Managing European Shorelines and Sharing Information on Nearshore Areas

messina

VALUING THE SHORELINE
Guideline for socio - economic analyses

Prepared in the framework of the MESSINA project

Swedish Geotechnical Institute
National Institute for Coastal and Marine Management of Netherlands
Lund University
Autonomous University of Barcelona
University of Szczecin
Municipality of Ystad
Centre for Coastal Erosion Studies

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North East South West INTERREG IIIC

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THE MESSINA INITIATIVE

The intensification of population migration towards the coast and increased frequency of coastal hazards due to global climate change have lead coastal managers at the local level to pay a particular attention to coastal dynamics and shoreline evolution. But in spite of major efforts invested and knowledge accumulated in the fields of shoreline management, lessons learned from European, national and regional initiatives have been so far poorly embedded in daily coastal management practices.

The MESSINA initiative - Managing European Shoreline and Sharing Information on Nearshore Areas - intends to partly bridge this gap by: (i) breaking "knowledge isolation" of some local authorities and institutions in Europe, (ii) raising their managerial and technical capabilities through a mutualisation of the experience accumulated by each of them, and (iii) upgrading existing shoreline management guidelines through an integration of the latest techniques and methods available in Europe.

The main products expected from MESSINA are:
(i) a "Coastal manager toolkit" made of 4 practical guides ("Monitoring and modelling the shoreline", "Valuating the shoreline", "Engineering the shoreline", "Integrating the shoreline into spatial planning policies") and a demo CD-ROM featuring a GIS-based prototype of shoreline management planning,
(ii) series of workshops in line with the topic of each practical guide, and
(iii) web site giving a full online access to the project outputs and to a database of approximately 50 shoreline management case studies.

The overall objective of MESSINA is ultimately to maximize the benefits of future investments in coastline management and raise the public awareness about the need to manage the coastline in a sound and sustainable way.

MESSINA is proposed by a European consortium made of the French Geographic Institute (IGN), the National Institute of Coastal and Marine Management of the Dutch Ministry of Public Works (RIKZ), the Municipalities of Ystad (Sweden) and Rewal (Poland), the Community of Agglomeration for the Thau Basin including the city of Sète (France), the Isle of Wight Council (UK), the Province of Ragusa (Italy), the Swedish Geotechnical Institute (SGI) and the Universities of Messina, Naples (Italy), Barcelona (Spain), and Szczecin (Poland).

This guideline of Component 3 "Valuing the shoreline – Guideline for socio-economic analyses" has been compiled by Mats Persson, Lund University, Karin Rankka and Bengt Rydell, Swedish Geotechnical Institute and Esther Uytewaal, National Institute for Coastal and Marine Management of the Netherlands.

1 READER'S GUIDE

1.1 Introduction

People have always wanted to live close to waterways, in the past mostly for the convenient transportation possibilities but today also for living close to the shoreline and recreation possibilities. Very seldom the coastline is statically. In fact, coastal zones are among the most dynamic and energetic environments on earth. Human activities in the coastal area are therefore most often affected by forces from waves, currents, winds, tides and sediment transportation. And, hence, the human activities affect the coastal processes.

Building and living in coastal areas do not only require an understanding of the processes acting there and how they interfere but also how different human activities should be socially and economically evaluated. The evaluation should answer questions like:

- How, and to what extent, is this area affected by the fact that it is situated in a coastal area?
- Is this area worth protecting from erosion, sedimentation or flooding?
- Which preventive measure is the most cost effective?

An understanding of possibilities and limitations of different methods, the data and knowledge they require and how the results could be considered in the planning and management processes is of great importance for local and regional planners. Since coastal processes most often affects areas in quite a long distance from each others there is need for co-operation and understanding between people working both in different location and in different fields. Hopefully this guide will facilitate increasing the knowledge and the understanding of coastal valuation and the co-operation between coastal managers.

1.2 Guide for valuation of shorelines

This guideline gives an overview on how to make socio-economic evaluations of coastal areas affected by erosion and flooding. The use of such an evaluation gives valuable information and insight into the function, needs, effects and costs for handling, - or not handling - the erosion problems.

The guideline could be used in order to make priorities between areas that need attention due to threatened shorelines and/or which actions would be most efficient and effective to apply. Management of erosion and flood protection must be long term and take into account all possible factors and impacts of projects (e.g. income sources from tourism, possibility for industrial use, such as fishing and transportation as well as environmental values).

1.3 Who should read this guideline?

This guideline is meant for people working at county administrations, municipalities, governmental authorities, private landowners, etc., dealing with or affected by coastal erosion issues. The guideline can also be used when procuring consulting services. The guideline is intended for those who are not experts in the field of coastal erosion or in the use of socio-economic analyses. The main purpose is to increase the knowledge on how to evaluate the shorelines and establish a sustainable coastal management.

The guideline is written in an easy to read format and gives an overview of socio-economic evaluation methods. It also explains the benefit of such evaluations and gives answers to why land areas should be evaluated.

1.4 Main contents of the guideline

An overview of **Why** and **When** socio-economic assessments should be performed is given in *Chapter 2*.

Chapter 3 describes **How** socio-economic assessments could be performed. The processes of and the main steps in a project appraisal is explained including hazard and risk analysis, identification of effects, how to select an appropriate analysis model and presentation of the results.

In *Chapter 4*, lessons learned by economic analyses of a number of cases are illustrated and some general remarks are given.

Different economic analysis models are described in *Appendix 1*. A guide to select an economic evaluation method is presented in *Appendix 2*. A summary and lessons learned by each of the case studies are compiled in *Appendix 3.* Literature for further studies is given in *Appendix 4*.

Figure 1-1. Sand dunes in Falsterbo, Sweden

2 WHY SOCIO-ECONOMIC VALUATION OF COASTAL PROJECTS?

2.1 Integrating costs and benefits in decision-making

Assessment of activities for prevention of coastal hazards should be used to maximise the benefits of future measures or investments in the coastal zone. From this point or view, it is important to give more attention to better integration of "erosion" into the decision making process, particularly into the strategy for sustainable coastal management.

This guideline aims to be a tool for the integration of costs and benefits in decision-making on initiatives or investments in coastal zones. The guideline is based on the recommendations of the joint European study on coastal erosion (Eurosion reports, 2004):

- **Internalize coastal erosion costs and risks in planning and investment decisions**

  "The impact, cost and risk of human induced coastal erosion should be controlled through a better internalization of coastal erosion concerns in planning and investment decisions. Public responsibility for coastal erosion risk should be limited and an appropriate part of the risk should be transferred to direct beneficiaries and investors. Environmental Assessment instruments should be applied to achieve this. Risk should be monitored and mapped, evaluated and incorporated into planning and investment policies."

- **Make responses to coastal erosion accountable**
  "Coastal erosion management should move away from piecemeal solutions to a planned approach based upon accountability principles by optimising investment costs against values at risk, increasing social acceptability of actions and keeping options open for the future. This move should be driven by the need to restore the coastal resilience and meet the conditions of favourable sediment status as developed in previous recommendations. It should be supported by the elaboration and implementation of Coastal Sediment Management Plans (CSMP)"

Directly or indirectly, coastal erosion affects societal values such as a safe place to live or recreation possibilities. Therefore, public authorities take the responsibility to combat or alleviate negative impacts. As the public authorities represent all groups in society, they have the responsibility to base decisions on an integrated assessment of the consequences of alternative coastal protection schemes. Accountability of investments has to do with transparency of decision-making based on clear criteria. The guideline describes valuation methods that can enhance accountability of decision-making by making costs and effects of measures explicit. As such these economic methods are supportive to decision-making.

2.2 Socio-economic analysis at different levels and timing

Socio-economic analyses can be made in different phases and for a number of purposes, such as studies in an early phase within the land use planning. It could also be useful when protective measures have to be performed for a certain location of the shoreline. All these analyses should be performed in a project form and in the following the term "project" is used for any of these phases.

Three levels of responses to combat coastal erosion and its negative impacts to society can be distinguished where project appraisal is required:

- ***The planning or policy level***, which includes the different policy options: "Managed realignment", "Hold the line", "Move seaward", "Limited intervention" or "Do nothing", see *Figure 2-1*.
- ***The engineering or project level***, which covers a range of hard and soft mitigation measures. Hard techniques include breakwaters, gabions, geo-textiles, groin fields, revetments and sea walls. Soft techniques include beach nourishment and re-profiling, dune and marsh regeneration and vegetation planting, beach and cliff drainage.

- ***The financial level*** includes measures and incentives, for example to control excess coastal urbanisation and tourism (development and land-use taxes, user charges) and to promote restoration and cultivation (e.g. through subsidies). It may also include measures to accommodate the resettlement of coastal population at risk (financial compensation) and to internalise costs of risk and events (insurance fees, property rights).

Socio-economic analysis can be applied to evaluate alternative responses on a policy or project level. The guideline doesn't explicitly describe financial measures and incentives to control potential damage as a result of erosion. In any project appraisal, the project goals, advantages and disadvantages, costs and the benefits, have to be identified, measured and evaluated. Human activities and interventions combined with natural variability in coastal zone processes produce an array of direct and indirect effects, only some of that can be directly valued in monetary terms.

Assessments can be used at different levels and purposes, for instance to assess a specific part of the coastline to determine the best alternative strategy to handle the erosion problems. Assessment can also be performed to select between a number of project proposals at different locations to determine which project gives the best value for money spent.

Project assessments can be made in different stages of a project, see *Figure 2-1*. *Ex ante* assessment is conducted before decision-making and primarily aims at selecting the best alternative, *Ex post* assessment is done after a project is completed and mostly aims at lesson learning. There are also examples of *In medias res* assessment (evaluation of a project in progress, also referred to as mid-term review). Similar assessment methods can be used for all of these types of project appraisals.

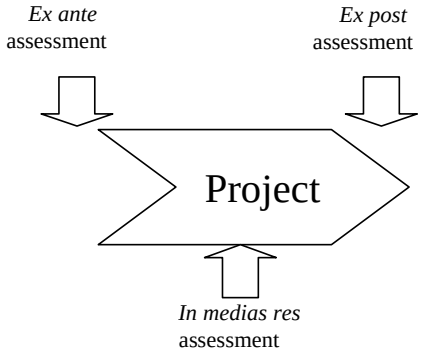

Figure 2-1. Project appraisals in different phases of a project (Messina, 2005)

Coastal projects are long-term initiatives and it is essential that long term economic monitoring of costs and benefits is part of a project to confirm the predictions and assumptions and to gain knowledge and experience for the future.

3 SOCIO-ECONOMIC ANALYSIS OF COASTAL EROSION PROJECTS

3.1 Main steps of a project appraisal

The normal sequence of steps in a socio-economic analysis for a project appraisal is shown in *Figure 3-1*. Initially, someone (e.g. a municipality, regional or national authority or landowner) identifies that there is a risk that coastal erosion and flooding will damage values worth saving. This forms the basis to perform a **problem analysis** leading to the **definition** of a project to address the hazards of erosion and flooding. The involvement of stakeholders are essential to achieve the necessary participation in the decision-making process. The proper communication and involvement in the entire project appraisal are key components in securing the acceptance of the results of a project appraisal. When the **scope** of the project is established and resources are allocated to conduct the investigation different **alternative options** to cope with the hazards are analysed based on possible strategic alternatives. The **effects** of the different options are identified, quantified, qualified and compared using a **selected evaluation method**. Identification and quantification of effects is also the main task of the parallel processes of **Environmental Impact Analysis** (EIA) with which close co-operation is essential. By evaluating the alternative options in a "Table of effects" the preferred alternative can be selected. This assists in giving transparency to the decision when public funding is used and it shows which economic, societal and ecological factors are included in the analysis. The steps of a project appraisal is further elaborated in this chapter.

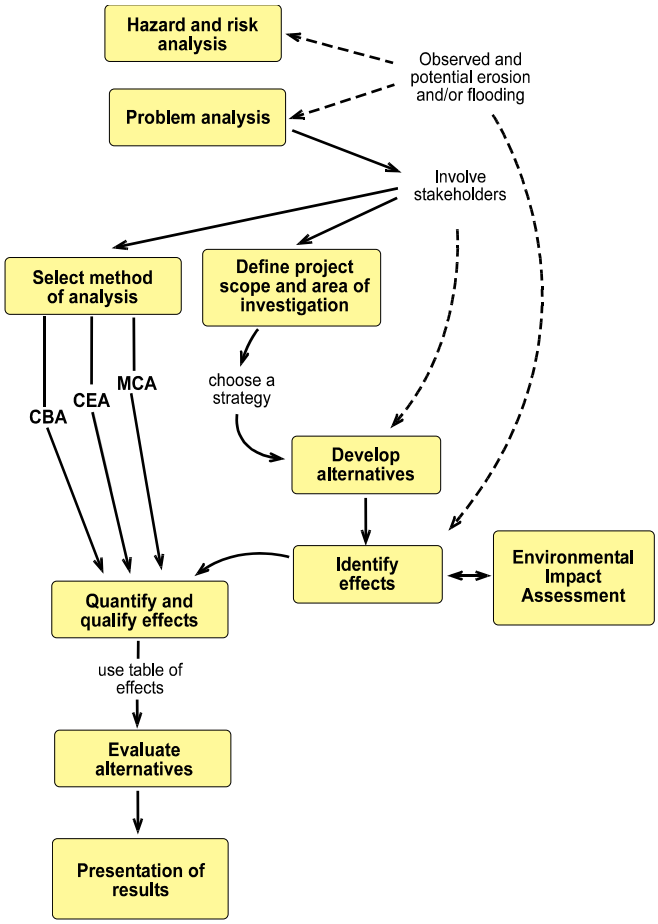

Figure 3-1. Steps in impact assessment and project appraisal of coastal projects

3.2 Hazard and risk analysis

Through continuous monitoring of the shoreline changes resulting from coastal erosion can be studied and noted. The impact of coastal erosion can mainly be divided into three different types of impacts (or risks):

- loss of land with economic value or with ecological value; a specific mechanism is the collapse of properties located on the top of cliffs and dunes,
- destruction of natural sea defences (usually a dune system) as a result of storm events, which may result in flooding of the hinterland,
- undermining of artificial sea defences as a result of chronic sediment loss.

Underestimation of hazards and lack of risk awareness in spatial planning leads to inefficient spending of public money. Developers have often a too short time horizon and in most countries they have to rely on (and receive) public assistance in case of damage as a result of erosion or flooding.

Based on local historical and technical information and an understanding of the local processes, a set of predicted erosions contours are generated over a time horizon of 50-100 years. Sensitivity analysis is undertaken to cover the issue of uncertainty.

Risk assessment estimates the risk that an event, for example erosion or flooding, causes damage to property, health, ecosystems etc. It includes identifying possible risks and estimating their frequency or probability and analysing their likely impact. A risk score can be estimated as:

*Risk score = Probability (of occurrence) * Impact (potential damage)*

An evaluation is made on the probability of occurrence and consequence of each risk. This can be done for different scenarios (worst, best, and normal). When the risks are delineated they can be ranked according to risk score and preventive measures can be planned and implemented. There are four ways of responding to identified risks: Acceptance, Avoidance, Transfer or Mitigation.

Risk and impact assessments provide essential information to take the right decision on the best use of investment capital against value at risk and the right approach to ensure shoreline stability.

Further reading regarding monitoring and modelling of the shoreline is available in the guideline “Monitoring and modelling the shoreline” (Messina, 2006:1) produced by the Messina project.

3.3 Problem analysis

After the hazard and risk analysis is made, the first step in appraising coastal projects consists of a thorough analysis of the problem of erosion at the specific location. This involves gathering all relevant data available to get a broader description of the problem. Data from coastline monitoring is used together with information from modelling of the natural coastal processes and human influencing factors acting preferably in the relevant sediment cell.

3.4 Involve stakeholders

It is important to identify the stakeholders of the project and plan how to involve and communicate with them. Such an analysis pictures all groups in society that is affected by the problem: industry, interest groups (such as environmental lobbies), other societal organisations and the public. The stakeholder groups are categorised and after importance and influence and appropriate communication and co-operation strategy is adopted to the different groups.

3.5 Define project scope and choose a strategy

Based on the analysis of the problems to be solved, different strategies for coastal management can be adopted. If the investigated threatened area is rural the alternative could be to let nature take its course. In an urban area maybe the only reasonable option is to maintain the present

coastline since moving houses, infrastructure, industry etc. would be very costly. Anyhow, the goal of the foreseen intervention should be agreed upon, and should align with applicable policies and plans at higher levels.

The project definition describes the goals, the activities required as well as the boundaries in space and time of the project. It should also consider resources required, which disciplines needs to be involved for an integrated assessment and who assesses which impacts. Another crucial input is knowledge about the coastal erosion process, present situation and prognosis of future shoreline development.

The alternatives developed can follow any of the five generic policy options as defined by the Eurosion project (Eurosion reports, 2004), see *Figure 3-2.*.

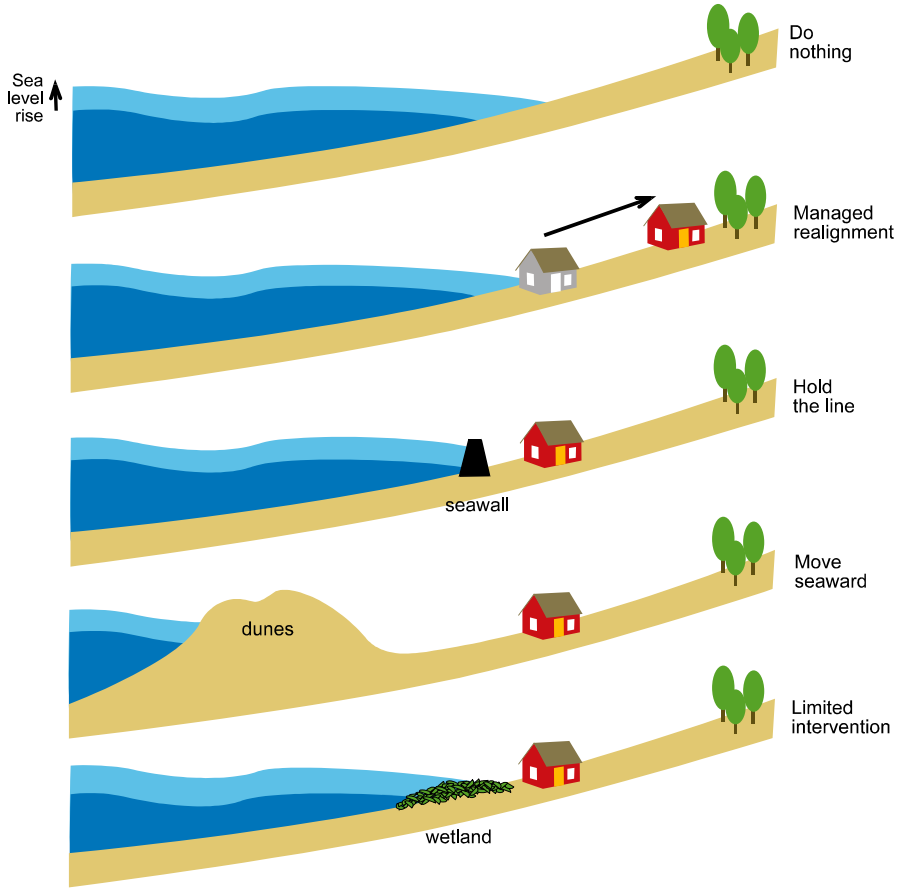

Figure 3-2. Generic policy options for coastal management (Eurosion reports, 2004)

- *Do nothing*
  There is no investment in coastal defence assets or operations, i.e. no shoreline management activity.
- *Managed realignment*
  Identifying a new line of defence and, where appropriate, constructing new defences landward of the original defences.
- *Hold the line*
  Hold the existing defence line by maintaining or changing the standard of protection. This policy covers those situations where works are undertaken in front of the existing defences to improve or maintain the standard of protection provided by the existing defence line. Policies that involve operations to the rear of existing defences should be included under this policy where they form an integral part of maintaining the current coastal defence systems.

- *Move seaward*
  Advance the existing defence line by constructing new defences seaward of the original defences. This use of policy is limited to those management units where significant land reclamation is considered.
- *Limited intervention*
  Working with natural processes to reduce risks while allowing natural coastal change. This may range from measures that attempt to slow down rather than stop coastal erosion and cliff recessions (e.g. nourishments), to measures that address public safety issues (e.g. flood warning systems, dune and forest maintenance, building restriction in the coastal strip).

To define the solutions, it is necessary to identify what will happen if nothing will be done. The "Do nothing"-option stipulates future erosion and problems without intervention to prevent erosion. Erosion contours for different time intervals, lets say 10, 20, 30 etc. up to 100 years, are estimated. This gives an indication of what year different land areas are at risk.

The "Do nothing" alternative describes the situation in the case where no coastal protection measures will be taken. This can be either the "no action" option: where no protection scheme exists, no further action is taken to intervene with natural processes, or the "walk away" option: where a scheme is existent and the option will be to walk away and abandon all maintenance to existent structures. Simply to continue with maintenance and repair of existent structures would be one of the "do-something" options to be considered.

If "Do nothing" is no option, (e.g. the potential damage considered to be huge) it may be more suitable to determine net effects of project alternatives on the basis of a minimal intervention scheme, such as maintenance of the existing defence structures. This then becomes a "Hold the line"-alternative.

To identify the strategic option, as defined in *Figure 3-2,* it is recommended to choose a wide range of possible alternatives covering different protective measures, different probabilities of failure and different time horizons. It is not feasible to analyse all possible alternatives. Selection of alternatives can be done in a brainstorming manner where a reasonable number of alternatives are selected for the analysis.

Based on the defined project scope and area of investigation and the possible strategic choices the alternatives to be investigated are identified and developed. Further reading regarding the possible alternatives to be developed in the guideline "Engineering the shoreline" available from the Messina project (Messina, 2006:2).

3.6 Select method of analysis

A parallel process to the steps "Define project scope etc. " and "Develop alternatives" is the selection of a socio-economic evaluation method. This depends on a number of factors such as:

- Scope of the project and function of the evaluation – what *phase* is relevant for the project in and what are the *objectives* and *goals* of the project.
- Resources available to conduct the evaluation – *timescale* for the project evaluation, *expertise* and *funding* available, availability of *input data and information*.
- Rules and requirements of the investigating organisation – requirements on *output documentation for decision making* and *communication* with stakeholders and the public

Depending on evaluation method, different work processes will be used and the requirements on data input and output will also vary.

3.6.1 Evaluation methods

Several methods can be used for the assessment and evaluation. The most commonly used are Cost-Benefit Analysis (CBA), Cost-Effectiveness Analysis (CEA) and Multi-Criteria Analysis (MCA). The methods are described briefly below and more information will be found in Appendix 1.

> The ***Cost-Benefit Analysis (CBA)*** is an evaluation method that gives an overview of the advantages and disadvantages of project alternatives or measures in terms of social welfare. These advantages and disadvantages are presented in the form of cost items and benefit items on a cost-benefit balance sheet. The items are expressed in terms of money ("monetised") as far as possible to enable the various project alternatives to be compared. The main question in a Cost-Benefit Analysis is "Do the benefits outweigh the costs?". The welfare effect is expressed in the balance of all costs and benefits (this is the net cash value). The differences in costs and benefits between the situation with the completed project and the situation that would arise if the project had not been carried out, indicate whether the project is socially desirable. The costs and benefits of alternatives can also be compared to determine which alternative is preferable.
>
> The aim of a ***Cost-Effectiveness Analysis (CEA)*** is to determine with which measures or packages of measures (project alternative) an objective can be reached at the lowest cost possible (cost minimisation). The analysis can also be used to determine which measure or package of measures (project alternative), given the maximum budget, will contribute most to the achievement of the objective (effect maximisation). With a CEA, either the objective or the available amount of money is fixed. MCA supports the discussions, since MCA can couple the available information on the political priorities or individual interests and translate them into the ranking of project alternatives.
>
> A ***Multi-Criteria Analysis (MCA)*** gives a decision-maker the opportunity to weigh a wide range of different effects against each other in the decision-making process. MCA methods can be used to get large quantities of dissimilar information into a manageable form for decision-making. A MCA produces a "weighted sum" of the project's effects. The first step is to draw up a summary of effects. For each project alternative, a number of criteria are used to give a weighing to each of the effects to be considered. The weightings determine how significant an effect is in the project alternative's overall score. The various alternatives are ranked in order of preference based on overall scores.

Some specific aspects on the analysis methods can be identified. When public money is spent, a socio-perspective normally is used, which include environmental, health and security aspects. For private stakeholders a more financial/business perspective and scope of the evaluation is used.

In a social CBA the decision criterion is the ratio between benefits and costs for a studied alternative. If benefits exceed costs (=welfare increase) the project is worth doing from a societal point of view. For a CEA, the least cost alternative such as the cost per protected meter of shoreline is calculated for a desired effect. In a MCA, all effects are assigned scores and the effects are given different importance (weights); the option with the best total score is selected. CBA and MCA include valuation of investment costs, economic, ecological and social-cultural effects, whereas CEA does not include valuation of all effects.

The main difference between the methods is that a MCA can incorporate more subjective qualitative data as it uses valuation through ranking score and assigning weights to effects/factors. In CBA and CEA on the other hand, the valuation is performed by using monetary values. Ranking score means that an alternative is given a scour number, e.g. between 1 and 10 for an effect. Valuation means putting a discrete monetary value on the effect. If it is possible to valuate an alternative monetarily the use of a ranking scale bring about a loss of information and accuracy. The values and ranking used in a MCA can always be questioned and discussed as subjective.

In a CBA it is difficult to monetise ecological and social-cultural effects. In fact, a CBA in theory strives after full monetisation but it is not always done (e.g. due to data limitations, cost, but also methodological problems). Employment effects are generally redistributed and do not affect nation's welfare, but they affect the individual and the municipality/region. Therefore CEA and CBA do not take into account employment effects, but a MCA can do. When an effect is not monetised or given a score a description, quantifying and qualifying of the effect is used as part of the total assessment.

3.6.2 Selection of economic analysis methods

When selecting the appropriate economic evaluation method to assess the economic challenges regarding a project, five Key questions should be answered to make a selection. The Key Questions are drawn up on the basis of literature studies, analysis of the Messina case-studies and from experience from other projects.

The Key Questions are related to:

1. The objective
2. The type of information required
3. The phase of the project
4. The means available
5. The role of stakeholders

The answers to these questions give a first indication on which method should be used, according to *Table 3-1*. This indication directs the user in further study on the method to be chosen. In Appendix 2 each Key question is shortly described, followed by examples and lessons learned from the Messina case studies and the theory in literature.

Table 3-1. Overview of evaluation methods

	Financial CBA	Social CBA	CEA	MCA
Objective				
Number of objectives	One-multiple	One-multiple	One	One-multiple
Status of objectives	Flexible-fixed	Flexible-fixed	Fixed	Flexible-fixed
Purpose of analysis	Develop knowledge on the alternatives. Rank the alternatives. Reduce the number of alternatives.	Definition of socially desired objective. Develop knowledge on the alternatives. Rank the alternatives.	Develop knowledge on the alternatives. Rank the alternatives. Reduce the number of alternatives.	Develop knowledge on the alternatives. Rank the alternatives. Reduce the number of alternatives.
Type of information				
Relevance of costs and benefits	Costs and benefits	Costs and benefits	Costs	Costs and benefits
Relevance of social effects	Not relevant	Relevant	Relevant	Relevant
Quantitative or qualitative	Medium quantitative nature	Maximum quantitative nature	Medium quantitative nature	Maximum quantitative nature
Monetary/non-monetary	Medium aspects considering financial aspects in monetary terms. Social effects not taken into account.	Maximum of information indicated in monetary terms.	Medium. At least a part of the information in monetary terms; benefits are not monetised.	Different measurement scales; manages both monetary and non-monetary information.
Phase				
Phase ini decision-making process	Development of alternatives. Evaluation phase.	Development of alternatives. Evaluation phase.	Strategic orientation phase. Development of alternatives.	Strategic orientation phase. Development of alternatives.
Means				
Time available	Medium (6 months-1 year)	Long (> 1 year)	Short (0-6 months)	Medium (6 months-1 year)
Budget available	Average	Large	Small	Average
Level of detail	Low - average	High	Low – high	Low -high
Stakeholders				
Role of stakeholders	Providing information	Providing information	Providing information	Providing information and participating in the decision-making process

3.7 Identify effects

The effects of all alternatives, including the "Do nothing" alternative, need to be identified, quantified and qualified through adjustments in design or compensation schemes. Considering as many effects as possible of an intervention can help to alleviate expected negative impacts already in an early phase of the project development.

It is normally of great help to involve stakeholder groups or representatives in the identification (through workshops or questionnaires). This is also desirable from the perspective of acceptance of the outcome of the analysis. After having listed effects in a brainstorm session or otherwise, this gross list requires critical review and some structuring. Some effects may overlap, appear twice, or some may still be missing.

The most obvious problem resulting from erosion is loss of land, either privately owned (housing, industry, agricultural land) or publicly owned (nature reserves, infrastructure). The benefit from coastal protection measures is a temporary but lengthy extension use of this land.

A good way of presenting the effects is by using a "Table of effects", where the effects are sorted under different categories, such as effects on the local economy and effects on nature. The effects can also be preliminary listed in order of significance to indicate which effects should be studied initially in the evaluation. An example of a "Table of effects" from a flooding study at Maas, the Netherlands, is shown in *Table 3-2*.

Table 3-2. Table of effects from a flooding study at Maas (Brouwer, 2003)

	Units	Alternatives				
		Do nothing	1	2	3	4
Direct effects						
Investment costs	million €	0	8353	5350	3262	6487
Maintenance costs	million €	0	250	305	358	293
Direct/indirect effects						
Maintaining legal safety levels	yes/no		yes	yes	yes	yes
Damage to property and infrastructure	million €	3947	0	0	0	0
Agriculture	million €	396	0	0	0	0
Recreation	million €	1754	0	0	0	0
Other damages	million €	2657	0	0	0	0
Effects on current usage						
Purchase properties	number	0	2290	320	70	1540
Purchase land	ha	0	15835	2980	2210	10705
Sand mining	million m3	0	74	26	21	25
Effects on future usage						
Extra nature areas	ha	0	16354	4229	3102	9869
Chances of landscape	+/-	0	-	+	+	-

Combination of effects/losses can occur when the erosion of higher grounds leads to increasing risk of flooding of areas behind or when erosion threatens or destroys the defence structure. The probabilities of flood and erosion damage should be combined. Property affected by severe and frequent flooding may be uninhabitable before it is lost through erosion.

One problem in defining and assessing the impacts and effects of coastal erosion related to the different alternative solutions to combat or alleviate these effects is to focus on the most important ones. This can be accomplished through co-operation with stakeholders and experts and via the parallel process of the Environmental Impact Assessment (EIA). In the following step of quantifying and qualifying effects resources must be available and assigned to work with the most important effects.

As in all project appraisals the results presented should include information on the accuracy of the presented information. Presentation of source and reliability of data used is part of this. The

result of the Interreg IIIC project DEDUCE (2004), Evaluation model for the Sustainable Development of European Coastal Zones, can assist in this respect.

3.8 Quantify and qualify effects

After having identified the relevant effects, these should be described and ***quantified*** as far as possible for all alternatives, including the "Do nothing" alternative. For example, if coastal erosion and flooding endangers a residential area, the hectares, number of houses, their average market value and number of citizens need to be defined. It is of high relevance to have a good information/research on effects, and as much as possible quantified. Co-operation with other disciplines is essential in order to agree on what effects should be analysed, which criteria are used to express the effects (hectares biotope lost, numbers of species lost, number of houses damaged, number of tourists affected etc.). Identification and quantification of effects is also part of the Environmental Impact Assessment and close co-operation with this parallel process is essential.

Qualifying means ranking each effect. The values can be monetary or non-monetary. Monetary values represent, among others, investment costs, production losses and costs of restoring damage. Non-monetary values include classification and ranking scales that describe the effects of alternatives such as loss of biodiversity, wildlife habitats and cultural values. There exist methods that can be used to assess monetary values for these non-monetary values (Messina 2005).

The costs of a project relate to the investment, operation, management and maintenance of the technical works for coastal protection. Investment costs are caused by initial expenditures, purchases to construct, build and perform a project. Operational and management costs are future cost that occur every year and is connected with the project (e.g. energy use, safety inspections). Maintenance costs are future costs to upgrade the facilities to "original" standard after "wear and tear" and with a periodicity of more than one year. The costs of all alternatives should be estimated within a framework of risk management to enable the definition of financial contingencies.

The most obvious method to value monetary effects is to use market prices. In a perfectly competitive market, this is the simplest possibility and the recommended way to start, for example the value of lost property, costs of investment or operational and maintenance costs. The cost of investments includes design/planning and construction. This comprises cost of labour, material, subcontractors, consultants, fees and taxes, insurance, financing and all overhead costs. The same principle applies for operation and maintenance costs.

An alternative to pricing is to work with non-monetary ranking scale or ordinal scales for different aspects of the potential problems of the alternatives under assessment. This is by many argued to be better way to include valuation of for example a human life and a scenic view. The non-monetary valuation deals with the same cause and effects but they can be grouped differently. Non-monetary values also have to take into account future changes.

To conduct a total assessment including all factors affecting the project under assessment will demand huge resources. It is recommended that the effects are preliminary evaluated and ordered after importance. Valuation starts with the most important effects and ends with only minor influence from the included effects. The selection of effects to be included in the evaluation is done by the project initiator, experts and key stakeholders involved to ensure a relevant outcome.

The case studies presented in Appendix 3 shows examples of different approaches and results in terms of the amount of presented results of quantitative and qualitative nature respectively and to what depth and reliability data and information has been gathered for the studies.

3.9 Evaluate alternatives and presentation of results

The final result of an economic evaluation is presented with its supporting background data to form a basis in the decision making process and to communicate the results and alternatives of action to stakeholders, end-users and the public. This can be done e.g. by reports, meetings and other information activities.

The presentation of the results of an economic evaluation depends on the method chosen for the analysis. The evaluation and decision criteria are described in Appendix 1.

With regard to distinctions between the presentation of information, the most likely are those between quantitative and qualitative results and between monetary and non-monetary results.

Quantitative versus qualitative information
A distinction can be made between quantitative results and qualitative results. The effect of a measure can be described in relative terms such as “Excellent”, “Acceptable” or “Poor”, or by a scale, for instance 1 to 10. This qualitative comparison usually takes place in relation to the effects of other measures. It can also be stated that measure A provides for let’s say 1000 acres of new nature while measure B only provides for 500 acres. A choice has been made between qualitative information and quantitative information.

Monetary versus non-monetary results
A somewhat more complex variable is the difference between monetary or non-monetary results. Crucial in this regard is the extent to which the information required is stated in monetary or financial terms. For example, one can state in quantitative terms how much nature will be developed in a project (for example 100 hectares) but this gives no information on the economic impact of the development of nature in the project. In order to do so, this quantitative but non-financial figure should be turned into monetary information.

Examples
Two examples illustrate economic project assessment summaries using a Cost-Benefit Analysis and a Social Multi-Criteria Analysis.

In **Ystad Sandskog** two options have been studied (see Appendix 3). Option 1 includes maintaining existing seawall and groins and establishing of new breakwaters while option 2 deals with beach nourishment and limited maintenance of existing erosion protection constructions. These options were compared with the “Do nothing” alternative.

In *Table 3-3* a summary of the analysis is shown. For a CBA the selection criterion is that if the ratio between benefits and costs is greater than 1 (benefits divided by costs >1) the option is worth doing. The option with highest benefit cost ratio gives “best value for money”. In this case study, both the options are worth doing, as they both have a cost benefit ratio greater than 1. Option 2, Beach nourishment, has the highest b/c ratio of 3.6.

A decision-maker can use the Benefit Cost Ratio (BCR) to select the best alternative. One possible way of reacting to this is to ask for better alternatives. Can we accept the predicted damage level of the case study? Is there an option that reduces predicted damages even better?

The report indicates that further investigation is recommended, to improve the appraisal. Further investigation is necessary to determine omitted items, better measures of the quantities and better basic cost data.

Table 3-3. Summary table of evaluation of case study Ystad Sandskog (see also Appendix 2)

Costs and benefits of options	Costs and benefits (MSEK)		
	No project	Option 1	Option 2
PV costs from estimates	0	38	31
Optimism bias adjustment		23	19
Total PV costs for appraisal PVc		60	50
PV damage PVd	235	53	56
PV damage avoided		182	180
PV assets PVa			
PV asset protection benefits		0	0
Total PV benefits PVb		182	180
Net Present Value NPV		122	130
Average benefit/cost ratio		3,0	3,6

The proposal to counter erosion in the **Lido of Sète** is based on a “move backward” strategy, which means removing infrastructures from the coastal zone and trying to restore the natural system to its original state. Nine alternatives are described in total. The study supplies a ranking of the alternatives (see Appendix 3).

In the MCA for the case of coastal erosion in the Lido of Sète only the costs (investment and maintenance) are measured in quantitative (and monetary) terms. The other social and ecological effects are described in qualitative terms (e.g. very good/good/moderate/bad/very bad). Some criteria are evaluated considering two sub-criteria. For example the criterion “long term effectiveness” is based on the extension of the dune system and the number of detached breakwaters. In order to conduct the evaluation in a transparent way and ease understanding graphic evaluations have been defined (see for an example *Figure 3-3*). By means of these graphics it is possible to conduct an evaluation without compensation between sub-criteria, and they are qualitative in nature.

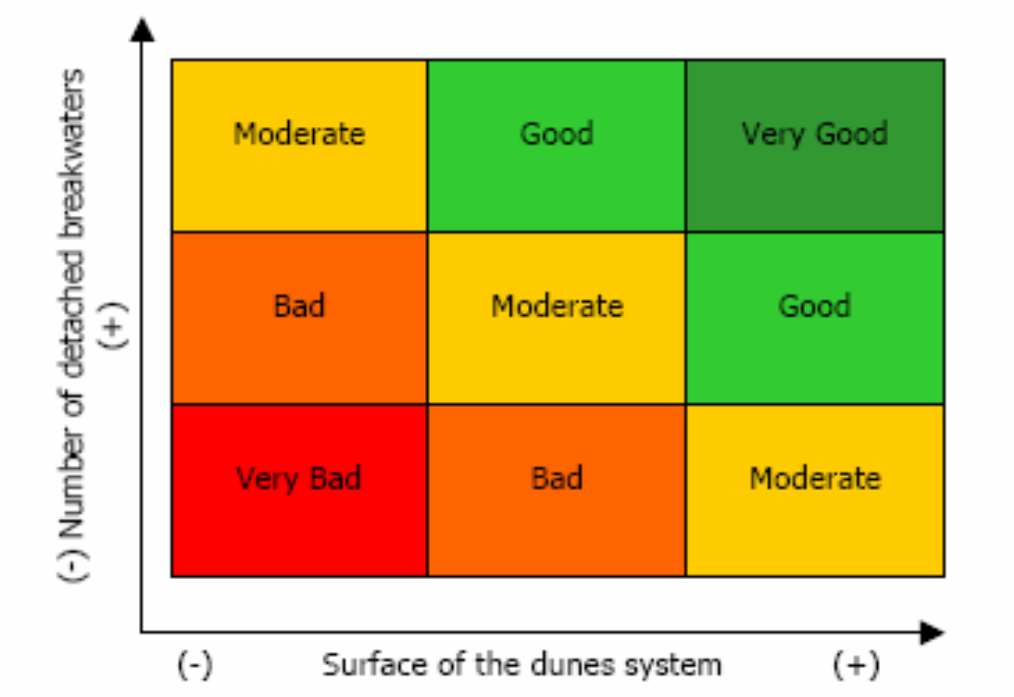

Figure 3-3. Graphic for evaluation longevity of the Lido of Sète

4 GENERAL REMARKS ON SOCIO-ECONOMIC ANALYSIS OF COASTAL EROSION

4.1 Case studies and economic evaluation methods

For each coastal project, it is important to have a thorough overview of the costs and benefits of the project and alternative measures. Coastal projects deal with preventing erosion and devising safety measures associated with flooding and coastal development. Many stakeholders and values like recreation, nature and the improvement of spatial quality are major characteristics of coastal projects. In recent years, policymakers have had a tendency to increasingly strive for integrated impact assessment of decisions in coastal management.

Within the Messina project a number of case studies have been performed in order to compile experience and to illustrate coastal management issues in different countries. As a basis for the valuation of shorelines, six case studies on socio-economic assessments have been carried out. These cases have been evaluated and the lessons learned are compiled in Appendix 3. The document aims at supporting policymakers who have none or limited economic background to understand and select the appropriate evaluation method for assessing the economic impact of coastal projects.

In this chapter a short description of the cases and the adopted economic evaluation methods is provided. Detailed descriptions of each of the cases can be found in reports available at the Messina web site.

Case 1: Coastal erosion at Ystad Sandskog (Sweden)
It is vital for Ystad that the erosion of the coastline of Sandskogen does not continue.
The present strategy of the municipality is the maintenance of the shore-protecting structures in place (existing seawall and groins). The municipality is investigating two alternative combinations of preventive measures. A Cost Benefit Analysis (CBA) of the area has been conducted.

Case 2: Coastal erosion at the Lido of Sète (France)
The Lido of Sète is a narrow strip of land that separates the lagoon of Thau and the Mediterranean Sea. The Lido of Sète has become very vulnerable to coastal erosion and sea level rise. Many activities developed on this land in addition to fishing activities inside the lagoon are at risk of serious economic, social and environmental adverse consequences. A combination of participatory process and Multi-Criteria Analysis (MCA) was applied.

Case 3: Coastal extension in South Holland (The Netherlands)
The Dutch parliament requested an exploration into the possibilities for coastal extension between Hoek van Holland and Scheveningen. This involves the creation of new land in front of the coastline of South Holland. The study investigates, by means of a Financial Cost-Benefit Analysis (CBA), whether the coastal extension is financially sustainable.

Case 4: Quick scan of economic optimisation of protection level of coastal areas outside the dike (The Netherlands)
Some parts of coastal towns along the Dutch coastline are situated in unprotected areas on or in front of the primary flood defence system. Activities or functions in these unprotected areas are essentially at the public's own risk. The result of the rising sea level and increasing storm influence will increase the probability of damage to unprotected buildings and infrastructure. This increase in the risk of damage can be counteracted by protection measures such as sand nourishment at the beach or nearshore areas.

The costs of these measures consist of construction costs and maintenance costs, and has the benefit of increased protection for coastal towns. The balance between costs and benefits can be questioned. In order to gain an insight into this issue, a social CBA is performed. This CBA is employed to explore the optimal protection level for three coastal towns in the Netherlands from an economic perspective.

Case 5: Beach nourishment in Ostia (Italy)
Beach nourishment has been carried out in the Levant sector of the Ostia Beach in 1999. The beach nourishment has been carried out to protect the shore from natural forces and to mitigate the effects of beach erosion. The nourishment associated with a 3,5 km stretch of coast, with 950.000 m^3 sand dredging. Six years after the intervention, the intervention was evaluated by a Cost-Benefit Analysis (CBA).

Case 6: Beach drainage in Procida (Italy)
The Ciraccio and Ciraccello beaches are sandy beaches used for bathing tourism, and they suffer from erosion. The beach drainage intervention was carried out in 2002, by placing four sections, each of them provided with two drainpipe parallel lines in the beach front. Collecting well for the drained waters and a lifting pump for the discharge: two small wells release the water into the sea and the other two, linked to each other, release the water into Chiaolella port. Six years after the intervention, the intervention was evaluated by a Cost-Benefit Analysis (CBA).

4.2 General conclusions from a European point of view

4.2.1 A paradigm shift

The assessment of case studies from several European countries highlights some common circumstances. It is clear that Europe as a whole, employs several different approaches to coastal management in general and to erosion economic assessments play only a minor role. Balanced choices and decisions that are readily accepted can best be taken if every impact of an economic, ecological and social project character is taken into account. An integrated assessment of the various impacts, together with stakeholder participation should lead to more sustainable and acceptable solutions. The choice to be made regarding the extent to which assessments are integrated in this way depends upon the information needs, the complexity of the decision and the resources available.

Ultimately, it is the public that incures the cost of erosion, an issue that may not be sustainable in the long run. If authorities, general decision makers, entrepreneurs and initiators of technical change are fully aware of the risk of both erosion and flooding it will be easier to achieve and create the appropriate priorities, procedures and distribution of funding in this area and to adequately internalise erosion and flooding costs.

It is important to monitor the economic impact during the lifetime of coastal erosion projects that have been completed and to review systematically the approaches and methods employed for the valuation of the economic, ecological and social impacts of the projects.

4.2.2 The need of a European harmonised approach

A more comprehensive and harmonised approach of the whole of the EU, to the principle of Integrated Coastal Zone Management (ICZM) is needed. The use of a centralised data collection system in connection with ICZM would be a step in this direction. Such a system should also reflect an understanding of the natural processes involved locally. In addition, a more adequate policy and strategy toward coastal zone management projects would be useful. These should encompass generic policy options both of holding the line and of realignment, as well as a combination of soft and hard engineering approaches. Increased co-operation between the member states within the EU and between different projects could facilitate sustainable decisions regarding measures to combat erosion in coastal areas. Such co-operation should include more efficient and better co-ordinated exchange of data and of experience in such matters, including the introduction of procedures and instruments.

The assessment methods discussed in this guideline, Cost-Benefit analysis, Cost-Effectiveness Analysis and Multi-Criteria Analysis, represent the major tools for evaluating the adequacy of the use of public funds for coastal erosion projects.

Coastal erosion is on on-going problem, one which public decision making authorities have no simple and easy solution to. Erosion is a gradual, continuos process and in the long run

inevitable. There is a number of difficulties and uncertainties associated with the prediction of the progression of erosion in the future and how effective various countermeasures may be. There are also complications in relation to the consideration of which funding of measures are adequate and how alternative investments in such measures can best be compared.

The case studies indicate some differences between the EU countries regarding the legislation applied, the responsibilities involved and how the necessary decision-making process takes place. Politically motivated strategies and the largely on-the-spot judgements of experts are often used in place of extended and thorough evaluations. This reduces the time required before work can begin and avoids costly analyses and the uncertainties of their outcome. However, the decisions made are often not adequately based on objective facts, despite this being expected and allegedly demanded when public funding is involved. Furthermore, the decision process is often lacking in transparency. One could note in this context that it has been stated officially that the implementation of EIA (Environmental Impact Assessment), ICZM (Integrated Coastal Zone Management) and SEA (Strategic Environmental Assessment) should reflect a willingness to use transparent decision models (Eurosion 2004 Part 5.3), something which in fact appears to often not be the case.

The use of evaluation methodology in connection with coastal erosion projects often appears to be insufficient and to vary markedly from country to country and from case to case within the EU. The complexity of the issues involved and the obvious geographical differences from country to country and region to region surely contribute to this. Legislation regarding coastal erosion measures and their administration, are also not harmonised between the EU countries. There are differences in landowner and compensation regulations and in organisational and governmental practices. For example, in United Kingdom, the Defra guidelines describe which evaluation methods should be employed. On the other hand, in most EU countries dealing with coastal erosion problems, it is the responsibility of the investigating organisation to decide which methods to use and the thoroughness with which potential coastal erosion projects should be investigated.

4.2.3 Cross-boarding co-operation for solving coastal problems

A wide range of competence and expertise is needed to evaluate erosion problems and their coastal processes comprehensively. This calls for teamwork and co-operation between disciplines that often compete with one another for resources as well as the assemblage of knowledge and experience that have been gathered at different geographical location and at different points in time. There are also limitations to what can be achieved in a practical taking into account that the more than 100,000 km of shoreline exists in the EU. This emphasises the importance of evaluation work to help determine where measures to combat erosion are most needed. Establishing networks of expertise can contribute to solving such problems in the best possible way.

There is a vast quantity of explicit knowledge and information on impact assessment and project appraisal available in different publications. The information differs in how it is structured and in what is emphasised, this makes it sometimes difficult to determine insofar as possible what approaches are best in the case of coastal erosion and different countries and regions. One can imagine that persons working for authorities in many countries and branches of government experience problems when faced with the task of internalising the explicit knowledge and information which is available. This guideline is one attempt to overcome this problem.

The case studies show that socio-economic valuation of shoreline projects:

- helps clarifies impacts and effects of coastal erosion
- provides documentation as a basis for decision-making
- can be directed towards different aims and situations
- requires co-operation between various disciplines in establishing present situation and forecasting future development, the subsequent impacts and effects, valuation of technical, economic and social aspects and presentation for decision-makers.

4.3 References

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APPENDIX 1. ECONOMIC ANALYSIS MODELS

In this appendix three major economic evaluation methods are presented. These methods are described in the State of the Art of the Messina project, Component 3 (Messina, 2005) and are well documented in literature and textbooks. The economic analysis methods are used in a wide range of evaluations and on different levels in society. Their use in various coastal erosion projects evaluations is also documented.

The presented methods are Cost-Benefit Analysis (CBA), Cost Efficiency Analysis (CEA) and Multi Criteria Analysis (MCA). All methods can be used on different levels and to different extent depending on who are the initiator of the evaluation and the scope of the evaluation. When public money is spent normally a socio-perspective is used and the evaluation method is labelled Social Cost-Benefit Analysis (SCBA) or Social Multi Criteria Analysis (SMCA). For private stakeholders a more financial/business perspective and scope of the evaluation is used.

A1.1 Cost-Benefit Analysis (CBA)

Introduction

The broad purpose of Cost-Benefit Analysis (CBA) is to assist society in decision-making and to facilitate more efficient allocation of society's resources. In a CBA all the costs and benefits to society as a whole are considered. By measuring social costs and benefits, information on optimal use of scarce resources to meet the agreed objectives is obtained and the efficiency of the investment can be judged. However given a governmental/political rationale, CBA is used to demonstrate the superior efficiency if a particular intervention relative to alternatives, including the status quo.

Economic (or social) CBA should not be confused with financial CBA. The objective of a social CBA is to determine whether a project is socially desirable, i.e. whether the net social benefits (NSB) are positive. A social CBA, which is carried out from a society perspective, is referred to as an economic CBA (increase/decrease in individuals' utility). A CBA carried out from an individual investor viewpoint is referred to as a financial CBA (maximising profit).

It can be informative to categorize the different perspectives of a Cost-Benefit Analysis (CBA) and label them according to their objective. A *Financial Cost-Benefit Analysis* (*FCBA)* is concerned only with changes that affect the organisation for which the analysis is done and with changes which have monetary consequences for the organisation and a FCBA excludes external effects. A FCBA is carried out from the perspective of a company. A (*socio-)economic* or *Social Cost-Benefit Analysis (SCBA)* is based broadly on the same method as an FCBA. In essence the difference is that an SCBA is concerned with the total net changes in resources, all costs and benefits across the nation and includes external (non priced) effects. A SCBA adopts the perspective of society as a whole. When the available information and indicators are limited, a preliminary CBA can be made, which presents alternative measures in general terms and the advantages and disadvantages of the project alternatives. Such an analysis is also referred to as a "quick scan" for making an initial selection from possible alternatives

Identification of effects

The effects of all project alternatives including the "do nothing" alternative need to be identified, quantified and qualified. Through the conservation of the effects of an intervention, it is possible to alleviate expected negative impacts already in an early phase of project development, through adjustments in design or compensation schemes.

It is usually helpfull to involve stakeholder groups or representatives in this exercise (through workshops or questionnaires). Inclusion of stakeholders in this assessment is also desirable from the perspective of acceptance of the outcome of the analysis. After having listed effects in a brainstorm session or otherwise, this gross list requires critical review and some structuring. Some effects may overlap, appear twice, or some may still be missing.

The most obvious problem resulting from erosion is loss of land, either privately owned (housing, industry, agricultural land) or publicly owned (nature reserves, infrastructure). The benefit from coastal protection measures is a temporary but lengthy extension use of this land.

A good way of presenting the effects is in a "Table of effects" where the effects are sorted under different categories, such as effects on the local economy and effects on nature. They can also be preliminary ordered in order of significance to indicate with which significant effects to start the evaluation.

The possible effects of coastal erosion can be distinguished in two major categories: *Direct effects* are effects such as impact on property, infrastructure, agriculture, tourism, land use, production functions, prject and operational costs. *Indirect effects* are effects such as improved economic value of the region and mitigation and replacement costs.

Economic valuation of effects

In a Cost-Benefit analysis project effects are first described in quantity and quality and ultimately expressed in monetary terms. For some effects there is a market price reasonably easily available that can be used. For other effects there are no market price, hence we have a situation with *Priced effects* and *Non-priced effects* (OEEI, 2000, Bower, 1997).

Priced effects
Investment and maintenance costs are calculated using normal cost estimating methods for each of the alternatives studied. Land with private houses and commercial buildings are examples of *property*. The loss or protection of property can be valued by market price of the property, or relocation costs. *Infrastructure* such as roads, railways, harbours, water and sewage pipes, electrical and telephone communication cables are generally valued with replacement costs. Loss of *agricultural land* or production should be valued by market value of the land or the current value of foregone agricultural production. Also for agricultural land shadow prices have to be used (Defra, 2000, Penning-Rowsell, 1992). *Recreation* at coastal sites is in most cases free. The tourists do not have to pay an entrance fee; in some cases a parking fee is charged. Recreation and tourism give an economic impulse to the (local) economy. The expenditures of the tourists (such as overnight stays, restaurant visits, purchase of goods and souvenirs) constitute a first estimate of the economic value of recreation.

Non-priced effects
For the valuation of non-priced or external effects no market prices exist, because goods and services are provided freely or are freely available as public goods. In coastal erosion and flooding, this is the case for most environmental and recreational assets but also of goods/direct effects such as quality of life, health, habitats, erosion and flood protection, Water nutrient regulation and indirect effects such as social and employment impacts. Various direct or indirect methods can be used for a monetary valuation.

In the absence of market prices, certain techniques can be used to evaluate effects of such non-market goods. They can be divided into (methods are described in section 2):

- Methods, which investigate the *"willingness to pay"* of people for environmental changes or impacts. These include the Travel Cost Method (TCM), the Hedonic Price Method (HPM) and the Contingent Valuation Method (CVM)
- Methods, which estimate the costs of an *environmental impact* or the costs to restore environmental damage. These include the Production Factor Method (PFM), the Prevention Cost Method (PCM) and the Shadow Project Method (SPM).

The *Benefit transfer method,* is also a low cost approach method. It provides rough estimates and is particularly useful in the feasibility stage. It uses the costs of goods or services from earlier made studies with similar characteristics from another location but with similar demographics as the current location. The use of the different methods is briefly summarised in *Table A1-1*. Data and information needed to conduct a CBA is summarised in *Table A1-2*.

Table A1-1. Methods for economic valuation (Brouwer 2003, Ruijgrok 1999, Defra 2000)

Effects of coastal erosion		Method						
		Market price	TCM	HPM	CVM	SPM	PFM	PCM
Property	Loss	X						
	Change in prices			X				
Infrastructure		X				X		X
Agriculture	Reduced salination						X	
	Loss of production	X*						
	Loss of land	X*				X		X
Tourism	Number of visitors	X**	X					
	Change in quality		X		X			
Environment	Biodiversity					X		
	Nature				X	X		
Social	Reduced risk level				X			
	Quality of life				X			
	Cultural sites				X			X

* corrected for subsidies and taxes
**entrance fee, and/or estimated expenditure by visitors etc.

Table A1-2. Example of data needed in a CBA.

	Quantification of effects	Valuation of effects
Economic effects		
Damage to property	Number of houses (size) damaged, description of damage, when are houses abandoned and can they be restored/relocated?	Costs of restoration, relocation or market price in case the house will be abandoned. Change in market price
Loss of infrastructure	Number, length, area of roads, bridges, railways, cables, pipes etc. relocated or lost.	Investment cost. If property lost the infrastructure may be obsolete.
Loss of agricultural land	Hectare of land lost, lost annual production, for how long production is lost?	Sales price of production (corrected for subsidies and taxes).
Tourism		
Change in tourism behaviour	Number of visitors and their activities Alternative activities	Willingness to pay. Expenditure in region from tourism.
Ecological effects		
Loss in biodiversity	Hectares of nature lost, specified for biotope, number of species etc.	Survey of willingness to pay and shadow project pricing.
Loss of nature areas	Hectare of land lost.	Survey of willingness to pay and shadow project pricing.
Social effects		
Reduced risk level	Risk analysis indicating reduced risk level for coastal zone hazards.	Survey of willingness to pay via Contingency valuation method.
Quality of life	Activities related to quality of life.	Survey of willingness to pay via Contingency valuation method.
Culture sites	Size and description of site lost.	Survey of willingness to pay via Contingency valuation method.

Methods to considering when potential effects of coastal erosion occur

While the CBA encompasses more than just the consideration of the economic returns of a project, most of project data on costs and benefits is provided by economic analysis. This analysis provides essential information on inputs and outputs, their prices and the overall timing structure of revenues and expenditures, benefits and costs. The economic analysis should be presented in a series of tables that collect the flows of investment, operating and maintenance costs and revenue and cash flow analysis of all effects for the time horizon selected (normally 100 years). These economic tables are established for the different alternative options analysed. (Inforegio, 2002)

The economic sustainability can be examined in the economic analysis tables. Similar B/C (benefit/cost) ratios and NPV's (Net Present Value) may show very different distributions of net

annual benefits. In such a case an outline appraisal over a longer period is appropriate to take longer-term gains and losses into account (Defra, 2000).

In order to test the economic efficiency of the different options on a comparable basis, it is necessary to consider the influence of general inflation and change in prices and to discount all costs and benefits of the scheme to their present value.

In project analysis, it is customary to use constant prices, for instance prices adjusted for inflation and fixed at a base-year. However, in the analysis of economic flows, current prices may be more appropriate; these are nominal prices effectively observed year by year. The effect of inflation, or rather the general increase in the price index, or oscillations in relative prices, may impact on the calculation. Therefore, the use of current prices is in general recommended. On the contrary, if constant prices are used, corrections must be entered for changes in the relative prices when these changes are significant. (Inforegio, 2002)

To discount economic flows to the present and to calculate Net Present Value (NPV) the suitable discount rate must be defined. The discount rate is the rate at which future values are discounted to the present. It is usually to be approximately equal to the opportunity cost of capital. An example of calculation is shown in *Box 1*.

Box 1. Calculation of Net Present Value

1 Euro invested at an annual discount rate of 4% will be:
1+ 4%=1.04 after one year
1*(1,04)*(1,04)=1,0816 after two years
1*(1,04)*(1,04)*(1,04)=1,124864 after three years, etc.

The discounted economic value of 1 Euro that will be spent or earned is
in two years is 1/1.0816= 0.924556
in three years 1/1,124864=0,886022

The key concept is that of the opportunity cost of capital i.e. the rate of return that could be obtained if investment was made for another purpose e.g. money in bank account. The discount rate should not be set to high since it reduces the impact of future costs and benefits. Authorities normally define the discount rate to be used.

The formula for calculating the present value (PV) if you know the future value (FV) with a discount rate (r) in year (n) is:

$$PV = FV / (1 + r)^n$$

The interest "discount rate" is sometimes also known as the "internal rate of return", the "equivalent rate of return", or "compound annual growth rate".

To compare the “do nothing” with the “do something” options, market values of properties are converted to their equivalent present values (PV), using the approximation:

$$PV = MV * df$$

where df is the discount factor and MV is the market value (Defra, 2000).

If without a scheme an asset would have been lost in year, *p*, but the scheme delays the loss by *s* years, than the benefit of carrying out the scheme is the difference between the two PV figures (see *Box 2*, Defra approach), which represent the gain from s years of equivalent annual profit. It is also illustrated by an example, where a series of assets, each worth 100 would be lost between year 1 and 45, and a proposed scheme would delay each of these losses by 20 years.

Box 2. Calculating asset loss and benefit of the erosion protection scheme with illustrated example (Source: adapted from Defra, 2000 - fcdpag3, Penning-Rowsell, 1992)

Defra approach

PV(without scheme) = MV $(1 - 1/(1+r)^{p})$

PV(with scheme) = MV $(1 - 1/(1+r)^{p+s})$

Penning-Rowsell proposes direct calculations of benefits using an extension of life factor (ELF)

PV benefits = MV $(1/(1+r)^{p} - 1/(1+r)^{p+s})$ = MV x ELF

Definitions
PV = present value
MV = market value
r = discount rate
p = year of loss without scheme
s = years of loss delay by scheme
ELF = Extension of life factors

This will provide the same result. However, Defra warns, because benefits are derived directly without explicit comparisons of "do something" and "do nothing" values. This can be confusing if several options are compared or flooding and coastal protection impacts are considered together.

Calculation example:
Asset losses and effects of proposed scheme (Extension of life: 20 years)

Market value	Year of loss		Without scheme		With scheme		PV benefit of scheme
	No scheme	With scheme	PV asset value	PV asset loss	PV asset value	PV asset loss	
100	1	21	5,7	94,3	70,6	29,4	64,9
100	5	25	25,3	74,7	76,7	23,3	51,4
100	10	30	44,2	55,8	82,6	17,4	38,4
100	20	40	68,8	31,2	90,3	9,7	21,5
100	35	55	87,0	13,0	95,9	4,1	8,9
100	45	65	92,7	7,3	97,7	2,3	5,0

The algorithms and mathematical presentation when calculating future cost give a picture of objectivity and accuracy. However, future development and extrapolation of present trends is difficult to capture. Values in the near future are less uncertain than values far away.

Decision criteria

The objective for a CBA is to find the "best value for money" within the constraints of budgets and uncertainties. The aim is to maximise the benefit cost ratio (B/C), Net Present Value (NPV) or Internal Rate of Return (IRR) seeking to achieve a certain standard of protection, as set by the national authorities or evaluation initiator. B/C, NPV and IRR use the same basic data but the results are presented differently.

Both NPV and B/C tests require that costs and benefits be presented in terms of their value as of the time of the decision-making. This involves a two-step process. First, all costs and benefits must be expressed in constant monetary value (which effectively controls for future inflation). Then, a discount factor is used to reduce the values of future costs and benefits to represent their present values. The B/C is then calculated as a B/C-ratio, benefits divided by costs. The higher B/C-ratio the better. NPV is calculated as the difference between Benefits and costs. The higher positive NPV the better.

By definition, any project with a positive NPV will also have a B/C ratio exceeding 1. However, a large project with lower B/C ratio (e.g., 1.5) may still have a higher NPV than a small project with a higher B/C (e.g., 1.7). For organisations with constrained funding resources, the B/C test is thus the preferred basis for decision-making among alternatives (such as the choice of project size, location or configuration). While in theory, any project with a B/C ratio exceeding 1 is worthwhile, most organisations have recognised that there is some uncertainty associated with both the benefit and the cost estimates. Accordingly, it is not uncommon for agencies to desire a threshold of B/C exceeding 1.5 for large new projects, and 1.3 for incremental projects (in which uncertainty is less.)

Internal Rate of Return (IRR) is a version of Net Present Value (NPV) and is based on the same principles and the same calculation. NPV shows the value of a stream of future cash flows discounted back to the present by a discount rate that represents the minimum desired rate of return, often an organisations cost of capital. IRR, on the other hand, computes a break-even rate of return. It shows the discount rate below that which an investment results in a positive NPV (and should be made) and above which an investment results in a negative NPV (and should be avoided). The break-even discount rate is the rate at which the value of cash outflows equals the value of cash inflows.

Another issue to consider in the appraisal of a project is the identification of who will gain from a project and who will experience a negative impact. Only if we know "the winners, losers and payers", costs and benefits can be assigned or eventual compensation claims be granted to economic actors who suffer damage from the project, or the environment. From the public point of view, the basic idea is that all effects to everyone in society are summarised and that the alternative with the best total value wins. In some cases this may not be acceptable because some individuals, groups in society or environment suffer severely from the erosion effects. This may influence the decision-making process.

Applicability and restrictions

CBA is applicable for the assessment of all types of coastal erosion projects. It is the method of choice for a number of governmental agencies as it assigns a monetary value to the projects. A monetary value is simple to explain: "If we invest this amount of money we will gain this much!"

One weakness is that CBA is difficult to apply if effects are difficult to express in monetary terms. Applicability is restricted for projects whose justification is specifically the improvement of ecological conditions, and projects that have large effects on ecological and socio-cultural circumstances. Although methods exist for valuing non-priced effects, their applicability is restricted due to methodological and practical drawbacks.

CBA disregards redistribution effects on welfare. A high NPV or B/C ratio may imply an undesirable situation in welfare redistribution. For example, where industry enjoys large production increases at the expense of the environment. Or where the population of village A is protected from erosion at the expense of increased erosion in village B.

The resource required to carry out the project appraisal must be in balance with the significance of the problem and the size of the project. A feasibility study could be useful to judge the importance and required details for the full appraisal. The relative cost of economic valuation of non-priced effects is shown in *Box 3*.

Box 3. Magnitude of evaluation costs of assessing some streams of Benefits and Costs (Defra, 2000)

Benefit or Cost stream	***Relative cost of assessment***
Flood alleviation scheme	
- protecting residential & small commercial/industrial properties	X
- protecting agricultural land	XXX
- protecting large commercial/industrial properties	XX
Coastal defence scheme	
- protecting residential & small commercial/industrial properties	XX
- infrastructure	XX
Traffic disruption	XX
Recreation benefits	XXXX
Environmental assets: replacement cost method	XX
Environmental assets: evaluation of non-use value	XXXXX
(the more "x", the greater the relative cost)	

A common critic on the use of CBA is that decision-makers trust blindly on the numeric outcome of the analysis, whereas important social effects (such as environment, employment, and redistribution of welfare) are not or insufficiently captured in the NPV. The OEEI guideline on Cost-Benefit Analysis for infrastructure projects of the Dutch government therefore stresses the importance of a clear presentation of the outcome of a CBA. A comprehensive table of effects in which the effects of all alternatives considered are quantified and, if possible, valued should be part of the CBA report.

Criticism against CBA is sometimes raised regarding questions as if everything really can be monetised (attached a monetary value) and if it is reasonable to make trade-offs e.g. between the losses of one person and the gains of another. However it can also be argued that with a clear presentation of the assumptions behind and outcome of a CBA, all factors are available and can be scrutinised and discussed (also with MCA). Other evaluation methods hide this kind of arbitration in verbal descriptions and different scales of measurement.

A1.2 Cost-effectiveness Analysis (CEA)

Introduction

Cost-Effectiveness Analysis (CEA) is a technique for selecting among competitive needs wherever resources are limited. There are many similarities between CEA and CBA and much of what is mention in chapter 1 also applies for CEA. Cost-effectiveness analysis is often seen as an alternative to Cost-Benefit Analysis. CEA is most useful when constraints prevent a full CBA to be conducted. The most common constraint is the inability or unwillingness to monetise benefits. In a CEA the benefits are not valuated.

Method

The stages of project definition, identification and valuation of cost and discounted cash flow analysis are similar to a CBA. An appropriate measure of effectiveness must be identified, close as possible to the objective of the project. As in CBA, a sensitivity analysis will be required.

Valuation of effectiveness involves deciding on a way of measuring the effectiveness. Examples of effectiveness measurement are saved lives, saved lives of specific species, protected length of shoreline etc. It is important to distinguish between the outputs of a project and effectiveness of a project. Effectiveness should compare the output of a project against the objectives specified for the project.

Decision criteria

CEA measures costs in common monetary value and effectiveness in physical units. Since the effectiveness measurements are difficult to add or subtract to an aggregated measurement one can determine the:

- Least cost to achieve a preset goal,
- CE ratio as C/E (e.g. amount of € spent per meter of protected shoreline) or
- EC ratio as E/C (e.g. meter of protected shoreline per expenditure in €).

CEA does not say whether a given option is intrinsically worthwhile merely whether the option is better than a different option.

There is also a possibility to reach halfway between CBA and CEA by computing an *adjusted CE ratio* = (social costs - other social benefits)/effectiveness. This approach includes benefits of effects that would otherwise have been omitted. By using this approach benefits that are relatively large and/or easy to value can be incorporated in the analysis, thus increasing the creditability of the valuation.

Applicability and restrictions

CEA is appropriate in cases where the main, benefits cannot be quantified in monetary terms and where the project is less complex and where the number of alternatives is limited. Examples where CEA is applied include the comparison of different methods to improve environmental quality or medical and health service projects.

One restriction with CEA is that it only measures on one effectiveness measure whereas there might exist side/secondary omitted impacts e.g. the effectiveness measure is the number of saved lives but a side-effect is a reduced number of injured as well. Then this "side-effect" is not included in the analysis.

A1.3 Multi-Criteria Analysis (MCA)

Introduction

Comparison of alternatives is an essential part of the decision making process. However, in the case of large, infrastructure projects, the information is mostly heterogeneous, many impacts cannot be measured in monetary terms and many actors (stakeholders) have competing and conflicting objectives. Multi-criteria analysis (MCA) is an approach for choosing from a set of alternatives in such complex, multiple objective situations and to incorporate all social, economic and ecological costs and benefits, measured on different measurement scales, monetary and not monetary, quantitative and not quantitative.

Whereas CBA and CEA use economic efficiency criteria (NPV, BCR) in the appraisal of projects, MCA adds other types of criteria like equity and ecological and distributional aspects.

Increased public participation in the decision making process has created the need to communicate large amounts of information in a transparent and understandable way. Through integration of the opinion of stakeholders and by incorporation all the economic, social and ecological aspects of a policy or project, MCA can make the decision process more transparent and the information more manageable for all stakeholders. MCA is also a well-established decision tool in Environmental Impact Assessment, to compare alternatives (Janssen, 2001).

Identification of criteria

The effects of all project alternatives including the "do nothing" alternative need to be identified, quantified and qualified. Considering as many as possible effects of an intervention can help to alleviate expected negative impacts already in an early phase of project development, through adjustments in design or compensation schemes.

It is usually of great help to involve stakeholder groups or representatives in this exercise (through workshops, focus-groups and in-depth interviews). This is particularly valid when working with an MCA. Inclusion of stakeholders in assessments is desirable from the perspective of acceptance of the outcome of the analysis as well as obtaining all valid information. After having listed effects in a brainstorm session or otherwise, the gross list requires critical review and some structuring. Some effects may overlap, appear twice, or some may still be missing.

A good way of presenting the effects is in a "Table of effects" where the effects are sorted under different categories, such as effects on the local economy and effects on nature. They can also be preliminary ordered in order of significance to indicate with which significant effects to start the evaluation.

From the Table of effects a "Table of criteria" is developed. The effects are rearranged and grouped into criteria definitions, which relies on and represent the social actor's preferences. Examples of criteria are: security, long-term effectiveness, investment costs, maintenance costs, visual impact, impact over marine environment, fragmentation of land use, regional impact on recreation and industry.

Valuation of criteria and effects

Problem definition involves the collection of all relevant information, the generation of a complete list of alternatives and the selection and definition of the criteria to evaluate the alternatives, i.e. the effects or indicators which are relevant for the decision and which represent and reflect the requests and conflicting objectives from all interested parties. The criteria to evaluate the alternatives may be measured on different measurement scales and are normally grouped into three main objectives: to maximise economic benefits, to maximise environmental benefits, and to maximise social benefits.

Scores can be assessed in many ways such as tests and simulation models, direct measurements and expert judgement. The impact of the criteria can be measured on a quantitative scale (ratio, interval or monetary) or on a qualitative scale such as ordinal, +++/--- (useful for expert judgement) or binary.

For the valuation of criteria and effects the technique commonly used is to apply numerical analysis in two stages:

1. Scoring: The expected consequences of each option are assigned a numerical score on a "strength of preference" scale for each option for each criterion. More preferred options score higher on the scale, and less preferred options score lower. In practice, scales extending from 0 to 100 are often used, where 0 represents a real or hypothetical least preferred option, and 100 is associated with a real or hypothetical most preferred option. All options considered in the MCA would then fall between 0 and 100.

2. Weighting: Numerical weights are assigned to define, for each criterion, the relative valuations of a shift between the top and bottom of the chosen scale.

Analysis work

The purpose of MCA is to derive a ranking of the alternatives. To do this the scores must be standardised to make them comparable and they must be weighted to determine the relative importance. There are several ways to standardise the impacts of the different criteria to a common dimension or dimensionless unit:

- Maximum standardisation: scaling the performance according the relative distance between zero and the maximum performance (between 0 and 1).
- Interval standardisation: scaling according the relative position on the interval between the lowest and highest performance.
- Goal standardisation: specify a goal value and a worst value and scale the scores between these two values.

The standardisation relations can be linear or non-linear (value functions).

Weights for each of the criteria can be attributed by experts based on accepted knowledge or by politicians on the basis of policy priorities. Weights can be set by direct assessment or by the use of pair wise comparison or to present an ordinal ranking of importance. This weighting step is criticised as subjective, to be prone to manipulation and to pretend a false sense of accuracy. However, this is only true if the choices are not made explicit and if not all interested parties/stakeholders are properly involved. Proponents claim that MCA provides a systematic and transparent approach that increases objectivity, includes all relevant aspects and generates results that can be reproduced (Janssen, 2001).

Criteria valuation

After valuating the criteria, it is possible to structure the information within an impact matrix. Mathematical routines, which may be implemented into computer software, then combine these components to give an overall assessment of each option being appraised. The softwares used can use approaches for compensatory MCA techniques, mutual independence of preferences and outranking methods. There are many methods available to transform the performance scores and the weights to a ranking of the alternatives. The most popular is "weighted summation": the weights and the standardised scores are multiplied and a linear function is used to calculate the weighted average of the standardised scores. Other methods are Evamix,

Electre2, the analytical hierarchy process (AHP) and the regime method (for a description see Janssen and Munda, 1999).

Sensitivity Analysis

The next vital step of MCA is to assess the robustness of the ranking to uncertainties of scores and weights. This is done by varying weights and scores individually or by using a more extensive Monte Carlo Analysis and investigating how the ranking of the alternatives change.

Reporting

Finally, the results have to be reported to all relevant stakeholders in order to validate the work performed. The stakeholders have different expertise and different interests and it is recommended to present the extended and complex information in graphical form. MCA support the discussions since MCA can couple the available information on the political priorities or individual interests and translate them into the ranking of alternatives.

Decision criteria

MCA uses weighted sums of the standardised economical, ecological and social criteria to structure and visualise the ranking of project alternatives.

The result of a multi-criteria analysis is presented in an Impact matrix (sometimes called performance matrix or consequence table), where each row describes an option and each column describes the performance of the options against each criterion. The individual performance assessments are often numerical, but may also be expressed as icons, or colour coding. The criteria can be measured in cardinal numbers (price, number of drawbacks), some in binary terms (a tick indicates presence of a particular feature), and one in qualitative terms.

In a basic form of MCA this Impact matrix may be the final product of the analysis. The decision makers are then left with the task of assessing the extent to which their objectives are met by the entries in the matrix. Such an intuitive processing of the data can be fast and effective, but it may also lead to the use of unjustified subjective assumptions, causing incorrect ranking of options. In analytically more sophisticated MCA techniques the information in the basic matrix is converted into consistent numerical values and graphs using the different computer software.

Applicability and restrictions

All choice processes have a subjective character. Thus, the MCA cannot objectively define a best alternative, and it cannot replace but support judgement.

An MCA created for a project is based on the specific conditions of that project. This makes the scores obtained for one project incomparable with another project. This makes MCA difficult to use for selection among projects.

An MCA does not give a value that says if a project is worth doing or not as a CBA does. Instead it compares alternatives of a project in the same way as a CEA does.

Some of the arguments mentioned for MCA also apply to CBA and CEA. It is of great importance how the whole assessment process is carried out. CBA and CEA can often be seen as very technical as you need to carry out extensive economic valuation to reach to the exact and correct value (you also need to be an expert to do this). On the contrary, when using a MCA almost anyone can participate and voice a point of view regarding the appropriate ranking and weighting.

A1.4 Methods for valuation of effects

These methods are the most commonly used methods to value effects in the absence of market price. The techniques to evaluate effects of such non-market goods can be divided into:

- Methods that investigate the “willingness to pay” of people for changes or impacts. These include the Travel Cost Method (TCM), the Hedonic Pricing Method (HPM) and the Contingent Valuation Method (CVM).

- Methods that estimate the costs of an environmental impact or the costs of restoration following environmental damage. These include the Production Factor Method (PFM), the Prevention Cost Method (PCM) and the Shadow Project Method (SPM).
- Benefit Transfer Method (BTM).

Environmental economists have identified different categories of environmental values, i.e. goods and services which are delivered by "nature" and which make up the **total economic value** (TEV) of the environment.

The TEV of a natural resource can be divided into (see also *Table A1-3*):

Table A1-3. Valuation of Non-market goods (Source: Nunes, 2000, see also Bower, 1998))

Total Economic Value	Use Value	Direct use value	Recreation benefits e.g. sight-seeing, fishing, swimming Method: TCM, CVM, market price, BTM
		Indirect use value	Ecosystem functional benefits e.g. regulating local chemical composition of the water Method: PFM, HPM
		Option Value	Insurance for having the asset on *stand-by* e.g. future visits, future genetic manipulations Method: CVM
	Non-use Value	Bequest Value	Legacy benefits e.g. habitat conversation for future generations Method: CVM
		Existence Value	Existence benefits e.g. knowledge of existence of marine wildlife diversity Method: TCM, CVM

Use values: they arise from the actual use and production. Normally, they can be measured by market prices and related means and are well accounted in decision making processes. They can be further divided into direct use values, indirect use values and option values.
Non-use values: for these values no market prices exist because they are not traded. They are usually divided into and existence and values bequest values (for future generations) they can be a significant part of TEV.

Travel Cost Method (TCM)

The Travel Cost Method primarily measures the recreational value that visitors place on particular recreation areas (parks, beaches, woodland etc.). It is assumed that the costs in terms of time and transportation that an individual incurs in visiting a site reflect the person's appreciation of that site. The basic principle is that people only visit an area if the expected benefits exceed the costs incurred. The costs incurred are then taken as an indicator of the benefits (recreational values). TCM is a useful method to assess recreational benefits. Travel costs are related to distance and can only capture part of the total value of nature (recreation).

Hedonic Pricing Method (HPM)

Hedonic Pricing Method relates differences in property prices (house and land prices) to variables in the surrounding environment. The basic principle is that property prices are affected to some extent by the characteristics of a particular environment effect. The environment effect can then be given a price tag based on house prices. An environment effect can be seen as positive (proximity to a recreational area, nice view) or negative (water pollution, risk of flooding). It may be to do with differences in time (time series data: prices in 1970 compared to prices in 2005 related to a change in the environment effect). It is also possible to analyse differences between areas with the same type of property however with one important difference in environment variable (cross-section data: the same type of housing in comparable environments with and without the environment effect).

Contingent Valuation Method (CVM)

The basis principle of the Contingent Valuation Method (CVM) is that people have preferences in relation to all goods, and therefore also in relation to goods that are not available on an existing market. The aim of a CVM study is to reveal these hidden preferences by means of questionnaires. People are asked the maximum amount of money they are willing to pay (or willing to accept as compensation) for a hypothetical change of a good. It is assumed that this professed willingness would equate to real willingness if a real market for the goods did exist. Only the Contingent Valuation Method can capture both use and non-use values. However, the surveys have to be carefully designed.

Production Factor Method (PFM)

The Production Factor approach rates changes in the productivity of natural or man-made systems as a result of a change in the environment. An example is the reduction in fish catch as a result of deterioration in water quality caused by a factory not cleaning its wastewater sufficiently before discharging it into the river. If the relationship between the water quality (dose) and the fish catch (response) is known, the value of deterioration in water quality can be calculated. The changes to the financial return of production (the fish catch) can be translated through the dose/response relationship into a counter value for the environment effect (the water quality).

Prevention Cost Method (PCM)

The Prevention Cost Method is based on the prevention expenditure incurred by households, companies or governments to mitigate or avoid particular environmental risks or effects. Examples include the cost of sound insulation (double-glazing, noise barriers) to prevent or reduce excessive noise, or the cost of dikes to prevent flooding. People will only incur this prevention expenditure if the expected usefulness of the expenditure is greater than the expected inconvenience created by the environment effect. Willingness to incur this expenditure is an indication of the minimum cost of the effect or of the minimum benefit of mitigation of the effect.

Shadow Project Method (SPM)

The restoration cost method calculates the cost of measures required restoring or compensating for deterioration in or loss of nature and environment as a result of a project. This is also referred to as the Shadow Project Method. The method estimates the cost of specific measures designed to restore or compensate for deterioration in or loss of nature and environment.

Benefit Transfer Method (BTM)

With the Benefit Transfer Method, estimates of the benefits of nature and the environment from earlier studies are taken as an indication of the economic value of the benefits of nature and the environment in a new, similar policy context.

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APPENDIX 2. SELECTION OF SOCIO-ECONOMIC EVALUATION METHOD

A2.1 Introduction to this appendix

This appendix allow help a user to select the appropriate socio-economic evaluation method to assess the economic challenges regarding a project. It does so by using five Key questions that should be answered to make a selection. The Key questions are drawn up on the basis of literature, analysis of the Messina case studies and our experience in other projects (Donkers and van Cleef, 2006).

Each Key question is shortly described, followed by examples and lessons learned from the case studies and the theory in literature.

For the identification of the Key-questions the following criteria have been used:

- The set-up of this document is question driven, i.e. it presents the information in such a way that it helps the user to find the correct criteria and answers to choose an economic evaluation method.
- The document is specifically intended for coastal management, it is elaborated upon criteria characteristically for projects related to coastal regions.
- The economic evaluation methods can be distinguished on the basis of the answers to these questions.
- The answers to these questions give a first indication on which method should be used.
- This indication directs the user in further study on the method to be chosen.
- The key questions can be recognised as main issues by project leaders and can be answered by local as well as regional as national managers of coastal defence lines.

These Key questions are related to:

1. The objective
2. The type of information required
3. The phase the project is going through
4. The means available
5. The role of other stakeholders

A2.2 Key question 1

In order to acquire information on which method could be suitable, the first essential question that should be answered is:

What are the objectives of the project?

We make a distinction in objectives:

- concerning the final outcome of the project;
- concerning the purpose of using the economic evaluation method.

Objectives concerning the final outcome of the project
Objectives concerning the outcome of the study are the objectives that the project are supposed to achieve, such as flood protection and/or recreational and environmental objectives.

Two variables of the objectives related to the final outcome of the project are relevant as factors in choosing the appropriate economic method: the number and the status of the objectives.

1. Number of objectives
Is there just one or do you have more (interrelated) objectives (such as flood protection, economic development, future investments, recreation, or environmental objectives)? We distinguish two categories:

- One objective
- Multiple objectives

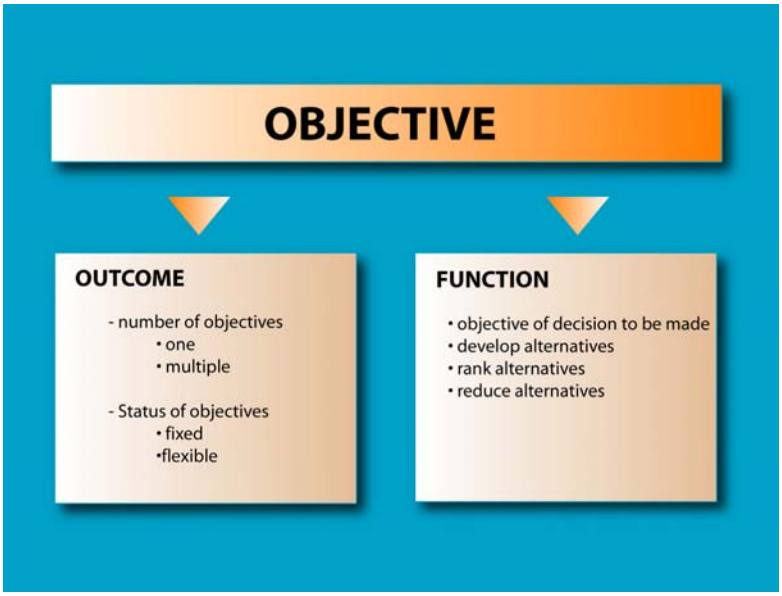
2. Status objectives
A fixed objective is an objective that is quantified as a prerequisite goal of the project (e.g. meeting the safety standard of 1:1250 years, or a fixed amount of money available to invest in improvements). A flexible objective is not specified as such for the decision making process (e.g. optimisation of spatial quality or improvement of recreational potential). The level up to which a flexible objective is realised depends on the choices during the decision making process. These choices include the weights given to the criteria related to the goals.

Hence, we distinguish two categories:

- Fixed objective
- Flexible objective

Objectives concerning the purpose of using the economic evaluation method
Objectives concerning the purpose of using the economic evaluation method have to do with the contribution of the method in the decision-making process. In other words, what do you want to achieve by using this method? Is the main purpose of using the method to develop more information or is it meant to rank alternatives? We distinguish four categories:

- *Definition of (socially) desired objective*
  The economic evaluation is meant to help to determine the appropriate level of the objective. For example, an economic evaluation method may result in a socially desired norm for flooding every 1000 years.
- *Develop knowledge on the project alternatives*
  The economic evaluation is meant to develop relevant knowledge on each of the project alternatives
- *Rank and prioritise the alternatives*
  The economic evaluation is meant to develop knowledge in such a way that on each of the project alternatives can be ranked against one another
- *Reduce the number of alternatives*
  The economic evaluation is meant to develop knowledge in such a way that sufficient information is available to erase project alternatives



Examples and lessons from practice

Number of objectives
The cases in coastal management prove that there are both projects with one as well as projects with multiple objectives.

In the cases we find the following examples of coastal projects with one objective.
The cases of ***Coastal erosion Ystad Sandskog, Beach nourishment Ostia and Procida, and the Quick scan economic optimisation of protection level of coastal areas outside the dike*** have one objective. This objective is to protect the coastline from coastal erosion and in some cases to protect the beaches and/or the coastal towns.

There are also examples of projects with multiple objectives. In the case of ***Coastal erosion in the Lido of Sète*** the main objective is to protect the Lido from coastal erosion. There is also the problem of high visiting rates by tourists which bring a wide range of impacts in the lido and its surroundings. Naturalising the area is another aim, through the restoration of the antique dune system giving a natural protection to the beach.

In the case of the ***coastal extension in South Holland*** the region requires protection against flooding, nature development, prevention of salt-water intrusion and space for recreation and housing.

Status objectives

In the case of ***Coastal areas outside the dike*** the objective (to decrease the probability of damage by dune erosion to currently unprotected coastal towns) is not fixed as a prerequisite. The economic evaluation was meant to determine the socially desired level of protection against flooding. The reduction in the risk of damage is a benefit in the cost-benefit analysis and a choice has to be made to determine what costs the government wants to pay for reducing (physical and emotional) damage.

Objectives concerning the purpose of using the economic evaluation method

From the coastal management cases we've learned that there can be different objectives as to what you and or the decision-maker may want to achieve with an economic evaluation.

Definition of socially desired objective:
In the case ***Coastal areas outside the dike*** the public authorities use the information of the CBA to determine the preferred policy of coastal protection; the ideal future protection level of currently unprotected areas.

Develop knowledge on the alternatives:
In the case of the ***coastal extension in South Holland*** the central question is to identify the conditions under which coastal extension could be financially sustainable in order to design reasonable alternatives. The financial CBA is used for investigating whether the project could be financially sustainable.

Rank the alternatives:
In the case of ***Coastal erosion in the Lido of Sète*** nine alternatives for a long-term solution to coastal erosion are described. The study supplies a ranking of the alternatives.

Reduce the number of alternatives:
The investigators from the case of the ***Coastal erosion in Ystad Sandskog*** conclude that by making a case study for an area, the right persons are activated and questions are put on the agenda. With the study a long-term perspective is generated and the influence over time of natural change (exogenous factors) and manmade intervention is evaluated in one context. These are reasons for using an economic evaluation method in general.

Lessons from theory
In Appendix 1 more information is given about economic evaluation methods.

Number of objectives

- Social CBA and MCA are all suitable for projects with one or multiple objectives.
- A Financial CBA only takes into account changes that affect the organisation for which the analysis is done and with changes which have monetary consequences for the organisation. Also a FCBA excludes external effects. This makes an FCBA less suitable for projects with multiple objectives. A CEA is best suited to deal with a single objective.

Status of objective

- Most economic evaluation methods deal with both flexible and fixed objectives. Only CEA is primarily meant to deal with fixed objectives.

Objectives concerning the purpose of using the economic evaluation method

- Social CBA can be used to define a socially desired objective. As all effects are monetised one can actually calculate the socially desired optimum. The other methods are less equipped to do so. CEA takes an objective as a starting point, and MCA does enable you to calculate an optimum however it does so on the basis of relatively subjective quantified information. CBA uses information in equal (monetised) terms.
- All evaluation methods can contribute to the other objectives concerning the decision-making process such as developing knowledge and ranking and reducing alternatives. However, the methods that only include monetised information give a unique ranking, while an MCA gives a ranking in relation to the relative valuation of the effects and the weigh these values receive in the final decision-making.

	Financial CBA	Social CBA	CEA	MCA
Objective				
Number of objectives	One-multiple	One-multiple	One	One-multiple
Status of objectives	Flexible-fixed	Flexible-fixed	Fixed	Flexible-fixed
Purpose of analysis	Develop knowledge on the alternatives. Rank the alternatives. Reduce the number of alternatives.	Definition of socially desired objective. Develop knowledge on the alternatives. Rank the alternatives.	Develop knowledge on the alternatives. Rank the alternatives. Reduce the number of alternatives.	Develop knowledge on the alternatives. Rank the alternatives. Reduce the number of alternatives.

A2.3 Key question 2

In order to acquire information, on which method could be suitable, the second essential question to be addressed is:

What type and presentation of information is required?

Economic information can be presented in many different ways. We make a distinction in:

- the required type of information;
- the required presentation of information.

Required type of information

When you chose for an economic evaluation method you must have a clear picture of the scope of the required results. What aspects do you want the results to include?

1. Relevance of costs and benefits

The economic analysis may include just costs or both costs and benefits. So here you have two possible answering categories:

- Costs are relevant
- Both costs and benefits are relevant

2. Relevance of social aspects

One also has to assess the question as to whether or not social aspects need to be addressed (nature, recreation, etc). Including the social aspects implies:

- a CBA adopts the perspective of society as a whole: the total net changes in resources, all costs and benefits across the nation are included;
- external (non priced) effects are included.

The aspect “nature” can for example be expressed in loss or gain in biodiversity and loss or gain in natural areas. Also the change in tourism can be relevant for coastal projects, as well as other social aspects like the risk level, quality of life and effects to culture sites. So here you have two possible answering categories:

- Social aspects are relevant
- Social aspects are not relevant

Presentation of information
The choice of an economic evaluation method also depends on how you want to present the economic results. With regard to distinctions between the presentation of information, the most likely are those between quantitative and qualitative results and between monetary and non-monetary results.

1. Quantitative versus qualitative information

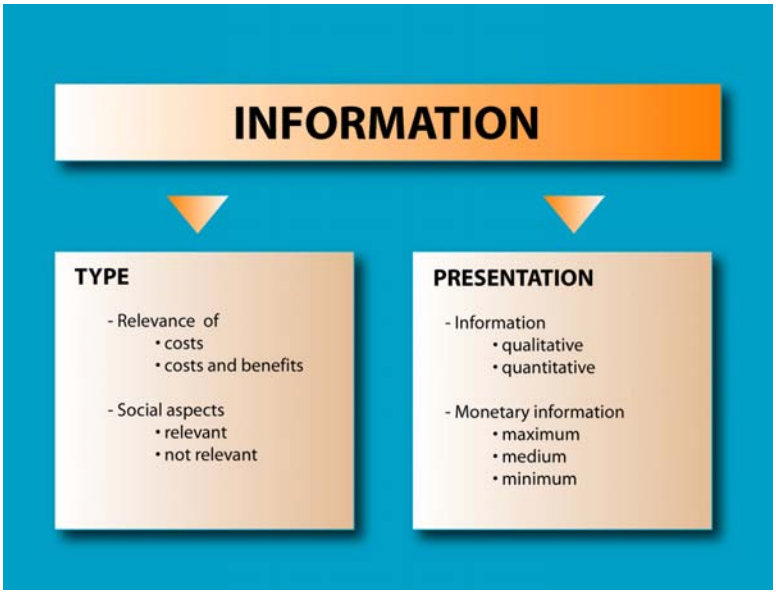
The first variable makes a distinction between quantitative results and qualitative results. One could state that the effect of a measure is good or ++ on a seven-point scale from --- to +++. This qualitative comparison usually takes place in relation to the effects of other measures. It can also be stated that measure A provides for 1000 acres of new nature while measure B only provides for 500 acres. This choice might influence the choice of the most appropriate evaluation method. You can choose between two categories:

- Qualitative information
- Quantitative information

2. Monetary versus non - monetary result

A second and somewhat more complex variable is the difference between monetary or non - monetary results. Crucial in this regard is the extent to which the information required is stated in monetary or financial terms. For example, one can state in quantitative terms how much nature will be developed in a project (for example 100 hectares) but this gives no information on the economic impact of the development of nature in your project. In order to do so, this quantitative but non-financial figure should be turned into monetary information. There are several economic methods that can help you in doing so (see Appendix 1). For this criterion you can choose between three categories:

- Maximum monetary information (all effects have to be expressed in monetary terms)
- Medium monetary information (some effects can be monetised, but it is not necessary that all the effects are)
- Minimum monetary information (for the decision-making monetary information is not required)



Examples and lessons from practice

Type of information

In all of the cases both costs and benefits were taken into account. However, different choices are made for determining the costs and benefits.

In the CBA-study for the ***Coastal erosion in Ystad Sandskog*** the investment and the annual maintenance costs were defined. Regarding the benefits, the total damage and loss of the "base case"-alternative were estimated. This value is later used as the benefit (or avoided damage) for the investigated options of preventive actions (minus the risk of damages that is still present for the investigated project alternatives). In the ***Quick scan of economic optimisation of protection level of coastal areas outside the dike*** a similar choice is made. The result of rising sea level and increasing storm influence will increase the probability of damage to unprotected buildings and infrastructures, assuming the flood defences remain fixed at the current location. In the CBA, the costs of protection measures consist of the construction costs and maintenance costs, and have the benefit of increased protection for coastal towns (reduction in the risk of damage).

In the case of ***Beach nourishment in Ostia*** and the ***Beach drainage in Procida*** only the turnover from beach activities has been taken into account, because that's the most important benefit considering the beach destination (bathing). In both cases a CBA is used. Avoided costs as a result of the mitigated effects of erosion for other markets or social aspects have not been taken into account.

The MCA for the case of ***Coastal erosion in the Lido of Sète*** describes the effects of the alternatives for a solution to coastal erosion in the Lido. The costs are the required investments and maintenance of land reclamation and opening up the infrastructure. The other (social and ecological) effects are described on the criteria security, long-term effectiveness, visual impact, impact on marine environment, fragmentation and regional impact.

The financial CBA for the case of ***Coastal extension in South Holland*** investigates whether the coastal extension is financial sustainable. On basis of the four different spatial development programs the costs of the required investments and maintenance of land reclamation as well as opening up the infrastructure are estimated. For the benefits the analysis did primarily concentrate on the benefits regarding selling houses. It is assumed that the magnitude of the housing development is the determent factor for financial sustainability.

Presentation of information

All cases strive for a maximum of quantified information.

In the case of the ***Coastal erosion in Ystad Sandskog*** the report indicates that further investigation is recommended, to improve the appraisal. The further investigation is necessary to determine omitted items, better measures of the quantities and better basic cost data.

In the MCA for the case of ***Coastal erosion in the Lido of Sète*** only the costs (investment and maintenance) are measured in quantitative (and monetary) terms. The other social and ecological effects are described in qualitative terms (e.g. very good/good/moderate/bad/very bad). Some criteria are evaluated considering two sub-criteria. For example the criterion "long term effectiveness" is based on the extension of the dune system and the number of detached breakwaters. In order to conduct the evaluation in a transparent way and ease understanding, graphic evaluations have been defined (see for an example *Figure A2-1*). By means of these graphics it is possible to conduct an evaluation without compensation between sub-criteria, and they are qualitative in nature.

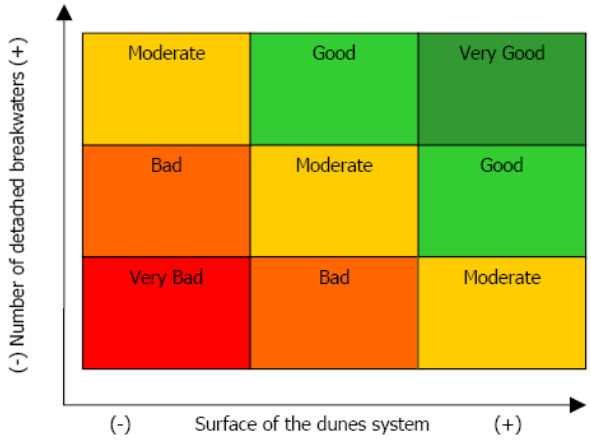


Figure A2-1. Graphic for evaluating longevity

The studies for ***Ostia*** and ***Procida*** conclude:

1. Because comparisons require a common metric, cost-benefit analysis uses a process called discounting to express all future costs and benefits in their present value equivalent. This takes place by discounting costs and benefits in each future time period and summing them to arrive at a present value. This gives rise to one of cost-benefit analysis weaknesses. Because the discounting process calculates its results from the present generation's perspective, one needs to be concerned about equity issues in time, that is, to the fairness of the decision to future generations.
2. Because the values chosen for the used benefit value indicator (the annual turnover per m^2 beach) will significantly influence the final values calculated, the decision-maker must ensure that the values chosen by the experts are reasonable.

Lessons from theory

In Appendix 1 more information is given about economic evaluation methods. This section explains how the different economic evaluation methods score for the variables referred to.

Relevance of costs and benefits

Cases in coastal management in general include both costs and benefits. This is the essence of the economic assessment.

- If only costs are relevant in relation to a fixed goal (one benefit, for example saved lives or protected length of shoreline), CEA should be used. If other benefits are relevant, a CBA or MCA should be used.

Relevance of social aspects
In general coastal management projects include social aspects. They seem to be a logical part of coastal issues. However, in some projects there may be reasons not to further explore the social aspects. Sometimes first priority is given to explore the financial effects to certain economic sectors instead of social aspects.

- The Financial CBA is the only economic evaluation method that is not meant to take social aspects into account.

Quantitative versus qualitative information
- All economic evaluation methods strive for a maximum of quantified information. In practice one will generally find that CEA and Financial CBA will be more quantified then Social CBA and MCA.
- In cases where the main benefits cannot be quantified in monetary terms, CEA could also be appropriate.

Monetary versus non-monetary results
In coastal projects a maximum of monetised information is usually preferred. However the costs and time consumption of generating these figures may lead to a less ambitious approach.
In general it can be said that there is little information available for determining social effects (like nature and spatial quality) in monetary values.
- Of all economic evaluation methods, Social CBA is best suited to present all information in monetary terms. The challenge is to present social effects in monetary values.
- In CEA benefits are not monetised. CEA measures costs in common monetary value and effectiveness in physical units.
- MCA usually combines both monetised and not-monetised information.
- Financial CBA also strives for maximum monetisation but social aspects are not included and therefore not monetised.

A2.4 Key question 3

In order to acquire information on which method could be suitable, the third essential question that should be answered is:

Which phase is the project going through?

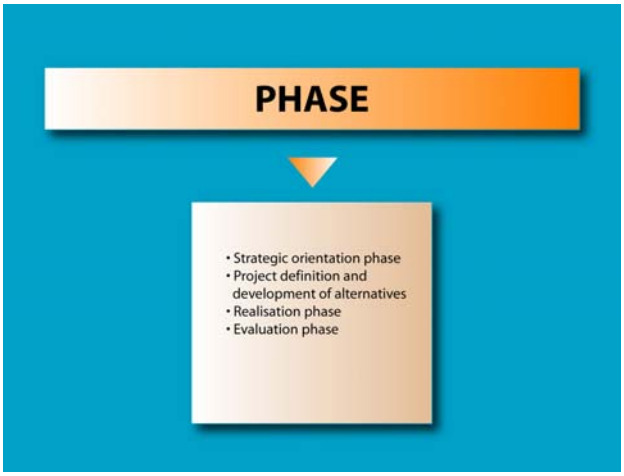
In each project a distinction between different phases can be made. For each of these phases the decision-making differs and, hence, the requirements for an economic evaluation method may differ.

Strategic orientation phase
In this phase the following questions are addressed: what exactly is the problem, what are the causes of the problem and which stakeholders are relevant? It is a strategic phase in which also a first orientation on possible solutions and their respective consequences may be conducted. This strategic orientation phase is the basis for the definition and structure of the project.

Project definition and development of alternatives
The phase of project definition and development of alternatives has different characteristics. In this phase the goals, the activities required to reach them and the preconditions in space and time should be described. Alternative solutions or measures to counter the problems are developed. A comparison between the “base case” alternative and the project alternatives is made in this phase.

Realisation phase
Realisation of the project is the last relevant phase but one. It implies that a decision on an alternative has been made and that the actual operational work starts.

Evaluation phase
An evaluation of the entire project may take place after realisation of the project has been completed.



Examples and lessons from practice

The ***Quick scan of economic optimisation of protection level of coastal areas outside the dike*** is used in the strategic orientation phase. Some parts of coastal towns along the Dutch coastline are situated in unprotected areas on or in front of the primary flood defence. Activities or functions in these unprotected areas are essentially at the public's own risk. The result of rising sea level and increasing storm influence will increase the probability of damage to unprotected buildings and infrastructure. The balance between costs of protection measures and the benefits can be questioned. A Cost-Benefit Analysis is used for getting insight in the optimal protection level for three coastal towns in the Netherlands from an economic perspective.

Beach nourishment has been carried out in the Levant sector of the ***Ostia Beach*** in the evaluation phase. This nourishment is the most important in the Lazio Region and it is the first 'soft' intervention realised in Italy. The nourishment was carried out in 1999. Six years after the intervention, information is available about internal costs (investment and engineering costs, maintenance and monitoring costs) and external benefits (social and economic, based on the annual turnover indication related to the beach activities) to evaluate the intervention with a Cost-Benefit Analysis.

Although it is not common, the financial CBA ***Coastal extension in South Holland*** is used in the strategic orientation phase of the decision-making process. The Dutch parliament did not have a specific problem in mind to be solved. Nevertheless, the presence of "weak" areas in the coastal defence line was a major cause of the revival of ideas for coastal extension in the 1980s and 1990s. Furthermore, coastal extension could contribute to other needs in the region, such as nature development, prevention of salt-water intrusion and space for recreation and housing. An unusual sequence of activities was chosen by first investigating the financial possibilities before questioning the added value for society as a whole. It was necessary to have a realistic picture of the financial feasibility at an early stage of project development.

Lessons from theory

In Appendix 1 more information is given about the economic evaluation methods.

Phase in decision-making process

- CEA and MCA are well suited for use in the strategic orientation phase. In a relatively short time it is possible to create an overview on the project alternatives main characteristics. MCA and CEA can also be used in the phase of project definition and the development of alternatives.
- Financial and Social CBA are usually conducted no sooner then in the phase of project definition and the development of alternatives. These evaluation methods imply a more detailed and more specific (no key figures) approach of a project
- For the realisation phase, the economic evaluation methods do not play a prior role.

- In the evaluation phase, especially Financial and Social CBA can be used. CBA is suitable for an extensive and detailed evaluation, while a preliminary CBA can be used for a quick evaluation.

	Financial CBA	Social CBA	CEA	MCA
Phase				
Phase in decision-making process	Development of alternatives. Evaluation phase.	Development of alternatives. Evaluation phase.	Strategic orientation phase. Development of alternatives.	Strategic orientation phase. Development of alternatives.

A2.5 Key question 4

In order to acquire information, on which method could be suitable, the fourth essential question to be addressed is:

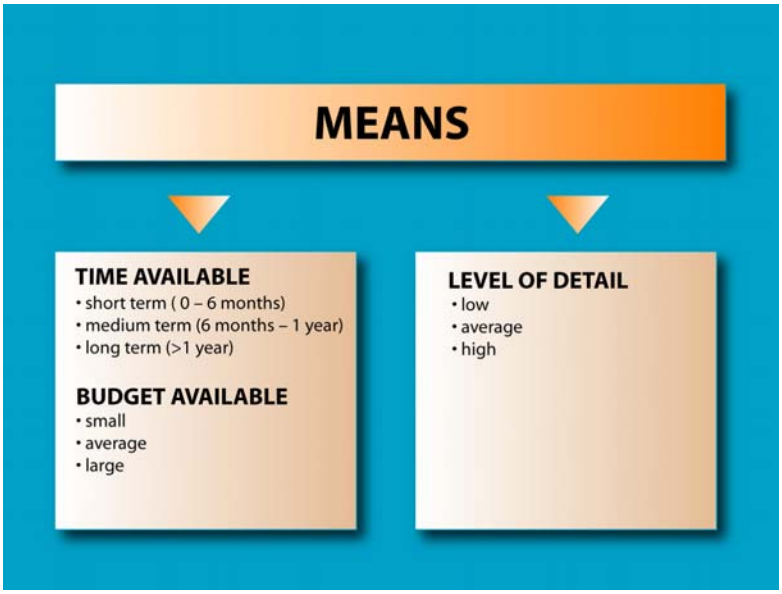
What means are provided to do the project?

In each decision-making process the availability of means will have a serious impact on the possibilities to use economic evaluation methods. The availability of time and budget are preconditions for the selection of an economic evaluation method. Together they interact strongly with the required level of detail with respect to results.

Time available
The first is the availability of time. Different economic evaluation methods require different time periods for their completion.

Budget available
Another critical variable is the availability of budget. Characterising different categories is difficult. If categories are stated in absolute terms, this implies that the size of the project is not taken into account (one research budget may be large for a small coastal project but small for a large coastal project). If categories are stated in relative terms, one does not take into account that there is not an endless linear relation between the size of the project and the budget required.

Level of detail required
Strongly correlated with availability of time and budget is the type of detail that is required for the evaluation of alternatives. A small budget and little time do not correspond with a high level of detail and vice versa.



Examples and lessons from practice

Data collection is often the most time-consuming part of estimating costs and benefits.

Timeframe and human resources for applying the MCA methodology can be a drawback. The whole case study of ***the Lido of Sète*** has been carried out by two people, working full-time during six months. The investigators wrote in their report that it is necessary to spend more time to apply the methodology than used for this study, because feedbacks and a learning process are very important to fine-tune the problem representation, and to guarantee the acceptance of the final solution. The time frame and human resources for applying a methodology can be a drawback.

The CBA for the coastal erosion in ***Ystad Sandskog*** is a brief evaluation which has been conducted with scare resources and is therefore only accurate enough to provide indications. There should be an additional technical and economic evaluation before the final strategy is decided.

The ***Quick scan of economic optimization of protection level of coastal area outside the dike*** concludes that the major limitation in using a CBA. In this case is the availability of reliable data and it will require a considerable investment of means (time as well as money) to gather the following information:

- The location of several erosion lines, with which to define zones of different safety levels;
- An overview of the economic value in each safety level zone;
- The amount of investments needed in order to increase the safety to several different levels.

Lessons from theory

In Appendix 1 more information is given about economic evaluation methods.

Time available

Although the time required for an economic evaluation can vary considerably per project, it is possible to give a general indication on this variable.

- In general, preliminary CBA and CEA are best suited for evaluations that have to be conducted in the short term. A preliminary CBA can make use of existing key figure this makes it possible to develop information in a relatively short term. As for CEA most benefits are not monetised this implies a relatively short time to develop information.
- MCA and Financial CBA would generally speaking fit best in the category medium term. MCA may be easy to fill in but determining the weight factors may be a more time consuming operation. A financial CBA does require some level of detail on the one hand, but does not cover all social aspects on the other hand, making it an average time consuming method.
- A Social CBA has most characteristics of a method that would require a relatively long period of time. A CBA requires both a lot of detail and has a broad nation wide scope (including external effects).

Budget available

Although the budget available for an economic evaluation can vary considerably per project, it is possible to give a general indication on this variable. In general, the conclusion for budgetary aspects of the use of economic evaluation methods is in line with those of the time required.

Level of detail required

- Preliminary CBA is the only economic evaluation method that is truly meant for projects where only a low level of detail is required. The other evaluation methods may vary in detail, with the exception of the Social CBA, which is in essence a detailed evaluation method.

	Financial CBA	Social CBA	CEA	MCA
Means				
Time available	Medium (6 months-1 year)	Long (> 1 year)	Short (0-6 months)	Medium (6 months-1 year)
Budget available	Average	Large	Small	Average
Level of detail	Low - average	High	Low – high	Low -high

A2.6 Key question 5

In order to acquire information on which method could be suitable, the fifth essential question that should be answered is:

What role do other stakeholders have?

In each coastal management project there will be various stakeholders besides your own organisation. All sorts of organisations, such as groups focused on nature conservation, agriculture or recreation may be stakeholders in the project. The main question is up to what level these stakeholders have to be involved in the process of an economic evaluation. This may have an impact on the selection of the economic evaluation method.

There are two distinctive roles these stakeholders may play:

- Development of or providing information
- (Partially) making the decision

These two roles can also be combined.

Development of information
Stakeholders can and in general prove to be a vital source of information that is required in an economic evaluation. A nature conservation group will be able to provide you with facts and figures on nature and a recreational organisation might be able to provide facts and figures on numbers of visitors, money spent per visitor and so on.

Making the decision (partially)
Another role a stakeholder could play is that of a (joint) decision-maker. This implies giving stakeholders a voice or vote in the process that will eventually lead to the decision.

Combination of roles
Naturally both roles could also be combined, which implies that a stakeholder not only provides information but is also involved in the decision-making process.

Examples and lessons from practice

In the case of coastal erosion in ***Lido of Sète*** local social actors (for example camping owners, a sailing school, the municipality of Sète, the tourism office and social movements) were actively involved. The reservations and expectations of the local social actors are gathered through social research to be incorporated in the problem structuring. They are used to construct the alternative solutions and the evaluation criteria. The results are presented to the stakeholders and their feedback is used in order to validate the work performed.

Some lessons learned:

- Through meetings, interviews and the documents review, a better perspective about the different interests involved is obtained. That is when it is possible to elucidate the evaluation criteria by analysing the opinions given by the different social actors.
- Some of the criteria represent the perceptions and worries of the social actors, the government and those involved in structuring the problem. This interaction represents a social control on the decision, an impulse to transparency. But good ways of communication are required for this aim. To this end, creativity has to be developed in order to stimulate people's motivation to participate.
- The participatory techniques provide greater legitimacy for the final decision. But participation does not mean scientists and politicians are not responsible for giving advise and making choices.

In the case of ***Coastal extension in South Holland*** the Ministry of Transport, Public Works and Water Management carried out the study in close co-operation with the provincial authorities of South Holland. Other parties were not involved. The outcomes of this study are presented to experts in a workshop to ensure the quality of the executed study. This expert meeting was organised with potential stakeholders and independent experts, who have experience with large-scale projects in the field of spatial development. The experts mentioned that the chosen assumptions for the costs and the benefits are reasonably and within the chosen range. Some comments were made at the defined heights of the ground shares. These remarks are incorporated in the sensitivity analysis.

Lessons from theory
In Appendix 1more information is given about economic evaluation methods.

- For most economic evaluation methods the role of the stakeholder is limited to that of providing information. For MCA, however, it is possible that stakeholders are also involved in valuing effects and giving weights to these criteria for the final decision.
- For most economic evaluation methods the role of stakeholders in the process of developing information is desirable, as they can provide information on the criteria that are of specific interest to them.
- If stakeholders are to be included in the decision-making process the use of an MCA is most appropriate. In an MCA the stakeholders can have a more active role in defining the weight of the criteria while with a Social CBA, weights are already implicitly given to the criteria during the monetisation of effects. Therefore, the input of involved actors in the decision between alternatives is less visible.

	Financial CBA	Social CBA	CEA	MCA
Stakeholders				
Role of stakeholders	Providing information	Providing information	Providing information	Providing information and participating in the decision-making process

A2.7 References

Donker, M. And van Cleef, R. (2006). Coastal management and instruments for economic evaluation – making choices: Lessons learned from Case studies. Messina, 2006. www.interreg-messina.org/publications.htm

APPENDIX 3. CASE STUDIES – LESSONS LEARNED

A3.1 Introduction

Within the Messina project a number of case studies have been performed in order to compile experience and to illustrate coastal management issues in different countries. As a basis for the valuation of shorelines, six case studies on economic assessments have been carried out.

The following cases have been studied:
- Coastal erosion at Ystad Sandskog (Sweden)
- Coastal erosion at the Lido of Sète (France)
- Coastal extension in South Holland (the Netherlands)
- Quick scan of economic optimisation of protection level of coastal areas outside the dike (the Netherlands)
- Beach nourishment in Ostia (Italy)
- Beach drainage in Procida (Italy)

These cases have been evaluated and lessons learned are compiled by Donkers and van Cleef (2006). A summary of there results are given in this appendix, following the same structure for each case. More information about the cases can be found in the reports on the cases, see list of references. Tables, figures and photos are extracted from the reports.

A3.2 Coastal erosion at Ystad Sandskog (Sweden)

***Figure A3-1*. The beach at Ystad Sandskog**

General description
Ystad Sandskog is an important part of the city of Ystad. The coastline of Ystad Sandskog consists of sandy beaches and the area is well visited for different kinds of recreational activities. It is vital for the municipality of Ystad that the erosion (50 meters inland over the last 100 years) does not continue.

The present strategy of the municipality is maintaining the shore-protecting structures in place (existing seawall and groins). The municipality is investigating two alternative combinations of preventive measures. The first alternative is to maintain the existing seawall and groins and to establish new breakwaters. The second alternative involves beach nourishment and limited

maintenance for the existing seawall and planned breakwaters. The base case ("do nothing" alternative) implies that land, properties roads and utilities are lost to the sea. This is not really an option for the municipality, but is used in the analysis to demonstrate what values are at stake

A brief Social ***Cost-Benefit Analysis (SCBA)*** of the area has been conducted.

The objective
The objective of the municipality of Ystad is to stop the erosion of the coast and protect the coastline and beaches.

The aim of the study is to evaluate the present strategy of the municipality in order to clarify if it is worthwhile. The efficiency of an alternative (beach nourishment) is analysed.

Type of information
The estimated total damage and loss of the "do nothing"-alternative is used as the benefit (or avoided damage) for the investigated options of preventive actions. The costs of implementing the options are estimated. Even if the options are fulfilled there is still a hazard of damage to property and infrastructure and the costs of these are calculated.

A simplified Table of effects for the Ystad Sandskog case is given in *Table A3-1*. A complete Table of effects is given in the main report of the case.

Table A3-1. Table of effects for Ystad Sandskog

	Alternatives		
	Do nothing	**Option 1 Maintain & repair**	**Option 2 Beach nourish-ment**
Direct effects			
Investment costs	0	Yes	Yes
Maintenance costs	0	Yes	Yes
Direct/indirect effects			
Damage to property and infrastructure	Yes	Some	Some
Agriculture	0	0	0
Recreation/Tourism	Yes	0	0
Other damages	Yes	0	0

The information given in the case study report about the costs, damage and losses are of a quantitative nature and they are indicated in monetary terms. Quantity data is collected from maps and from the municipality of Ystad. Cost data is estimated from historical data and past experience.

Phase in decision-making process
No information available.

Means
It is a brief SCBA, which has been conducted with scarce resources and is therefore only accurate enough to provide indications. There should be an additional technical and economical evaluation before the final strategy is decided.

Role of other stakeholders
No information available.

Summary results
By making the study a good base from which to proceed, technical people involved are activated and questions are put on the agenda. With the CBA a long-term perspective is generated and the influence over time of natural change and man-made intervention is evaluated in one context.

The results are summarised in a table which indicates that the benefits of maintaining and protecting the present shoreline are three times greater than the costs. For the beach nourishment, the benefit/cost ratio is 3.6. Of the two investigated project-alternatives, beach nourishment is the best option.

Lessons learned
The total damage and loss of the “do nothing”-alternative (No Project) can be used as the benefit (or avoided damage) for the investigated project alternatives, minus the risk of damages that is still present for the investigated project-alternatives.
Further investigation to improve the appraisal is recommended. Are there omitted items? Can the quantities be better measured? Are there better basic cost data?
A decision-maker can use the benefit/cost ratio to select the best alternative.

Analysis: choice of the evaluation method
The information on some criteria is limited (phase in decision-making process, means, role of other stakeholders). To judge the choice of the evaluation method, it is important to have information on all of the criteria. On the basis of the available information, we can conclude that a brief CBA is suitable in this case to evaluate the present strategy of the municipality on financial aspects.

Because of the flexible objective, a CEA would not be appropriate. A financial CBA could not take the social aspects (e.g. recreation, tourism, forests) into account. Apparently the resources available were scarce, therefor a social CBA is less appropriate.

It could be considered necessary to apply a MCA in this case. However, the role of other stakeholders is not explicitly mentioned; it appears there was no role in either providing the information nor in participating in the decision-making process. This makes the use of a MCA less appropriate.

Additional investigation (with a social CBA or MCA) can provide more information about the costs and (social) benefits of the measurements.

A3.3 Coastal erosion at the Lido of Sète (France)

Figure A3-2. The Lido of Sète

General description
The Lido of Sète is a narrow strip of land that separates the lagoon of Thau and the Mediterranean Sea. The Lido of Sète has become very vulnerable to coastal erosion and sea level rise. Many activities developed on this land as well as fishing activities inside the lagoon are at risk of serious economic, social and environmental adverse consequences.

A combination of participatory process and ***Multi-Criteria Analysis (MCA)*** was applied. After gathering the perceptions, opinions and objectives of different social actors, the information is structured in an MCA framework according to a sequence of steps:

- The identification of the problem at hand and the isolation of the relevant stakeholders;
- The creation of alternatives to solve the problem;
- The criteria definition;
- Criteria valuation and the structuring of the information within an impact matrix;
- Multi-criteria evaluation;
- Presentation of results and validation.

The objective
The municipality of Sète started a process at the end of the 1990's to search for a long-term solution to coastal erosion in the Lido of Sète.
The main objective of the alternatives is to define a strategy to protect the Lido from coastal erosion. In addition to the problem of erosion, there is the problem of high frequentation rates. The parking along the road, the access to the dunes and to the natural spaces reflects this trouble. Naturalising the area is another aim, through the restoration of the antique dune system giving natural protection to the beach.

The proposal to counter erosion in the Lido of Sète is based on a "move backward" strategy, which involves removing infrastructures from the coastal zone and trying to restore the natural system to its original state. Nine alternatives are described in total. The study supplies a ranking of the alternatives.

Type of information
Only the investment costs and maintenance costs are measured in quantitative and monetary terms. The other criteria (security, long-term effectiveness, visual impact, impact on marine environment, fragmentation and regional impact) are described in qualitative terms.

A brief overview of the evaluation criteria is given in *Table A3-2.*

Table A3-2. Overview of evaluation criteria

Dim	Criteria	Index
Social	Security	Qualitative based on: Number of access to the road for vehicles. Easiness of access to the beach for pedestrian.
	Long term effectiveness	Qualitative based on: Extension of the dune system (from the sea to the road). Number of detached breakwaters.
Economic	Impact over tourism	Not evaluated.
	Costs of the works	Quantitative. Unit: €
	Costs of management and maintenance	Quantitative Unit: €/year
Ecological	Visual impact	Qualitative based on: Degree of interference between an observer on the road and the horizon line.
	Impact over the marine environment	Qualitative based on: Number of constructions into the sea. Level of intervention into the sea in the future.
	Fragmentation (longitu-dinal, transversal and regional)	Qualitative based on: Number of longitudinal cuts in the dune system. Number of access to the beach. Number of elements interfering to sediments transportation and affecting currents.

In order to conduct the evaluation in a transparent way and ease understanding, graphic evaluations have been defined (see for an example *Figure A3-3*).

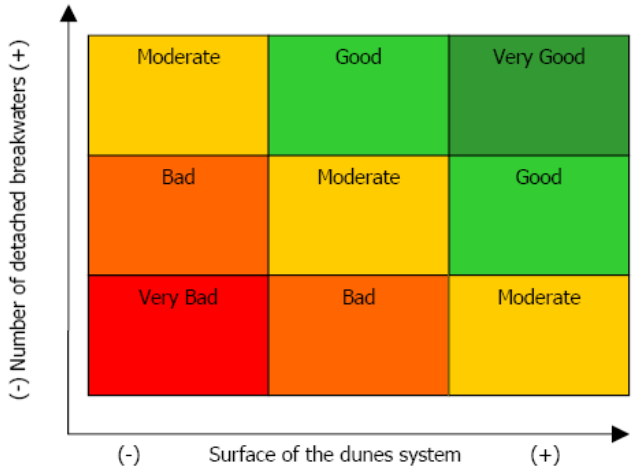


Figure A3-3. Graphic for evaluating Longevity

Phase in decision-making process
In France this kind of intervention begins with a pre-operational phase (diagnosis, the creation of scenarios and project guidelines). At the time of study was conducted, the pre-operational phase was near completed.

Means
A considerable amount of time is required to apply the methodology (two people, working full-time during six months have carried out the whole study). The investigators wrote in their report

that it is necessary to spend more time to apply the methodology than used for this study, because feedbacks and a learning process are very important to fine-tune the problem representation, and to guarantee the acceptance of the final solution. The time frame and human resources for applying a methodology can be a drawback.

Role of other stakeholders
The fears and expectations of the local social actors are gathered through social research to be incorporated in the problem structuring. They are used to construct the alternative solutions and the evaluation criteria. Some of the criteria represent the perceptions and worries of the social actors, the administrative authorities and those involved in structuring the problem. The results are presented to the stakeholders and their feedback is used in order to validate the work performed.

Summary results
After valuating the criteria, the information is structured in an impact matrix, which is presented in two forms, see *Tables A3-3* and *A3-4.*

Table A3-3. Impact matrix, alternative 1

	Alt. A	**Alt. B1**	**Alt. B2**	**Alt. C1**	**…**
Criteria					
Security	+ or – Low	+ or – Low	High	+ or – High	…
Long-term effectiveness	Very Bad	Good	Good	Moderate	…
Investment costs	0	~48	~46.5	~38.9	…
Maintenance costs	~500	~1.500	~1.500	~800	…
Visual impact	High	Very High	High	Moderate	…
Impact over marine environment	Moderate	Very High	Very High	Low	…
Fragmentation	Very High	Very High	Very High	Moderate	…
Regional impact	Moderate	Very Bad	Very Bad	Bad	…

Table A3-4. Impact matrix, alternative 2

	Alt. A	**Alt. B1**	**Alt. B2**	**Alt. C1**	**…**
Criteria					
Security	Fifth	Fifth	First	Third	…
Long-term effectiveness	Ninth	Fifth	Fifth	Seventh	…
Investment costs	First	Ninth	Eighth	Third	…
Maintenance costs	First	Eighth	Eighth	Second	…
Visual impact	Seventh	Ninth	Seventh	First	…
Impact over marine environment	Seventh	Eighth	Eighth	First	…
Fragmentation	Seventh	Seventh	Seventh	Fourth	…
Regional impact	First	Eighth	Eighth	Second	…

With the so-called NAIADE method the alternatives are compared. Three alternatives rank in the first positions:

- backward movement, cycling track in the west limit of the ancient dunes
- backward movement, cycling track parallel to the road
- medium displacement of the road and parking areas

These alternatives have medium-high investment and maintenance costs, but they present good scoring in the environmental and social criteria.

Lessons learned
Through meetings, interviews and the document review, a better perspective about the different interests involved is obtained. That is when it is possible to elucidate the evaluation criteria by analysing the opinions given by the different social actors.

As some criteria are evaluated considering two sub-criteria, the multi-criteria method must consider the use of weighting factors to compensate between criteria and qualitative or ordinal

valuations. By help of graphical presentation (see above) it is possible to conduct an evaluation without compensation between sub-criteria, and they are qualitative in nature.

The interaction with social actors represents a social control on the decision, an impulse to transparency. But good ways of communication are required for this aim. To this end, creativity has to be developed in order to stimulate people's motivation to participate. The participatory techniques provide greater legitimacy for the final decision. But participation does not mean "de-responsibility" for scientist's advice and for politician's choices.

The time frame and human resources for applying the methodology can be a drawback. Feed-back and a learning process are very important to fine-tune the representation of the problem and to guarantee the acceptance of the final solution.

The information presented in the two impact matrices can be very useful for raising awareness diversity of impacts, and the different views that have been considered for evaluating the alter-natives.

Analysis: Choice of the evaluation method
MCA is a suitable method for this project, mainly because:

- Multiple and flexible objectives (CEA is not appropriate).
- The aim is ranking alternatives. MCA can contribute to that objective concerning the deci-sion-making process.
- Social effects were relevant (financial CBA is not appropriate).
- Information is available on different measurement scales, MCA manages qualitative infor-mation and can combine both monetised and not-monetised information.
- The participation of the actors is very important. With a MCA stakeholders can participate in the role of providing information and in the decision-making process.

A3.4 Coastal extension in South Holland (the Netherlands)

Figure A3-4. Coastal extension in South Holland (Uytewaal and Essen, 2005)

General description
The Dutch parliament requested an exploration into the possibilities for coastal extension between Hoek van Holland and Scheveningen. This means the creation of new land in front of the coastline of South Holland.

The province of South Holland has supplied the relevant framework and assumptions for the different spatial programmes, for the functions nature, recreation, tourism, housing, company premises/glasshouses, infrastructure, coastal protection, coastal maintenance and dune compensation (compensation for the Mainport development in Rotterdam).

The study investigates, by means of a ***Financial Cost-Benefit Analysis (CBA)***, whether the coastal extension is financially sustainable. The question whether coastal extension could be a financially healthy and sustainable investment has been studied through a "business case" analysis. The financial benefits of the investment should outweigh the costs of investment and maintenance. It is assumed that the magnitude of the housing development is the determinant factor for financial sustainability.

The objective
The Dutch parliament did not have a specific problem in mind to be solved. Nevertheless, the presence of "weak" areas in the coastal defence line was a major cause of the revival of ideas for coastal extension in the 1980's and 1990's. Furthermore, coastal extension could contribute to other needs in the region, such as nature development, prevention of salt-water intrusion and space for recreation and housing.

The central question of the first phase of the study is to identify the conditions under which coastal extension could be financially sustainable. This study has a tentative character and does not have a formal status to prepare decision-making. The aim of the study is also to develop knowledge on the alternatives in order to define them more precisely.

Type of information
On the basis of the four different spatial development programmes, the costs of the required investments and maintenance of land reclamation as well as opening up the infrastructure are estimated in quantitative and monetary terms.

The analysis concentrated mainly on the need for housing. The benefits of selling houses are estimated in quantitative and monetary terms. The possibilities for tourism and recreation as well as nature are also explored in qualitative terms.

The following table shows for each spatial program (or rough design), the surface of the programme, the area built (red functions), the investment costs and the number of houses that are to be built and sold to make the investment profitable.

Phase in decision-making process
The evaluation method is used in the strategic orientation phase in the decision-making process.

Means
No information available.

Role of other stakeholders
The Ministry of Transport, Public Works and Water Management carried out the study in close co-operation with the provincial authorities of South Holland. Other parties were not involved.
The outcomes of the findings of this study are presented to experts in a workshop to ensure the quality of the executed study.

Program	1	2	3	4
New land	Green – blue[1]	Green-blue and red[1]	Green-blue and red[1]	Green-blue and red[1]
Area (ha)	1100	1600	1300	3000
% red functions	0	18	34	23
Costs (in euros * million)				
Superstructure[2]	292-451	476-706	467-708	875-1352
Substructure[3]	35-50	388-504	501-664	998-1321
Opening up	8-8	59-59	56-56	59-59
Unforseen	17-25	46-63	51-71	96-136
Total	**352-534**	**969-1333**	**1075-1499**	**2028-2868**
Nature compensation	*Not yet vakued*			
Morphological effects elsewhere				
Traffic effects mainland	-	+	+	++
Benefits to bear the costs				
Number of houses	14000	12000-22000	12000-23000	22000-48000
Sale-period (yr)	7	6-11	6-12	11-24

[1] *Red = housing/infrastructure; Green = nature; Blue = water*
[2] *Superstructure: utility companies (gas, water, electricity), nature facilities, make land ready for building and living.*
[3] *Substructure: land reclamation, sand loss, reinforcement dam "Hoek van Holland", dam marina "Hoek van Holland", northern pier, southern pier, pier at "Ter Heijde"and maintenance coastline.*

Summary results
The Financial CBA showed that coastal extension is financially sustainable if a large number of houses can be sold. Coastal extension with housing gives plenty of possibilities for nature development and recreation. A financial contribution of the involved government reduces the necessary amounts of houses to get a feasible financial outline.

Lessons learned
A financial CBA can be used for investigating whether a project is financially sustainable.

An unusual sequence of activities was chosen in the study by first investigating the financial possibilities before questioning the added value for society as a whole (in a Social CBA). The reason for this order is to have a realistic picture of the financial feasibility at an early stage of the project development.

Analysis: choice of the evaluation method
A financial CBA is a suitable method for this project, mainly because the aim of the project is to investigate if coastal extension is *financially* sustainable. Social aspects were not taken in account. This seems a narrow approach. In this case a choice has been made to only study the financial aspects of the coastal extension. However, social aspects may be of importance for this case. For further analysis and decision-making, the social aspects have to be studied. The financial CBA does not answer these issues. In this phase of the decision-making process a preliminary CBA could have been considered. With a preliminary CBA the financial as well as the social aspects of the issue could have been taken into account in general terms.

A3.5 Quick scan of economic optimisation of protection level of coastal areas outside the dike (the Netherlands)

Figure A3-5. Protection against erosion in Dutch coastal cities

General description
Some parts of coastal towns along the Dutch coastline are situated in unprotected areas on or in front of the primary flood defence system. Activities or functions in these unprotected areas are essentially at the public's own risk. The result of the rising sea level and increasing storm influence will increase the probability of damage to unprotected buildings and infrastructure. This increase in the risk of damage can be counteracted by protection measures like sand nourishment at the beach or strengthening of the dunes. The costs of these measures consist of the construction costs and maintenance costs, and have the benefit of increased protection for coastal towns.

The balance between costs and benefits can be questioned. In order to gain insight into this problem, a ***Social Cost Benefit Analyses (CBA)*** is performed. This CBA is used for choosing the economically optimal level of protection for three coastal towns in the Netherlands (Bergen aan Zee, Zandvoort and Scheveningen). Social costs and benefits (avoided damages on business, infrastructure and properties)are taken into account.

The objective
The costs and benefits of four policy options (physical measures) for risk management are determined. The objective is to decrease the probability of damage by dune erosion to currently unprotected coastal towns. The goal is an economic optimisation by minimising the total costs of measures and the (remaining) damage, The aim of the project is to choose a policy, therefore four policies are used as alternative options.

This study investigates the possibilities of reducing the risk by sand nourishment. This would give a strengthening of the dune at the seaward side in order to move the erosion line (and the associated probability of failure) in a seaward direction.

Type of information
Public authorities use the collected information when making a decision on the preferred policy of coastal protection. In the Cost-Benefit Analysis, the costs are the cost of additional measures and the benefits are the reduction in the risk of damage. The economic values at several erosion lines are determined.

Both costs and benefits are determined in monetary terms.

The following data is needed:

- The location of several erosion lines, in order to define zones of different safety levels;
- An overview of the economic value in each safety level zone;
- The amount of investments needed in order to increase the safety to several different levels. Ideally these are the costs of several methods.

This study was based on a very limited amount of data and several assumptions were made during the analysis. For example, for Zandvoort it was assumed that there are no buildings seawards of the 1/300 erosion line (so the economic value is zero), and also assumptions were made for the economic value between the 1/10,000 and 1/1,000,000 erosion lines.

Phase in decision-making process
Strategic orientation phase.

Means
No information available.

Role of other stakeholders
No information available.

Summary results
The results of the assumptions for the economic values can be presented as a cumulative risk as a function of the erosion probability. *Figure A3-6* displays the total costs of the investments as a function of the probability of erosion including factors for economic growth and rising sea level for Zandvoort. The total costs are the cost of the investments (beach nourishment) and the benefits (avoided damage). In this case it is not profitable to further invest in safety (see the figure). The present value of the risk is equal to 17.5 million €, by moving the erosion line by measures the total of cost and risk becomes higher.

For Zandvoort and Bergen aan Zee the conclusion can be drawn that it is not profitable to invest in increasing the level of safety. For Scheveningen a conclusion cannot be drawn, since no information on the cost of investments (beach nourishment) was available.

In the report a subjective estimation of the uncertainty of parameters used in the cost-benefit analysis is given. The costs of the measures and the location of the erosion lines is one of the major causes of uncertainty.

Lessons learned

- A cost-benefit analysis can be used to determine the ideal future protection level of currently unprotected areas from cost benefit perspective.
- The major limitation in using a CBA in this case is the availability of reliable data. For Scheveningen no information on the cost of investments was available. For the other cases several assumptions are made. The conclusions on the optimum investment should be considered with great care, since this was based on a very limited amount of data and several assumptions were made during the analysis.

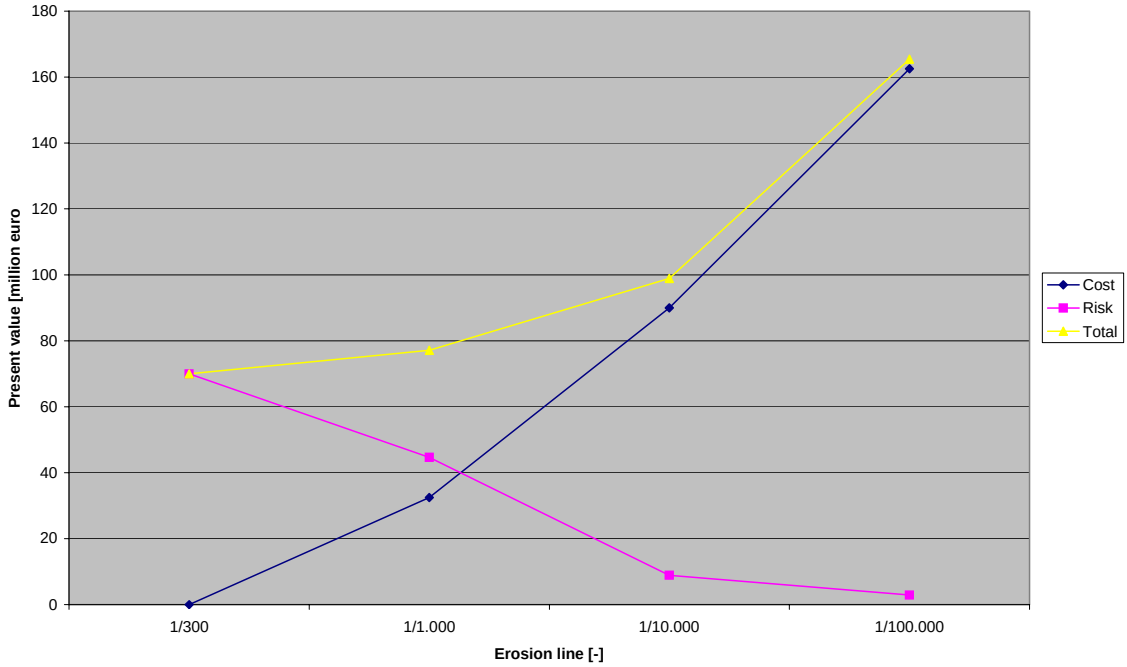


Figure A3-6. The total costs of the investments as a function of the probability of erosion including factors for economic growth and rising sea level for Zandvoort, the Netherlands

Analysis: choice of the evaluation method
The information on some criteria is limited (means, role of other stakeholders). To judge the choice of the evaluation method, it is important to have information on all of the criteria. On the base of the available information, we can conclude that a CBA is a suitable method for choosing the economically optimal level of protection for the coastal towns, mainly because social aspects were relevant.

A3.6 Beach nourishment in Ostia (Italy)

General description
Beach nourishment has been carried out in the Levant sector of the Ostia Beach. It has been carried out to protect the shore from natural forces ant do mitigate the effects of beach erosion. This nourishment is the most important in the Lazio Region and is the first soft intervention (without any protection) realised in Italy. Innovative and environmentally friendly engineering techniques have been implemented (for example beach nourishment, beach drainage, wetland creation and restoration, dune rehabilitation, artificial reef creation).

This intervention was based on a CBA to choose between sheltered nourishment (with a submerged barrier) and a soft one (only sand). The nourishment was carried out in 1999. The nourishment is concerning a 3.5 km stretch of coast, with a 950,000 m^3 sand dredging. Six years after the intervention, information is available to evaluate the intervention with a ***Cost-Benefit Analysis (CBA)***.

The objective
The objective of the project is to evaluate the soft beach nourishment. The beach nourishment has been carried out to protect the shore from natural forces and to mitigate the effects of beach erosion.

Type of information
The information concerns internal costs (investment and engineering costs, maintenance and monitoring costs) and external benefits based on the annual turnover indicator related tot the beach activities. Costs and benefits are expressed in quantitative and monetary terms. With

respect to the benefits, only the turnovers from beach activities have been taken into account. The Ostia main economy is concerning services linked to tourism. Some examples of these services are lidos (bathing establishments), hotels, bed & breakfast, dressing rooms and camping areas. The used benefit value indicator is 25.20 €/m^2 (annual turnover from beach activities).

Phase in decision-making process
Evaluation phase.

Means
No information available.

Role of other stakeholders
No information available.

Summary results
The present net benefit of the beach nourishment (over 25 years) is about 33 million euros and the Benefit/Cost ratio is 2.78.

Lessons learned

- Only the turnover from the beach activities has been taken into account, even if the increasing of the beach surface implies an impact on the other economic activities like restaurants and hotels. That is really remarkable in this case, because Ostia is the bathing station of Rome.
- Comparisons require a common metric and so CBA therefore uses a process called discounting to express all future costs and benefits in each future time period and summing them to arrive at a present value. This gives rise to one of the weaknesses of CBA. Because the discounting process calculates its results from the present generation's perspective, one needs to be concerned about inter-temporal equity issues; to the fairness of the decision with respect to future generations.
- The values chosen for the used benefit value indicator (the annual turnover per m^2 beach) will significantly influence the final values calculated, therefor the decision-maker must ensure that the values chosen by experts are reasonable.

Analysis: choice of the evaluation method
The information on some criteria is limited (means, role of other stakeholders). To judge the choice of the evaluation method, it is important to have information on all of the criteria. On the basis of the available information, we can conclude that a social CBA is a suitable method for this project. A SCBA adopts the perspective of society as a whole. In this case a limited SCBA is conducted, because the only social aspects taken into account are the effects on recreation activities. A FCBA is not appropriate because a FCBA is carried out from the perspective of a company. In this case the municipality is responsible for the interventions to mitigate erosion. A CEA could not be used because besides the costs also the benefits are relevant. Moreover, a CEA is appropriate to compare different alternatives. In this case only one alternative is studied. A MCA is not necessary because in this case only one sector (namely recreation) is of importance. This interest can easily be expressed in financial terms.

A3.7 Beach drainage in Procida (Italy)

General description
The Ciraccio and Ciraccello beaches are sandy beaches used for bathing tourism and they suffer from erosion. The beach drainage intervention was carried out in 2002. The most important economic activity in Procida is tourism.

The intervention was carried out by placing four sections, each of them provided with two drainpipe parallel lines in the beach front, a small collecting well for the drained waters and a lifting pump for the discharge: two small wells release the water into the sea and other two, linked to each other, send out the water into Chiaolella port. Information is available to evaluate the intervention with a ***financial Cost-Benefit Analysis (CBA)***.

The objective
The objective of the project is to evaluate the beach drainage intervention. The intervention is also compared to a pure nourishment one (aimed to produce the same result).

Type of information
The information concerns internal costs (investment and engineering costs, maintenance and monitoring costs) and external benefits (social and economic) based on the annual turnover indicator related to the beach activities. Costs and benefits are expressed in quantitative and monetary terms. Regarding the benefits, only the turnovers from beach activities have been taken into account. The used benefit value indicator is 22,64 €/m^2 (annual turnover from beach activities).

Phase in decision-making process
Evaluation phase.

Means
No information available.

Role of other stakeholders
No information available.

Summary results
The present net benefit of the beach drainage (over 25 years) is about 1.36 million Euro and the Benefit/Cost ratio is 2.28.

It is interesting to compare the beach drainage intervention with a pure nourishment one, intended to give the same result. In respect of the beach drainage intervention, only the costs differ. The costs are strongly linked to the reloading sand cost and to the availability of a suitable submarine loan sandpit. The simulation shows that the nourishment only gives a net benefit higher than the beach drainage solution when the sand costs are kept under the value of 6,96 €/m^3. This value is unlikely to be achieved in Italy.

Lessons learned
- Only the turnover from the beach activities has been taken into account, even if the increasing of the beach surface implies an impact on the other economic activities like restaurants and hotels. This scenario would be considered extraordinary as Ostia is the bathing station of Rome.
- Because comparisons require a common metric, CBA uses a process called discounting to express all future costs and benefits in each future time period and summing them to arrive at a present value. This gives rise to one of the weaknesses of CBA. Because the discounting process calculates its results from the present generation's perspective, one needs to be concerned about inter-temporal equity issues; to the fairness of the decision with respect to future generations.
- Because the values chosen for the used benefit value indicator (the annual turnover per m^2 beach) will significantly influence the final values calculated, the decision-maker must ensure that the values chosen are reasonable.

Analysis: choice of the evaluation method
The information on some criteria is limited (means, role of other stakeholders). To judge the choice of the evaluation method, it is important to have information on all of the criteria. On the basis of the available information, we can conclude that a social CBA is a suitable method for this project. A SCBA adopts the perspective of society as a whole. In this case a limited SCBA is conducted, because the only social aspects taken into account are the effects on recreation activities. A FCBA is not appropriate because a FCBA is carried out from the perspective of a company. In this case the municipality is responsible for the interventions to mitigate erosion. A CEA could not be used because besides the costs also the benefits are relevant. Moreover, a CEA is appropriate to compare different alternatives. In this case only one alternative is studied. A MCA is not necessary because in this case only one sector (namely recreation) is of importance. This interest can easily be expressed in financial terms.

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