possible to practise agricultural activity. Almost 50% of the area is used for keeping dairy cattle.

The regional authority, the Province of North-Holland, wishes to enlarge the nature area in its territory. This could be done by inundating about 40% of the Horstermeer polder and converting it into wetlands, at the same time relieving the water problem. Inundation of such a large area was considered a major intervention in the natural environment, for which an environmental impact assessment (EIA) had to be performed.
The scope of EIA is primarily environmental and not aimed at optimising the social cost-benefit balance. It was therefore decided that in addition to the EIA, an SCBA would be performed. Originally, the various alternatives distinguished in the EIA were taken as input for the SCBA. Seven alternatives were taken into account, along with the so-called autonomous development scenario. For each alternative, an SCBA was carried out. The results of this process were reported to the client of the study. Until this moment, there was no interactive process. But since the project has not finished yet, this may yet come about. One main conclusion so far is, that SCBA itself is a useful method to find the optimal model, but the differences between the models are too small for SCBA to have an added value as compared to simple financial cost-benefit analysis.
At the same time, however, the inhabitants of the Horstermeer realised, that partial inundation of their polder might be a sub-optimal solution. Supported by the government-sponsored Habiforum Knowledge Network for Multiple land use, the inhabitants of Horstermeer developed two far-reaching models. In these models, known as the “mirror project”, the polder was completely redesigned. In sessions

with the inhabitants and the client for the EIA study, the researchers identified the essential elements of these models, both in quality and quantity. Local representatives could provide some key indicators. With this input, an SCBA for the mirror project models was performed, in which a clear contrast between the models appeared.
The lesson learned from this application of SCBA is that the discussion between researchers, clients and other participants should focus on two or three clearly distinctive models. Too much detail should be avoided. On the other hand, key indicators used in calculating effects have to be available and well documented.

From both cases, it becomes clear, that information about the social effects of spatial development plans should come from two sources. On the one hand, the regional stakeholders, who have their visions and opinions about the development as a whole as well as detailed information about one or two specific functions. On the other hand, there are the researchers who must have at their disposal methods to manage the process and general data and key indicators. With respect to this latter fact, both parties are aware of the concept of multiple land use, but adequate data are scarce. For example, in the Apeldoorn Canal case the aspect of combining drinking water and navigable water are examples of the second and fourth dimension of multiple land use as distinguished by Habiforum (Van Vliet, 2000). In the case study very different data sources had to be combined and a balancing could only be made indirectly.
In general, this poses the problem of reliable data for combinations of functions, be it in space, time or otherwise. Almost all monitoring systems are still concerned with unique, non-interacting functions, *e.g.* added value for agricultural activities or even valuation of nature areas. The fact, that one plus one might be larger than two yet cannot be derived from basic data.

5. Interactive SCBA

For the ideal integration of interactive planning and SCBA the stages of both processes must be intertwined. Interactive planning focuses on the participants, their problems and communication. These elements do not exist in SCBA; because it computes welfare for society as a whole (all stakeholders), it assumes that the problem is identified (and shared) and that the project with the largest contribution to welfare is preferred. Public support and distribution of the benefits over the community are not part of SCBA, but are prerequisites for an interactive planning process. In the remainder we focus on the SCBA steps in this integration. We distinguish four steps in our interactive SCBA approach.

A. Getting acquainted with SCBA

To create support for the use of SCBA in the planning process, in the first interactive session an introduction into the method of SCBA is presented. In this introduction we spend little time on the formal facts of SCBA. Our experience is

that these facts do not reach the participants entirely. Instead we invite them to play our interactive SCBA game. In this game the participants create in small teams their own plan for the Horstermeer polder (this polder is described in a previous section). The group that creates the largest balance of costs and benefits with their plan wins the game. We developed for this purpose a Sketch GIS application (Van Deursen) in which the costs and benefits of every type of land use is attached (in euro per hectare) to a GIS-application that computes the relevant areas.. The Sketch GIS application is extremely user friendly, hence the participants very quickly draw their own plan on the laptop computers. They discuss in their team how to add value to their plan, by arranging the available land uses (agriculture, houses, nature, recreation and water). After a quarter of an hour the facilitator invites all participants to have a look at the plan of the first team and lets the team explain their reasoning behind the plan. The facilitator reflects on their ideas about costs and benefits in SCBA and explains their score (SCBA balance). All teams (plans) are discusses consecutively.

Our experience is that the participants learn a lot more playing this game than just listening to a formal presentation of SCBA. They all want to look inside the "black box of SCBA" to learn why their plan did not win. To prevent that the team that plans the largest area of the most profitable land use (houses) wins the game, a few ad hoc rules (loosely based on SCBA) are added to the SCBA computation.

B. Using interactive SCBA to create the first plan.

The goal of this phase in the planning process is to start a discussion among the stakeholders about the direction in which to look for a solution of the problems encountered in the region. For this purpose an interactive GIS-SCBA-model is developed of their planning area. The participants are invited to draw their plans or ideas about possible plans on the specially designed GIS map. The SCBA model that runs behind the map is developed based on the situation in the actual planning region. The actual values of he costs and benefits of the distinguished land uses are incorporated.

This version of the model also includes interactions among the relevant functions. The actual location of a land use determines the value of costs and benefits. Houses located on a lakeshore are more valuable than houses without any water in the vicinity, because people find these houses more attractive. This is reflected by a higher house price for houses adjacent to water. The interactive SCBA-model contains different costs and benefits for three types of houses: houses close to water, houses neighbouring natural sites (green areas) and other houses. The GIS-model computes automatically the acreage of these types of houses based on computing buffer strips around the water surface and nature area and presents the SCBA balance.

The summation of these costs and benefits provides a first impression of the financial and social feasibility of the plan. This information on the costs and

benefits of a project is important if the budget for solving the problem is limited or when the project with the surplus benefits is selected. To calculate this first project balance a database of average costs and benefits of all relevant land uses must be available, for instance based on previous studies.

Our objective is to add as much scientific information in the interactive SCBA as possible. Then the participants can use this state of the art information without even knowing this specific data. Now we are implementing ecological networks into the interactive SCBA model. A substantial literature exists on both environmental-economic and ecological-economic modelling that takes account of spatial processes. Many studies showed the economic significance of nature. Humans are part of nature, and must utilise the goods and services it provides in order to survive. Ecosystem goods (such as seafood, forage, timber, and many pharmaceutical and industrial products) and ecosystem services (which are the conditions and processes of natural ecosystems that support human activity and sustain human life) represent the benefits humans populations derive, directly or indirectly, from the functions of nature (Daily 1997; Costanza *et al.* 1997). Even though there have been numerous environmental valuation studies of biodiversity and ecosystem functions in the US and in Europe (Nunes et al., 2001; Costanza et al., 1997; Garrod et al., 1992) to our knowledge, a valuation approach that allows for a simultaneous analysis of biodiversity and economic goals in the spatial development of a region has not been completed.

C. Discussing the value of identified effects

While drawing the land uses on the map, the stakeholders immediately see the impact on the SCBA-balance. The results of this first project balance can already lead to changes in the desired situation. This first cost-benefit analysis is a quick method, because not all the interaction between the different land uses is taken into account. The results can be used to start a discussion among the various actors about the potential tradeoffs in the plan - for instance, building houses versus creating nature reserves. The role of this first cost-benefit analysis in the planning process is to create consensus about the direction of the plan. Therefore it is essential to identify the effects of the plan in a group session. Although a long list of potential welfare effects exists in literature, it is necessary to analyse with the group of stakeholders and shareholders what effects are important in their context. This identification of relevant effects (relevant to the goals of the actors) is essential because it makes the impact of the plan clear to all and it facilitates the group process. The different goals of the actors are related to the impact of the plan, new coalitions may emerge. This session based on the first SCBA results also improves the acceptability of the final SCBA.

If the stakeholders and shareholders are not familiar with the current situation, joint fact finding is necessary to create a shared starting point for the planning process. These joined facts can be used to define the default situation, to compare the

effects of projects. A result of phase B is that people will understand that the value attached to the land uses distinguished affects the SCBA balance. Goods and services traded on a market have known prices. But for the others valuation techniques are necessary to determine the relevant prices. A lot of information can be 'borrowed' from similar regions, using benefit transfer. The credibility of these values is important. A further analysis of these values within the group is important to improve the support of the plan.

D. Designing the plan
Based on the experience gathered in the previous phases the participants can design their final plan, together with relevant alternatives. SCBA balances can be computed for these plans. Due tot the fact that an exact SCBA balance is warranted these computation are not performed interactively. The results are discussed with the participants in a separate session.

In this phase the plan is being refined. The land uses are located more exactly on the map. Again the costs and benefits are computed but now the relation between land uses is taken into account more completely. For instance a recreational facility adjacent to a city generates more benefits than one located at a larger distance from that city. Often information about the magnitude of interaction between two adjacent land uses is not available. To minimise this negative interaction actors can make arrangements based on the local situation. An interactive process of planning the locations and computing the project balances will generate a plan with a higher project balance. In this phase two or more alternatives are defined. It is important that the argumentation of these plans is described well. The exact project balance of these alternatives will be computed afterwards, based on more exact information on the region. If the exact balance differs significantly from the results of the second phase the researcher can advise changing the plan slightly to improve the project balance while still following the argumentation of the actors.

advantages of the approach
One of the advantages of this approach is that the actors get acquainted with the simple version of the cost-benefit method. This improves the support for SCBA of the final project. This approach also provides information for discussing the essence of the plan in the first phase before the plans are elaborated in detail. It also provides the stakeholders and shareholders with information about the feasibility of the plan at an early stage. Another advantage is that SCBA focuses on the benefits to society as a whole and not to specific groups. The distribution of costs and benefits could also be provided in addition to the standard SCBA to improve the acceptability of the approach and results for specific groups.

6. Concluding remarks

We note the growing demand for space and need for more spatial quality. In areas where the demand for space exceeds supply (for instance in metropolitan delta areas), interactive regional planning is seen as a solution for potential problems. To create this support and to avoid time and money being spent on elaborating plans that are not beneficial to society, it is important that the costs and benefits of plans are clear early in the planning process. We postulate that social cost-benefit analysis is the most suitable method to achieve this. We present a method for interactive regional planning processes.

points of special interest

The essence of our method is the fact that SCBA is performed at various stages of the process, based on the input of interactive sessions. The problem must be clear and the actors have to support the planning process to solve the shared problem. This approach allows improvement of the plans towards the desired developments. Fine-tuning of the plans in a final stage can also be based on an interactive session in which SCBA is calculated instantaneously. This step requires a very flexible SCBA model, which is prepared for the region. An important requirement is that all stakeholders and shareholders have to participate from the beginning. A situation where some actors stand aside and only become active when their own interest is threatened (the nimby effect) should be avoided. This also poses certain requirements for the interactive process; it should be quite simple to allow all actors to understand and to participate actively. A first quick-and-dirty SCBA shows the playing field, but for the remainder of the process

An accepted set of indicators for the costs and benefits of various land uses is necessary. Combining GIS facilities and SCBA models and a module to divide costs and benefits over the relevant actor groups will be a valuable extension of the SCBA instrument for interactive planning.

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