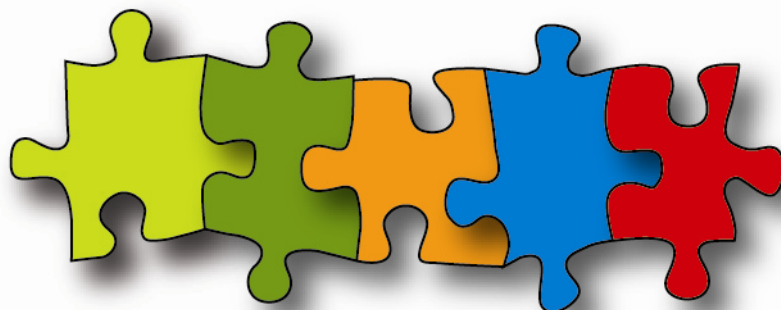


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COASTAL MANAGEMENT AND INSTRUMENTS FOR ECONOMIC EVALUATION

“MAKING CHOICES: LESSONS LEARNED FROM CASE STUDIES”



COMPONENT 3 VALUATION OF THE SHORELINE MESSINA PROJECT

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I. INTRODUCTION

This document is written for the Messina project. Messina (Managing European Shoreline and Sharing Information on Nearshore Areas)¹ is a European consortium of local and national authorities on coastal management from different countries in Europe. The Messina project contains several components. Component 3 ‘Valuation of the shoreline’ aims to internalise coastal erosion costs and risks in planning and investment decisions and to make responses to coastal erosion accountable. The final outcome of the Messina project will be a practical guide for economic valuation of shorelines. This document is an analysis of the Messina-case studies and a background-document for the practical guide.

For each coastal project, it is important to have a thorough overview of the costs and benefits of the project and the alternative measures. Coastal projects deal with for instance preventing of erosion, safety measures against 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 tended to strive increasingly for integrated impact assessment of decisions in coastal management. This document contains a case study analysis with lessons on the selection and use of economic evaluation methods. This document aims at supporting policymakers who have no or little economic background to globally understand and select the appropriate evaluation method for assessing the economic impact of coastal projects.

The coastal projects described in this document are listed in the following table.

The first five projects in the table are carried out as part of the Messina project. The other cases are included in this study as it is expected that these experiences provide useful lessons for the selection of the most appropriate economic evaluation method. All the cases are coastal projects, except for the “Space for the Rivers”-case. It is expected that this case also provides useful lessons.

Project	Country	Short description of the problem and potential measures
Coastal erosion Ystad Sandskog	Sweden	Coastal erosion mitigated by strengthening coastal defence structures or beach nourishment combined with maintenance of existing structures.
Coastal erosion the Lido of Sète	France	Vulnerability to erosion and sea level rise. Solutions sought in removing infrastructure (road / parking lot), coastal defences on the shoreline and restoring natural protection (dune system)
Coastal extension in South Holland	The Netherlands	Presence of weak spots in the coastal defence line and study of the potential for coastal extensions to protect the locations

¹ For more information about Messina see www.interreg-messina.org.

Beach nourishment in Ostia	Italy	To mitigate the effect of beach erosion, soft beach nourishment (without any protection, only sand) was chosen from different alternative measures.
Beach drainage in Procida	Italy	Beach erosion mitigated by beach drainage intervention.
Quick scan of economic optimisation of protection level of coastal areas outside the dike	The Netherlands	Investigating the balance between costs and benefits of the Protection of coastal areas outside the primary defence structures by strengthening dunes or carry out beach nourishments.
Weak Link Noord-Holland	The Netherlands	Not meeting the national safety standards for several locations in the coastal defence system is countered by various measures that also answer to the objective of improved spatial quality.
Weak Link West Zeeuwsch-Vlaanderen	The Netherlands	Answering to the national safety standards in the near future can be secured by consolidation or landward reinforcement of the coastal defence line or by seaward based solutions. The best alternative also includes meeting the goals for spatial quality.
“Space for the Rivers”	The Netherlands	In this project safety measures against flooding from the main river system are identified and selected.

This document starts in *chapter II* with an overview of the case studies and a short description of the used economic evaluation methods. *Chapter III* will help to select the appropriate economic evaluation method to assess the economic challenges regarding a coastal project. It does so by leading the reader through 5 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. Using theory and the experience from the selected cases we will attempt to give an overview in *chapter IV* of the arguments that are to be used to select a method for two coastal projects that are actually being carried out in the Netherlands.

The *annexes* contain further information on the economic methods (Annex 1 – 4) and the analysed cases (Annex 5). Annex 6 has a list of references that points the interested reader towards further information.

II. THE CASE STUDIES AND THE ECONOMIC EVALUATION METHODS

This chapter contains a short description of the cases and the used economic evaluation methods. Detailed descriptions of these methods (and the steps to follow) can be found in Annex 3. Detailed descriptions of the case studies can be found in chapter III and Annex 5.

The following steps are the main steps of an evaluation of coastal projects and different alternatives. More information on the steps can be found in the State-of-the-art report of Messina Component 3 [1].

- Problem analysis;
- Project definition and development of alternatives including the “base case” (no extra measures);
- Identification of effects;
- Quantifying and qualifying effects;
- Comparing alternatives (with an evaluation method);
- Hazard and risk analysis.

For the identification of the effects a table of effects can be used.

Table of effects

A table of effects enables the effects of a wide diversity of solutions to be put side by side in a logical way. The table of effects and the score card are presented as a matrix with the alternatives on one axis and the criteria on the other. The cells can show absolute and relative scores (e.g. compared to the reference situation). This gives a conveniently arranged picture of how the alternatives being investigated score on each criterion. The effects of the alternatives on the criteria can be indicated qualitatively and quantitatively. A ranking can then be made based on those effects. The experts who fill in the effects table are not specifically trying to rank the project alternatives (a project alternative is a measure or a package of measures required to reach the objective). The effects can also be converted into a rating or a score that reflects the effect in the light of the objectives being pursued.

An example of an table of effects from the Flooding study Maas (from the State-of-the-art report of Messina Component 3 [1]):

	Alternatives					
	Units	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						
Acc. Safety legislation	yes/no	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 m ³	0	74	26	21	25
Effects on future usage						
Extra nature areas	ha	0	16354	4229	3102	9869
Chances landscape	++/- -	0	0	++	++	+

Case: Beach nourishment in Ostia (Italy) [33]

A 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 is concerning a 3,5 km stretch of coast, with a 950.000 m³ sand dredging. Six years after the intervention, the intervention is evaluated with a Cost-Benefit Analysis (CBA).

Cost-Benefit Analysis (CBA)

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.

There are different types of Cost-Benefit Analysis (CBA). 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.

Case: Beach drainage in Procida (Italy) [33]

The Ciraccio and Ciracello 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, a little collecting well for the drained waters and a lifting pump for the discharge: two little wells release the water into the sea and other two, linked each other, send out the water into Chiaolella port. Six years after the intervention, the intervention is evaluated with a Cost-Benefit Analysis (CBA).

Case: Coastal extension in South Holland (The Netherlands) [29] [34]

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 study investigates, by means of a Financial Cost-Benefit Analysis (CBA), whether the coastal extension is financially sustainable.

Case: Quick scan of economic optimisation of protection level of coastal areas outside the dike (The Netherlands) [30]

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 under water.

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 CBA is performed. This CBA is used for getting insight in the optimal protection level for three coastal towns in the Netherlands from an economic perspective.

Case: "Space for the Rivers" (the Netherlands) [38]

The aim of the Space for the Rivers project is to improve the safety measures against flooding. A secondary aim is to improve spatial quality. A social Cost-Benefit Analysis (CBA) and a Cost-Effectiveness Analysis (CEA) have been carried out, for different purposes. The CBA is looking at what the optimum safety strategy is, without taking the national standard as fixed objective. The result of the cost effectiveness analysis is a ranking of measures based on the costs for answering to the targets for safety improvement and spatial quality.

Cost-Effectiveness Analysis (CEA)

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.

Case: Coastal erosion the Lido of Sète (France) [31]

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.

Multi-Criteria Analysis (MCA)

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. 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.

Case: Coastal erosion Ystad Sandskog (Sweden) [32]

It is vital for Ystad that the erosion of the coastline of Sandskogen 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. A Preliminary Cost Benefit Analysis (PCBA) of the area has been conducted.

Preliminary Cost Benefit Analysis (PCBA)²

A Preliminary Cost Benefit Analysis (PCBA) is a rough Cost-Benefit Analysis that presents alternative measures in general terms and is based primarily on available information and indicators (key figures). It outlines the effects of the various project alternatives in general terms. It draws primarily on existing or simple model instruments and the results of previous studies. A full CBA (financial or social) can be carried out when the a first selection of project alternatives has been made. The main idea of a PCBA is to present a general picture of the advantages and disadvantages of the project alternatives. A PCBA is also referred to as a "quick scan" for making an initial selection from possible alternatives.

Case: Weak Link Noord-Holland (The Netherlands) [35]

In the not too distant future, some Dutch coastal defences will no longer meet safety standards. The most vulnerable parts of the dikes are called Weak Links. Possible solutions are consolidation or landward reinforcement of the coastal defence line or seaward based solutions like sand nourishment or defence structures.

The Province of Noord-Holland has set up an Integrated Evaluation for the Weak Links as a basis for administrative decision-making. A Preliminary Cost Benefit Analysis (PCBA) of the various project alternatives is part of this Integrated Evaluation.

Case: Weak Link West Zeeuwsch-Vlaanderen (The Netherlands) [36]

It is foreseen that in the near future, some Dutch coastal defences will no longer meet safety standards. The most vulnerable parts of the dikes are called Weak Links. A more detailed plan study for strengthening the North Sea coast of West Zeeuwsch-Vlaanderen has been launched. Possible solutions are consolidation or landward reinforcement of the coastal defence line or seaward based solutions like sand nourishment or defence structures. The Preliminary Cost Benefit Analysis (PCBA) is part of the plan study.

² Developed as part of the OEI procedure in the Netherlands for the evaluation of effects of large infrastructural projects

Preconditions for economic methods

For some of the economic instruments the methodology has been standardised and made obligatory. The OEI (Dutch abbreviation for the instrument to study effects of infrastructure development) can be obligatory for the SNIP procedure (annex 6. ref. 4), which stands for the rules that have to be followed when developing water infrastructural projects in the Netherlands³. The OEI is obligatory for larger projects (>euro 15m) and is initiated with an economic orientation by developing a simple table of effects. This table of effects helps you to map all relevant effects of a project in a transparent way. In Annex 1 you will find more information about tables of effects. For a Cost-Benefit Analysis for large infrastructure projects, one should follow the rules as described in the OEI Guideline (annex 6. ref. 13). For other methodologies such strict guidelines do not exist. However, further explanation and best practices can be found in several documents and sites such as www.waterwaarden.nl and “de waterwaarderingswijzer” (both available only in Dutch).

³ SNIP: “*Spelregels Natte Infrastructuur Projecten*”, Formal procedure for water infrastructure projects, used by the Dutch national government

III. CHOOSING AN ECONOMIC EVALUATION METHOD

Introduction to this chapter

This chapter will help you to select the appropriate economic evaluation method to assess the economic challenges regarding your project. It does so by leading you through 5 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.

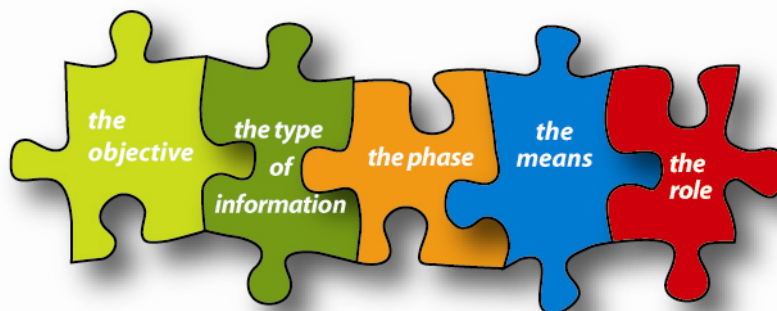
Each key question is shortly described, followed by examples and lessons learned from the case studies and the theory in literature.

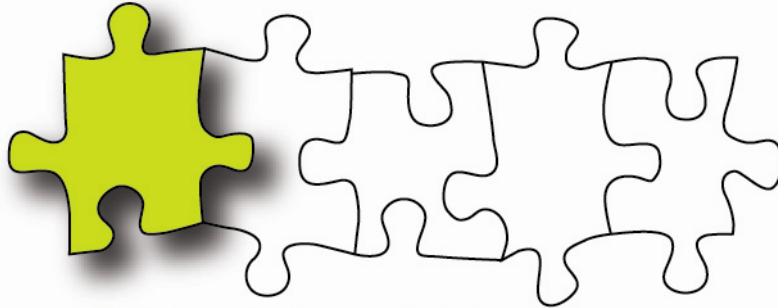
For the identification of the key-questions we have used the following criteria:

- The set-up of this document is question driven, i.e. it presents the information in such a way that it helps the user in finding 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 recognized 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.





1. THE OBJECTIVE

1.1 Introduction to the key question

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 is 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. optimization 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.

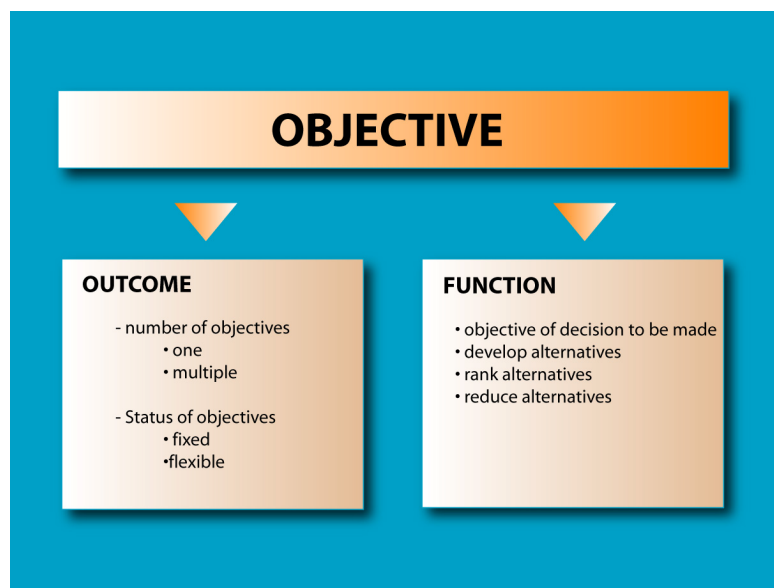
Hence, we distinguish two categories:

- 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



1.2 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 tourist 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.

For the cases of the *Weak Links in Noord-Holland and West Zeeuwsch-Vlaanderen* the objectives are meeting the safety standards in terms of flood prevention and improvement of spatial quality.

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.

The case of the *Weak Link Noord-Holland* contains a combination of flexible and fixed objectives. The objectives are: meet the safety standards of flood prevention (fixed) and improve the spatial quality (flexible). All the alternatives meet the safety standard and are not differentiated at all in that respect. The alternatives are a combination of safety measures with spatial quality measures.

In the case *Space for the Rivers* a cost effectiveness analysis is carried out. The result of the CEA is a ranking of measures based on the combination of safety improvement efficiency and spatial quality. For each measure the benefits are compared to standardized costs (key figures for different cost categories) needed to obtain similar benefits. The standardized costs of a project alternative are compared to the real costs of the measures, which indicate the efficiency of the alternative. If the real or actual costs of the measure are lower than the standardized costs this implies that the measure is cost effective.

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.

The number of possible solution directions for the project “***Space for Rivers***” was huge. The method (CEA) was designed to help compare measures with one another and rank them on the base of costs efficiency.

Reduce the number of alternatives:

The case of the ***Weak Link West Zeeuwsch-Vlaanderen*** contains an evaluation of the different solution directions on the basis of an understanding of the costs and social effects. Initial choices can be based on this evaluation. Remaining options will be explored further in a follow-up project.

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.

Overall protection and defence needs in the UK (Case from the State-of-the-art report of Messina Component 3 [1])

To assess future funding requirements, Defra estimated (on a high scale level) in a CBA the costs and benefits associated with investment in flood and coastal defence infrastructure in England. A “base case”-option as well as several maintenance options and “improvement”-options were considered. In order to demonstrate the robustness of the proposed investments, the benefit to cost ratio (B/C ratio) has been calculated. The study demonstrates the need for effective targeting and prioritisation of both investment and maintenance capital to avoid unnecessary expenditure.

1.3 Lessons from theory

In Annex 3 you find more information about the economic evaluation methods.

Number of objectives

- Social CBA, PCBA 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.

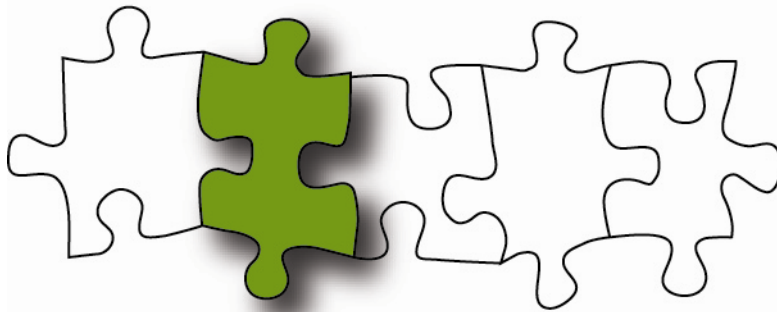
Objectives concerning the purpose of using the economic evaluation method

- Social CBA and PCBA can be used to define a socially desired objective. Because all effects are monetized 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 (monetized) 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	PCBA	CEA	MCA
1. Objective					
Number of objectives	One - multiple	One – multiple	One – multiple	One	One – multiple
Status of objectives	Flexible – fixed	Flexible – fixed	Flexible – fixed	Fixed	Flexible – fixed
The purpose of using the method	<ul style="list-style-type: none"> •Develop knowledge on the alternatives •Rank the alternatives •Reduce the number of alternatives 	<ul style="list-style-type: none"> •Definition of socially desired objective •Develop knowledge on the alternatives •Rank the alternatives 	<ul style="list-style-type: none"> •Definition of socially desired objective •Develop knowledge on the alternatives •Rank the alternatives 	<ul style="list-style-type: none"> •Develop knowledge on the alternatives •Rank the alternatives •Reduce the number of alternatives 	<ul style="list-style-type: none"> •Develop knowledge on the alternatives •Rank the alternatives •Reduce the number of alternatives



2. THE TYPE OF INFORMATION REQUIRED

2.1 Introduction to the key question

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 SCBA 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 nature 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.

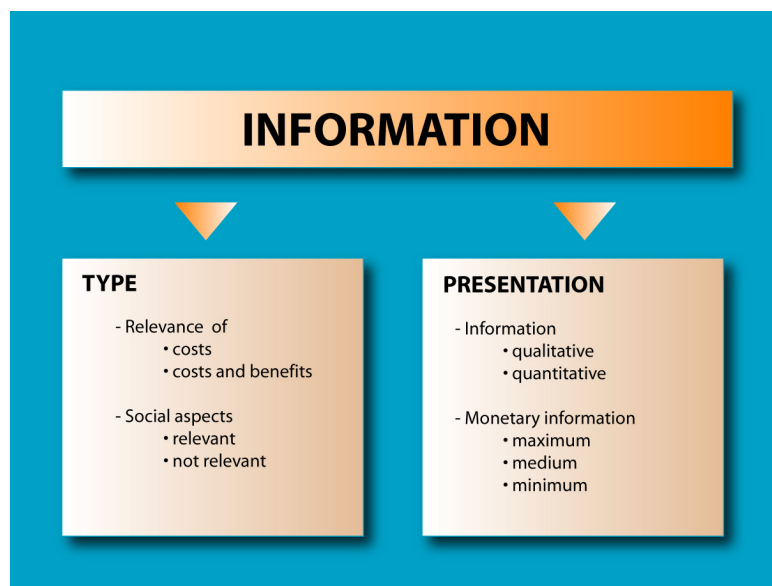
The first variable makes a distinction between quantitative results and qualitative results. One could state that the effect of a measure is good or ++ on a seven-point scale from --- to +++. This qualitative comparison usually takes place in relation to the effects of other measures. It can also be 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 Annex 4). 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)



2.2 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 PCBA-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.

In the PCBA-studies for *the Weak Links of West Zeeuwsch-Vlaanderen* and *Noord-Holland* the major benefits (the effect of the safety measures against flooding) were not quantified in more detail. Because all alternatives must meet the statutory standard, this effect does not serve to differentiate the alternatives. The safety benefits are therefore not defined and expressed in monetary terms, which makes these PCBA-studies look like a Cost-Effectiveness Analysis (CEA). The studies were called CBA-studies because they include benefits (like spatial quality, recreation and nature). These benefits would not have been taken into account in a CEA, because a CEA compares the costs of alternative measures with a fixed goal (one benefit, for example saved lives or protected length of shoreline),

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 ecologic) 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 determinant factor for financial sustainability.

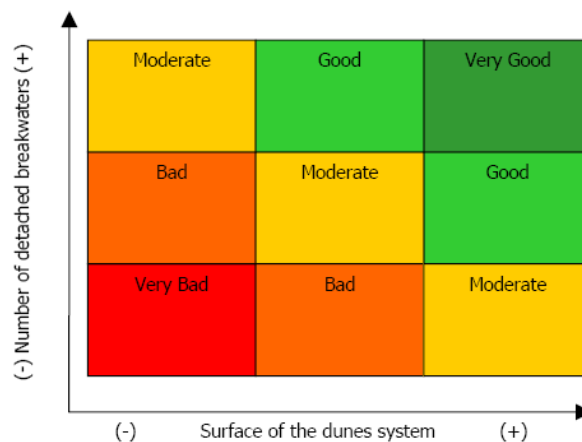
Presentation of information

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 the figure below). By means of these graphics it is possible to conduct an evaluation without compensation between sub-criteria, and they are qualitative in nature.

Figure 13. Graphic for evaluating Longevity



The PCBA-study for the *Weak Link West Zeeuwsch-Vlaanderen* points out that the differences in spatial quality are difficult to quantify. The PCBA only quantifies the direct effects, the indirect and external effects are mainly qualitative in nature. It was not possible to reliably quantify the indirect and external effects due to a lack of relevant information.

In the PCBA-study for the *Weak Link Noord-Holland* some effects are in a range (upper and lower limit) because of an uncertainty in the effects or in the used indicators (for example, the used indicator for the value of nature is 10 – 20 euro per household).

Some (mainly social and ecological) effects appear to be very difficult to quantify and monetise. In the PCBA for the *Weak Link Noord-Holland* the direct effects (e.g. investment and maintenance costs, recreation) are quantified and valued in more detail than the indirect effects (e.g. labour market and houses). Some effects remain not defined (e.g. safety guarantee and chances for development after 2060). In particular, information on benefits is limited and difficult to access. More research is needed into the valuation of nature effects and the number of domestic and international recreation visitors.

It was also not possible to reliably quantify the indirect and external effects (e.g. nature) in the PCBA for the *Weak Link West Zeeuwsch-Vlaanderen* due to a lack of relevant information.

For the effects in spatial quality an approximation is given based on what turned out to be the maximum consumers were willing to pay for land.

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

- 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.
- Because the values chosen for the used benefit value indicator (the annual turnover per m² beach) will significantly influence the final values calculated, the decision-maker must ensure that the values chosen by the experts are reasonable.

Social CBA and MCA Hondsbossche sea dike (Case from the State-of-the-art report of Messina Component 3 [1])

The Hondsbossche sea dike has been build in 1880 and has a length of 5 km. The long-term safety can be questioned. The objective of the government is to maintain the current shoreline, but measures are necessary. Three possible options were assessed from an economical, an ecological and a social-cultural point of view. For the economical point of view, a social CBA has been carried out. In the CBA, the costs of the measures are the investment costs and the operational and maintenance costs. The benefits are:

- the productivity and land used for agriculture
- the creation of breeding grounds for the fish population
- the increased number of visitors (recreation)
- the influence on the fresh water production
- the change in perception of the security (of the local people)
- the change in perception of the biodiversity
- property: changes in house values and number of houses
- the reduced flood damage

The values of these effects have been determined with different valuation methods.

In the decision-making process also an MCA has been carried out to provide a complete comparison of the effects. This integrated assessment included the economical, the ecological as well as the social-cultural dimension.

2.3 Lessons from theory

In Annex 3 you find more information about the 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 PCBA, CEA and Financial CBA will be more quantified than 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 PCBA the effort to monetise is more restricted to the core parameters.
- 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.

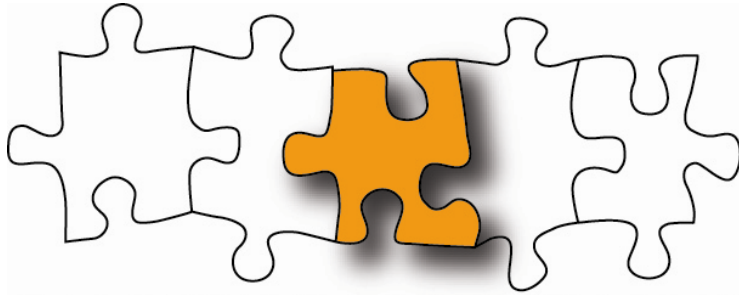
For the project *Space for the Rivers* a CEA was chosen for evaluating the measures for safety against flooding and spatial quality. The result of the cost effectiveness analysis is a ranking of measures based on the efficiency with which safety gains and spatial quality are combined.

A CEA results in less-far-reaching conclusions than a CBA, but when the occasion arises a CEA can be a more suitable analysis instrument than a CBA. In this case there were two reasons for choosing a CEA which have to do with the type and presentation of information:

- The most important reason for opting for a CEA rather than a CBA has to do with the project's secondary aim: spatial quality. It is extraordinarily difficult to express the non-priced social benefits of spatial quality in monetary terms. The versatility of the concept makes it difficult to identify all the possible factors, let alone quantify them or even put them in order. A CBA would lose considerable significance if these important project effects could not be expressed in money terms and only figured as pm-items.

- The second reason was the availability of the information did not meet the requirements for a CBA to be carried out. Constraints on time and financial means led the decision-makers to carry out a CEA.

	Financial CBA	Social CBA	PCBA	CEA	MCA
2. Type of information					
Relevance of costs and benefits	Costs and benefits	Costs and benefits	Costs and benefits	Costs	Costs and benefits
Relevance of social effects	Not relevant	Relevant	Relevant	Relevant	Relevant
Quantitative or qualitative	Medium quantitative nature	Maximum quantitative nature	Medium quantitative nature	Medium quantitative nature	Maximum quantitative nature
Monetary or non-monetary	Medium aspects considering financial aspects are indicated in monetary terms. Social effects, however, are not taken into account.	Maximum of information indicated in monetary terms.	Medium. The effort to monetise is more restricted.	Medium. At least a part of the information is indicated in monetary terms, however benefits are not monetised.	Different measurement scales. MCA manages both monetary and non-monetary information.



3. THE PHASE THE PROJECT IS GOING THROUGH

3.1 Introduction to the key question

In order to acquire information on which method could be suitable, the first 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

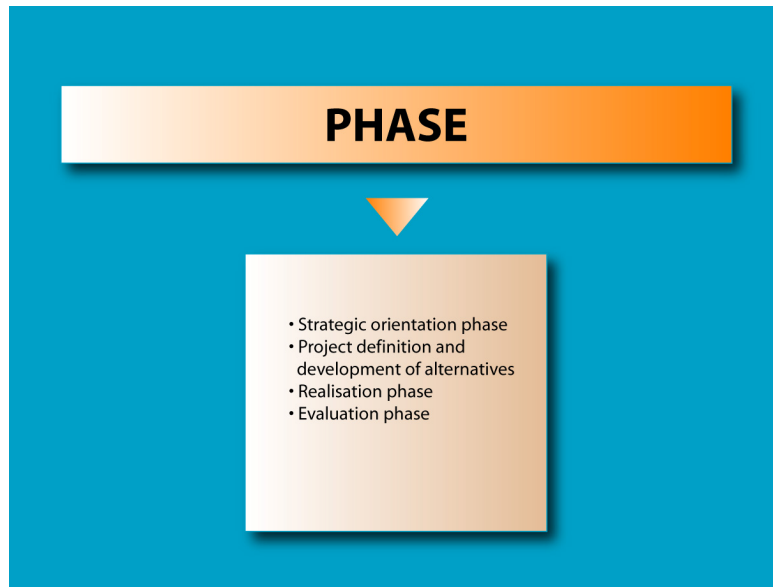
The phase of project definition and development of alternatives has different characteristics. In this phase the goals, the activities required to reach them and the preconditions in space and time should be described. Alternative solutions or measures to counter the problems are developed. A comparison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



3.2 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 the 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.

The PCBA *Weak Link West Zeeuwsch-Vlaanderen* is part of the plan study phase for the strengthening of the North Sea coast. The PCBA provides at this stage an understanding of the costs and social effects for a proper (broadly based) evaluation of the different alternatives.

A 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 economical, 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.

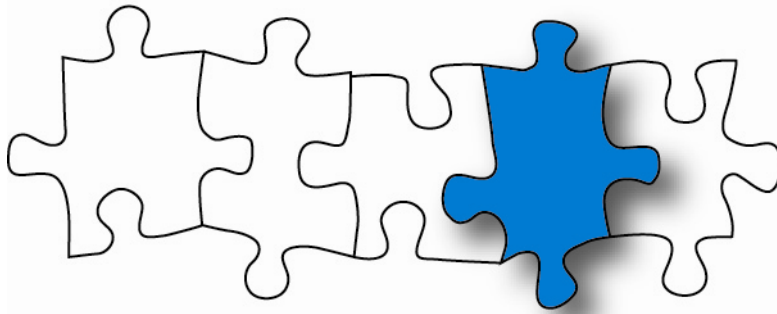
3.3 Lessons from theory

In Annex 3 you find more information about the economic evaluation methods.

Phase in decision-making process

- CEA, MCA and PCBA 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 as well as PCBA can be used. CBA is suitable for an extensive and detailed evaluation, while PCBA can be used for a quick evaluation.

	Financial CBA	Social CBA	PCBA	CEA	MCA
3. Phase in decision-making process	<ul style="list-style-type: none"> •Development of alternatives •Evaluation phase 	<ul style="list-style-type: none"> •Development of alternatives •Evaluation phase 	<ul style="list-style-type: none"> •Strategic orientation phase •Evaluation phase 	<ul style="list-style-type: none"> •Strategic orientation phase •Development of alternatives 	<ul style="list-style-type: none"> •Strategic orientation phase •Development of alternatives



4. THE MEANS AVAILABLE

4.1 Introduction to the key question

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

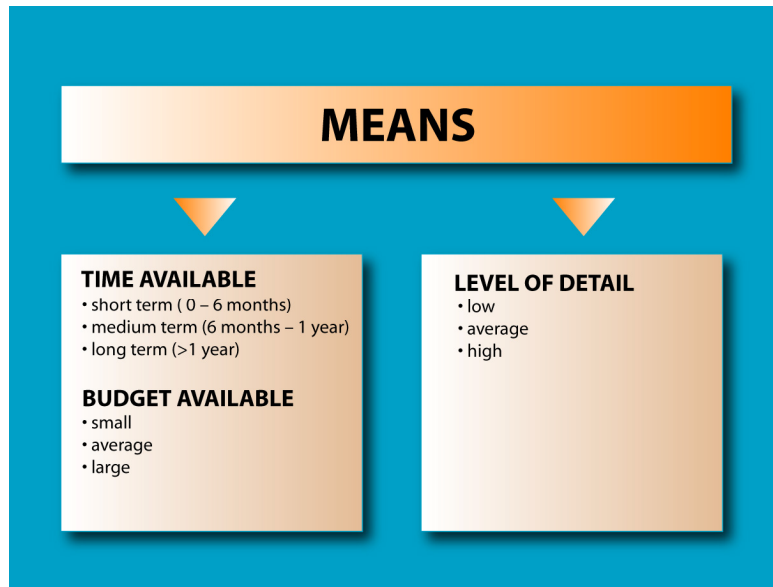
The first is the availability of time. Different economic evaluation methods require different time periods for their completion.

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.



4.2 Examples and lessons from practice

Data collection is often the most time-consuming part of estimating costs and benefits. Because time and resources for fieldwork were not available for the PCBA *Weak Link Noord-Holland* (including a study of the value of new nature), values from other studies and evaluations were used to estimate effects.

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 PCBA for the coastal erosion in *Ystad Sandskog* is a brief evaluation 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.

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.

4.3 Lessons from theory

In Annex 3 you find more information about the 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, PCBA and CEA are best suited for evaluations that have to be conducted in the short term. As the PCBA 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 monetized 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).

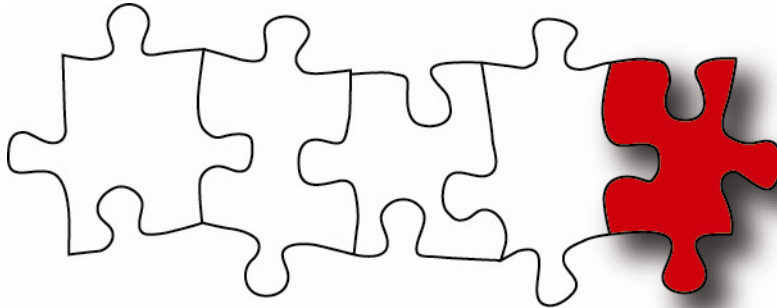
Budget available

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

- PCBA 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	PCBA	CEA	MCA
4. Means					
Time available	Medium	Long	Short	Short	Medium
Budget available	Average	Large	Small	Small	Average
Level of detail	Low – average	High	Low	Low – high	Low – high



5. THE ROLE OF OTHER STAKEHOLDERS

5.1 Introduction to the key question

In order to acquire information on which method could be suitable, the first 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.



5.2 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 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. 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 cooperation 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 organized 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.

5.3 Lessons from theory

In Annex 3 you find more information about the 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 monetization of effects. Therefore, the input of involved actors in the decision between alternatives is less visible.

	Financial CBA	Social CBA	PCBA	CEA	MCA
5. Role of other stakeholders	Providing information	Providing information	Providing information	Providing information	Providing information and participating in the decision making process

IV. A BIRD'S EYE VIEW OF CHOICES IN PRACTICE

Using theory and the experience from our selected cases we will attempt to give an overview of the arguments that are to be used to select a method for two coastal projects that are actually being carried out in the Netherlands.

Prioritising weak links in the coastal defence line

It is foreseen that, in the near future, coastal defence in the Netherlands will not meet the high safety standards. The most vulnerable locations are called 'weak links'.

The responsible authorities for the meeting safety standards are the provinces. They are actually carrying out studies to develop the eight weakest locations. Major goals in these projects are related to the protection against flooding from the sea and increasing quality of spatial development.

These development studies are directed to identifying three alternatives for the strengthening coastal defence systems. These three are to be found in (see annexes 5.7 and 5.8):

- **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.
- **Managed realignment** -Identifying a new line of defence and, where appropriate, constructing new defences landward of the original defences.

From these alternatives one preferred alternative has been selected for each 'weak link'.

It is foreseen that, in the short term, there are insufficient means to strengthen all the weak links, hence, projects have to be prioritized in time. Improving safety as soon as possible is the most important criterion in the prioritization process.

Economic evaluation methods can be used to assist in the prioritization process, taking the efficacy on safety as main objective. To decide on which method is most appropriate for the prioritization we will try to find the answer to the five criteria and related questions discussed in this report.

1. The objective

The objective for the prioritization itself is safety. This objective is fixed on formal national safety standards. Whenever weak links are prioritized equally based on the objective of safety, other criteria are taken in to consideration (spatial quality, procedural feasibility, available budget)

The goal for using an economic evaluation method is to rank the projects included in this study on priority.

What does this mean for choosing the most appropriate method?

All methods are appropriate for the answers given, but given the fact that there is one fixed goal (the national safety standards), the CEA seems to be most appropriate considering this criterion. Whenever more and flexible objectives have to be taken in to consideration the CEA is less appropriate.

2. Type of information

The relevance of determining costs as well as benefits is depending on a variety of choices. Is the goal to evaluate the costs in relation to the realization of the fixed objective (meeting the national safety standard) then the CEA is most appropriate when you're aiming at choosing the alternative with the lowest costs. Whenever (indirect) benefits or additional objectives are included in the decision making then a CBA or an MCA will be more appropriate.

What does this mean for choosing the most appropriate method?

Appropriate methods to handle the required information are SCBA, PCBA, CEA and MCA.

One of the conclusions of *PCBA Ystad Sandskog* is:

When CBA is adopted to choose priority between projects, additional care should be taken that the different projects are analysed using the same methods to estimate quantities and to establish cost data.

The Weak Link cases show that the different cases are not analysed using the same methods to estimate quantities and to establish cost data for the indirect and external effects. So prioritising the projects on these criteria will be difficult. A decision can be made, but the decision maker should be aware of the differences.

3. Phase in decision-making process

The development of alternatives has been carried out and preferred alternatives have been identified per weak link. Prioritizing is aimed at choosing the Weak Link where the preferred alternative will be carried out first. This process takes place in the final phase of decision-making before the realization phase.

What does this mean for choosing the most appropriate method?

Considering the criterion of the project phase, appropriate methods are the financial and social CBA, CEA and MCA. All of these methods are suit to use in the phase of project *definition and development of alternatives*. Taken in to consideration that the selection of preferred alternatives for each Weak Link was based on the results of PCBA's it is expected that the level of detail of these evaluations is sufficient to prioritize between Weak Links as well.

4. Means

Regarding the means there is no information available.

5. Role of other stakeholders

The question that has to be answered is: do other actors play a role in the decision-making process? Possibly the involvement of other actors in the decision-making process is important to increase the support of these actors for the choices made in order to increase their willingness for cost sharing.

What does this mean for choosing the most appropriate method?

If it is the case that actors should be involved in the decision-making process, an MCA would be most appropriate as this method allows for discussion on valuing effects and the weights assigned to the criteria included in the decision-making process. In this case provinces prioritize on provincial level while the ministry prioritizes on national level. If these actors agree on the economic valuation methods used, also a pure economic evaluation method will be appropriate. If more actors with diverging goals are involved, the decision making process becomes more complex and the MCA will be more suitable to support the discussion between these actors.

Conclusion

	Financial CBA	Social CBA	PCBA	CEA	MCA
1. Objective	+	+	+	+!	+
2. Type of information	-	+	+	+	+
3. Phase in decision-making process	+	+	-	+	+
4. Means	?	?	?	?	?
5. Role of other stakeholders	+	+	+	+	+!

+ = *appropriate*

- = *not appropriate*

+! = *extremely suitable*

? = *no information available*

The methods appropriate for the prioritising of the weak links are: social CBA, CEA and MCA. The final decision on which method has to be used depends on the choices made on criteria 2 (type of information; direct or indirect costs or benefits) and 5 (role of involved actors).

The case “*Space for Rivers*” shows how a CBA and CEA can be used for dealing with combined goals for safety and spatial quality. In this case a CBA is used to determine the optimum safety strategy, which is defined as the smallest difference between the investment required to develop additional safety measures (raising dikes) and the remaining cost of anticipated damage during floods. On the base of the results from the CBA (the most the social desired objective) the CEA is used for determining the most cost-effective alternative(s). The intended effects of measures are not measured in terms of money, but in physical units or value judgements.

Defra funding point scheme

For more information see the State-of-the-art report of Messina Component 3 [1]

In the UK, Defra introduced the Priority Scoring scheme, where coastal defence and protection schemes are assessed individually and only projects exceeding a given point threshold are provided with grant aid support.

The Defra scheme divides 44 potential points score into three categories: economics (20 points), people (12 points) and environment (12 points).

The *economic* section deals with the BC ratio: a BC ratio of 1 receives 1 point and for BC ratio >10,5 the maximum of 20 points is allocated. All ratios between 1 and 10,5 are awarded 1-20 points on a linear scale.

The *people* score is divided into three sections:

1. The number of properties at risk over the life of the scheme (50-60 years, regardless of the individual value) is multiplied by 75 and divided by the costs of the scheme (kpounds). The maximum score is 8 for defence costs less than 100 pounds per house.
2. Points are given for areas at very high risk (2 points) and high risk (1 point). Protecting from erosion is not regarded as high risk.
3. All regions are ranked according to their social vulnerability. Points range from +2 for the most deprived to -2 for the least deprived areas.

The *environment* section accounts for any environmental benefits that may be achievable by the implementation of a scheme. This includes the protection of an existing designated area, heritage sites or listed buildings and the creation of new habitat through realignment. The threshold score for 2004/5 is 20 (with a decreasing trend indication for the following years).

Evaluation of dynamic maintenance of the coastal defence line

In 2005 a policy evaluation was carried out on the effectiveness of existing policies on maintenance of the coastal defence line in the Netherlands. The most important question that had to be answered was up to what level the objective for coastal defence had been met and if this had been the direct result of the introduction of dynamic maintenance of the defence line.

It was concluded that the national policies carried out between 1990 and 2005 (maintenance of the coastal defence line by beach nourishment) had been efficient and effective. Policy goals had been met and this was (mainly) the result of the policies and activities identified for coastal management.

The evaluation was a qualitative analysis of the policies related to the management of the coastal defence line. Only the actual policies were included, a comparison with policy alternatives was not part of the study. Nor did the study include an evaluation of the balance between the effectiveness / benefits of the extra protection against floods and the costs of the sand fillings that were required. Recently the question has been asked what the future costs and benefits will be if the actual policies continue and how this compares to the costs and benefits of alternative policies (existing as well as new alternatives).

The wish to develop new alternatives leads to the question which economic evaluation method would be most suitable to evaluate the costs and benefits of the alternatives that were available in 1990. These results should be compared with the alternative of taking no action at all or with new alternatives that are to be developed. An evaluation will be made whether the 'best' alternative was selected. The result can be used in the discussion on the added value of new policy alternatives to be considered for future choices.

1. The objective

The policy document "kustverdediging na 1990, beleidskeuze voor de kustlijnverzorging" (coastal protection after 1990, policy decisions for management of coastal defence line) of the Ministry of Transport, Public Works and Water Management, indicates the policy goals: sustainable maintenance of safety, sustainable protection of the sand dune area (for the land use functions and existing ecosystems), political feasibility and costs of the coastal protection measures.

The goal for the application of an economic evaluation method is to rank the alternatives in the order of preference and evaluate whether the 'best' alternative was chosen in 1990. The policy alternatives were: landward retraction of the coastal defence line, selective maintenance, overall maintenance or seaward based solutions.

What does this mean for choosing the most appropriate method?

Appropriate methods in relation to the criterion discussed above, are financial and social CBA, PCBA and MCA. The CEA does not fit taking in to account the number of objectives and the fact that the level up to which these objectives are realized is flexible and depending on choices made in the decision making process..

2. Type of information

The costs as well as the benefits are relevant. Also the social-economic aspects are taken in to consideration.

What does this mean for choosing the most appropriate method?

Appropriate methods for the type of information required, are a social CBA, PCBA and an MCA. Not suitable are the financial CBA nor the CEA.

3. Phase in decision-making process

Strategic orientation phase and/or evaluation phase.

What does this mean for choosing the most appropriate method?

For this phase in the decision-making process all methods are suitable.

4. Means

No information available.

5. Role of other stakeholders

It is not clear whether it is essential that stakeholders play a role in the decision-making process. It might be crucial for obtaining support of a broad range of stakeholders for the final decisions.

What does this mean for choosing the most appropriate method?

If it is important to let stakeholders participate in the decision-making process, then the MCA would be most suitable. This will provide the stakeholders with the possibility to be involved in valuing the effects and award weights to the criteria.

Conclusion

	Financial CBA	Social CBA	PCBA	CEA	MCA
1. Objective	+	+	+	-	+
2. Type of information	-	+	+	-	+
3. Phase in decision-making process	+	+	+	+	+
4. Means	?	?	?	?	?
5. Role of other stakeholders	+	+	+	+	+!

+ = *appropriate*

- = *not appropriate*

+! = *extremely suitable*

? = *no information available*

The methods appropriate for the questions that have to be answered are: social CBA, PCBA and MCA. The final choice depends on the role that should be given to the actors involved, and available means. If actors have to be involved in the decision-making then the MCA is most suitable. Otherwise the social CBA or PCBA is appropriate (but then also a role for other stakeholders in the decision-making is possible). For a social CBA and MCA more time and budget is needed then for a PCBA, this has effects on the level of detail of the study.

ANNEX 1: TABLE OF EFFECTS

A table of effects enables the effects of a wide diversity of solutions to be put side by side in a logical way. The table gives the most important differentiating criteria/qualities. The effects of the alternatives on the criteria can be indicated qualitatively and quantitatively. A ranking can then be made based on those effects. The experts who fill in the effects table are not specifically trying to rank the alternatives (measure or package of measures). The effects can also be converted into a rating or a score that reflects the effect in the light of the objectives being pursued. In this case the effects table is converted into a score card.

In practice, effects tables and score cards are often used indiscriminately without making any clear distinction between them. The rating of the effects on the criteria and the ranking derived from it is left to those who are responsible for making choices.

The effects table and the score card are presented as a matrix with the alternatives on one axis and the criteria on the other. The cells can show absolute and relative scores (e.g. compared to the reference situation). This gives a conveniently arranged picture of how the alternatives being investigated score on each criterion. Transparency is guaranteed. A number of different procedures can be used for the conversion to scores, so careful documentation is essential if results are to be reproducible.

Example of an effects table: Flooding study Maas (from the State-of-the-art report of Messina Component 3 [1]):

	Alternatives					
	Units	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						
Acc. Safety legislation	yes/no	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 m ³	0	74	26	21	25
Effects on future usage						
Extra nature areas	ha	0	16354	4229	3102	9869
Chances landscape	++/- -	0	0	++	++	+

ANNEX 2: OVERVIEW OF THE EVALUATION METHODS

	Financial CBA	Social CBA	PCBA	CEA	MCA
1. Objective					
Number of objectives	One - multiple	One – multiple	One – multiple	One	One – multiple
Status of objectives	Flexible – fixed	Flexible – fixed	Flexible – fixed	Fixed	Flexible – fixed
The purpose of using the method	<ul style="list-style-type: none"> •Develop knowledge on the alternatives •Rank the alternatives •Reduce the number of alternatives 	<ul style="list-style-type: none"> •Definition of socially desired objective •Develop knowledge on the alternatives •Rank the alternatives 	<ul style="list-style-type: none"> •Definition of socially desired objective •Develop knowledge on the alternatives •Rank the alternatives 	<ul style="list-style-type: none"> •Develop knowledge on the alternatives •Rank the alternatives •Reduce the number of alternatives 	<ul style="list-style-type: none"> •Develop knowledge on the alternatives •Rank the alternatives •Reduce the number of alternatives
2. Type of information					
Relevance of costs and benefits	Costs and benefits	Costs and benefits	Costs and benefits	Costs	Costs and benefits
Relevance of social effects	Not relevant	Relevant	Relevant	Relevant	Relevant
Quantitative or qualitative	Medium quantitative nature	Maximum quantitative nature	Medium quantitative nature	Medium quantitative nature	Maximum quantitative nature
Monetary or non-monetary	Medium aspects considering financial aspects are indicated in monetary terms. Social effects, however, are not taken into account.	Maximum of information indicated in monetary terms.	Medium. The effort to monetise is more restricted.	Medium. At least a part of the information is indicated in monetary terms, however benefits are not monetised.	Different measurement scales. MCA manages both monetary and non-monetary information.
3. Phase in decision-making process					
Phase of the decision-making process	<ul style="list-style-type: none"> •Development of alternatives •Evaluation phase 	<ul style="list-style-type: none"> •Development of alternatives •Evaluation phase 	<ul style="list-style-type: none"> •Strategic orientation phase •Evaluation phase 	<ul style="list-style-type: none"> •Strategic orientation phase •Development of alternatives 	<ul style="list-style-type: none"> •Strategic orientation phase •Development of alternatives
4. Means					
Time available	Medium (6 months - 1 year)	Long (> 1 year)	Short (0 - 6 months)	Short (0-6 months)	Medium (6 months - 1 year)
Budget available	Average	Large	Small	Small	Average
Level of detail	Low – average level of detail	High level of detail	Low level of detail	Low – high level of detail	Low – high level of detail
5. Role of other stakeholders	Providing information	Providing information	Providing information	Providing information	Providing information and participating in the decision making process

ANNEX 3: EVALUATION METHODS

Index:

3.1 Cost-Benefit Analysis (CBA) (Financial and Social)

3.2 Preliminary Cost Benefit Analysis (PCBA)

3.3 Cost-Effectiveness Analysis (CEA)

3.4 Multi-Criteria Analysis (MCA)

3.1 Cost-Benefit Analysis (CBA) (Financial and Social)

Short description

The Cost-Benefit Analysis is an evaluation method that gives an overview of the advantages and disadvantages of alternative projects 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 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 did not go ahead; indicate whether the project is socially desirable. The costs and benefits of alternatives can also be compared to determine which alternative is preferable.

There are different types of Cost-Benefit Analysis (CBA). An economic or *Financial Cost-Benefit Analysis (FCBA)* only includes the costs and benefits expressed directly in money terms. An 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. The big difference is that an SCBA includes indirect economic costs and benefits as well as direct financial costs and benefits. An SCBA adopts the perspective of society as a whole. A third type is the *Preliminary Cost Benefit Analysis (PCBA)*, which is a rough Cost-benefit Analysis that presents an alternative in general terms and is based primarily on available information and indicators. The PCBA is explained in more detail in Annex 3.2.

1. The objective

The Cost-Benefit Analysis method is suitable for projects with fixed as well as flexible objectives. A Financial CBA does not take social objectives into account. A Social CBA is suitable for projects with one or multiple objectives.

This method can be used when choosing an project alternative on the basis of economic profitability. The presentation of the cost-benefit balance sheet is a transparent statement of direct and indirect effects and helps to clarify a comparison of alternatives. A Social CBA can also be used to determine the socially most desirable alternative.

2. Type of information:

As far as possible, costs and benefits are determined quantitatively and specified in monetary terms. With a Social Cost-Benefit Analysis it is important for the vast majority of the effects to be expressed in monetary terms (using economic valuation methods; see Annex 4). If this is not possible, the effects should be described as explicitly qualitative as possible in order to give them their due weight in the decision-making process.

Project effects can be divided into two major categories: *direct effects* and *indirect effects*. *Direct effects* are project and operational costs directly caused by the project. *Indirect effects* are effects such as improved economic value of the region and mitigation and replacement costs.

For the valuation of non-priced effects no market prices exist, because goods and services are provided freely or are freely available as public goods. In coastal projects this is the case for most environmental and recreational assets but also of goods such as quality of life, health, habitats, erosion and flood protection, and social and employment impacts. Various methods can be used for valuation of those effects (see Annex 4).

A Financial Cost-Benefit Analysis is used when the direct economic costs and benefits are the primary consideration, whereas with a Social Cost-Benefit Analysis indirect economic costs and benefits are included in the decision-making. Financial CBA strives for maximum monetisation but social aspects are not included and therefore not monetised.

3. Phase in decision-making process

Financial and Social CBA are usually no sooner conducted than in the phase of project definition and development of alternatives. For the realisation phase the economic evaluation methods do not play a prior role. In the evaluation phase Financial and Social CBA can be used.

4. Means

Data collection is often the most time-consuming part of estimating costs and benefits. The resources required to carry out the project assessment must be in balance with the seriousness of the problem and the size of the project. A Social CBA requires more time and a larger budget than a Financial CBA due to the broader range of indicators.

5. Role of other stakeholders

Because it concerns an economic analysis and no evaluations of the costs and benefits are requested, the method should be implemented entirely by experts who are able to identify and monetise the costs and benefits. Depending on what is being studied, players should make information available on the reference situation, the cost of measures and possibly the trend of external factors. They are not approached to actively participate in ranking alternatives since this is done by the method itself.

Applicability and restrictions

- A monetary value is fairly easy to explain: “If we invest this amount of money we will gain this much!”
- CBA is difficult to apply if effects are difficult to express in monetary terms. This restriction is applicable to projects whose justification is specifically the improvement of ecological conditions and projects that have substantial effects on ecological and socio-cultural circumstances.

- A common criticism of CBA is that decision-makers place blind trust in the numeric outcome of the analysis, whereas important social effects (such as environment, employment, and redistribution of welfare) are not or insufficiently captured.
- Criticism of CBA is sometimes raised regarding its treatment of aspects involved as though these can all really be monetised (attached to a monetary value). However, it can also be argued that, with a clear presentation of the underlying assumptions and outcome of a CBA, all factors are available and can be scrutinised and discussed.
- The risk of double-counting and transfers is greater with an SCBA than with a FCBA because indirect and external effects are also included in the analysis.
- It is not possible to have an integrated evaluation based on an SCBA because socio-cultural values and ecological values cannot be adequately incorporated. And these are the very values that are vital to many coast-related projects.
- The danger of emphasising costs and benefits is that non-monetary effects (for example safety, environment, inconvenience and distribution effects) are not included sufficiently in the decision-making.
- The idea that “money = truth” can give the appearance of certainty, while the methods on how these values are deducted are not questioned.

Approach:

The main elements of a cost-benefit analysis are:

- *Define the project goal*
- *Define project alternatives and the no-project alternative*
It is evident that a quantitative estimate of the effects of project alternatives requires a clear definition of these alternatives. The no-project alternative is a combination of the best alternative use of (financial) alternative resources and the best possible other solutions to the problem. The no-project alternative is, therefore, not the same as ‘doing nothing’ nor is it ‘existing policy’.
- *Determining the project effects*
Project effects can be defined as the differences between a development with the project and without the project.
 - direct effects: costs and benefits of a project that influence the owner, exploiter or user of that infrastructure) (for FCBA and SCBA)
 - indirect effects: effects that are not direct effects.
 - external effects: changes in welfare to others than the owner, exploiter or user of the project services that are the result of the project and that are not taken into account by owners, users or exploiters of the infrastructure. ⁴
- *Quantify and monetize the effects*
- *Calculate the net present value of costs and benefits*
- *Decision*

⁴ Definitions stated in Evaluation of large infrastructural projects and Valuation of Nature Water and soil in a Cost Benefit Analysis

3.2 Preliminary Cost Benefit Analysis (PCBA)

Description

A Preliminary Cost Benefit Analysis (PCBA) outlines the effects of the various alternatives in general terms. It draws primarily on existing or simple model instruments and the results of previous studies. The outcomes of a CBA may differ from a PCBA, but the main idea of a PCBA is to present a general picture of the advantages and disadvantages project alternatives. In other words, in a PCBA all cost and benefit items are identified and information on them is provided by existing material as far as possible. In a CBA this needs to be done much more accurately and by means of an individual study carried out specifically for the purpose of the CBA.

A PCBA is also referred to as a “quick scan” for making an initial selection from possible alternatives.

1. The objective

PCBA is suitable for projects with one or multiple objectives and can deal with both flexible and fixed objectives. PCBA can be used to set a socially desired objective. All evaluation methods can contribute to the other objectives concerning the decision-making process such as developing knowledge and ranking and reducing alternatives.

A PCBA can help to bring the right considerations to the fore and support the political-administrative decisions on project alternatives. The aim is to avoid spending time on irrelevant alternatives while relevant alternatives disappear into the background. A PCBA is therefore used to reduce the number of alternatives before exploring in to more detail.

2. Type of information

PCBA can take both costs and benefits and social aspects into account.

As with a CBA, it is essential to be able to express the vast majority of effects in monetary terms (at least at indicator level). If this is not possible, the effects should be described as explicitly as possible in order to give them their due weight in the decision-making process. To be able to make use of the quick scan nature of a PCBA, enough indicators need to be available.

3. Phase in decision-making process

A PCBA can be used if a full CBA is not yet appropriate. PCBA is well suited for use in the strategic orientation phase. In this phase the alternatives are not yet adequately crystallised and there are often still too many alternatives under consideration. Producing an inventory of types of effects can help to “filter out” some of the alternatives. PCBA can also be used in the evaluation phase.

4. Means

In general, PCBA is best suited for assessments that have to be conducted in the short term with a relatively small budget. PCBA is the only economic evaluation method that is truly meant for projects where only a low level of detail is required for comparison of alternatives.

5. Role of other stakeholders

Because it concerns an economic analysis and no evaluations of the costs and benefits are requested, the method should be implemented entirely by experts. They are able to identify the costs and benefits, to monetise them or distil information from previous research and translate this for use in the current research (benefit transfer). Depending on what is being studied, stakeholders might be asked to facilitate information on the reference situation, the cost of measures and possibly the trend of external factors. They are not approached to take an active part in ranking alternatives since this is done by the method itself.

Applicability and restrictions

- The danger of emphasising costs and benefits is that non-monetary effects (for example safety, environment, inconvenience and distribution effects) are not included.
- The idea that “money = truth” can give an ‘over-appearance’ of certainty.
- A number of PCBA's carried out in recent years were in fact in-depth CBA's. It is clearly quite difficult to stick to the general nature of the analysis and not be drawn fairly quickly into studying subjects at greater depth. For a PCBA to be a real quick scan, these analyses should be formulated in a relatively short space of time (e.g. two months) and be of limited depth.
- A PCBA should be carried out as early in the project as possible. Firstly, political positions will often not have been adopted yet if the PCBA is carried out at an early stage. This enables the results of the analysis to be judged better on their merits than if a variety of political preconditions apply. Such preconditions would adversely affect the broad aim of a PCBA. Secondly, a PCBA carried out during the development of a vision or early in the planning stage avoids the result of a more in-depth, integrated profitability analysis (CBA) at a later stage being at odds with the preparation and decision-making stages. A PCBA gives a good idea of a project's problems and potential and possible alternatives.

Approach:

The approach is the same as the approach of a CBA. The information is provided by existing material as far as possible.

3.3 Cost-Effectiveness Analysis (CEA)

Description

The aim of a Cost-Effectiveness Analysis (CEA) is to determine which alternative will achieve a concrete objective at the lowest possible cost (cost minimisation). The analysis can also be used to determine which alternative, given the maximum budget, will contribute most to the achievement of the objective (effect maximisation).

With a CEA, both the main objective and the alternatives able to achieve that objective are regarded as given. A CEA is designed purely to identify the cheapest alternative.

1. The objective

A CEA can be used to find out how a given (fixed) aim can be achieved at the lowest cost or what effect the various alternatives produce per euro invested. A CEA has a limited evaluation framework: only one specific effect is weighed only against the cost of the measure(s). A CEA is therefore most suitable for issues that have one fixed objective. The outcome is a ranking of the cost of the effects of each alternative, which shows which alternative is cheapest or has the greatest effect.

2. Type of information

All economic evaluation methods strive for a maximum of quantified information. 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 CEA benefits are not monetised. CEA measures costs in common monetary value and effectiveness in physical units.

3. Phase in decision-making process

CEA is well suited for use in the strategic orientation phase.

4. Means

In general, CEA is best suited for evaluations that have to be conducted in the short term with a relatively small budget.

5. Role of other stakeholders

The experts who carry out the analysis can apply the method using the information collected. There is no need for any interaction with the target group, or at most only to gather details of objectives and preconditions.

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 the number of alternatives is limited.
- Getting at the information required can be a complicated business, but if the objective is clearly formulated, the method is not complex.
- The method is easy to document and present, which makes it reproducible and transparent.
- A cost effectiveness approach does not, however, always produce a single best solution to an objective. This makes the optimisation process more complex and less transparent.
- Distribution aspects, such as the distribution of effects over income groups, can only be taken into account to a limited extent, but this is a problem with all methods.

Approach:

The main elements of a Cost-Effectiveness Analysis (CEA) are:

- *Define the project goal.*
- *Define project alternatives and the no-project alternative.*
- *Determining the costs of each alternative (investment, exploitation and maintenance cost).*
- *Decision*

3.4 Multi-Criteria Analysis (MCA)

Description

A Multi-Criteria Analysis (MCA) gives a decision-maker the opportunity to weigh up 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. Its systematic approach is a significant advantage. MCA obliges the user to strictly separate facts and value judgements and substantiate them. The decisions made are explicit. The process is simple to document, so the results are easy to reproduce.

An MCA produces a “weighted summation” of the project’s effect. The first step is to draw up a summary of effects. For each alternative, the same set of criteria is used and weights are given to these criteria. The weights determine how significant an effect is in the alternative’s overall score. The various alternatives are ranked in order of preference based on overall scores.

An important feature of MCA methods is that widely differing criteria can be combined without all the criteria needing to be equally important.

MCA supports the discussions, since MCA can couple the effects and the available information on the political priorities or individual interests and translate this into the ranking of alternatives.

1. The objective

Multi-criteria analysis (MCA) is an approach for choosing from a set of alternatives in complex, multiple-objective situations and to incorporate all social, economic and ecological costs and benefits. MCA can contribute to developing knowledge and ranking and reducing alternatives.

2. Type of information

MCA can take costs and benefits as well as social aspects into account. The effects do not need to be expressed in money terms or to be measured in the same units. The effects can be measured on different measurement scales, monetary and non-monetary, quantitative and qualitative. MCA usually combines both monetised and non-monetised information. Scores can be assessed in many ways, such as tests and simulation models, direct measurements and expert judgement.

The input required depends very much on the structure of the evaluation framework. Input is also needed to evaluate the effects and determine the relative weightings of the criteria.

An MCA is an instrument for structuring and aggregating information. An MCA may be too laborious a method for simple decisions with few criteria. It is not worthwhile using this method if the user finds the available information manageable enough already (e.g. if the table of effects is small).

3. Phase in decision-making process

MCA is well suited for use in the strategic orientation phase, but MCA is usually conducted no sooner than in the phase of project definition and development of alternatives.

4. Means

The time needed for conducting a complete MCA depends on the amount of criteria included, but generally speaking a period of 6 months to one year is required. The cost of a MCA is

comparable to that of a Financial CBA and less expensive than a Social CBA, but again, this highly depends on how the MCA is structured.

5. Role of other stakeholders

By 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-making process transparent and the information more manageable for all stakeholders.

The extent to which parties are involved in the MCA depends on the stage at which the MCA is carried out. It is important for managers and the stakeholders involved to be present when the objective is defined. It is assumed that experts will design the evaluation framework. Since the choice and definition of criteria are essential components of the decision-making process, intensive interaction with managers and the players involved is very important at this stage. Deciding on criteria and their weightings is a political matter. Researchers can play a supporting role in this, but administrative support is essential. The effects are measured by the experts, and in some cases this may require, for example, the cooperation of the local residents in the area. The effects are then converted into ratings or scores. It is desirable for the experts and managers to be involved in this. The decision-makers then decide what the relative weightings of the criteria are. The MCA method enables different decision-makers at each level of the objective tree to contribute to the discussion on weighting allocation.

The allocation of weightings and therefore the ranking can vary from one interest group to another and can give an idea of the extent to which different target group preferences can lead to different preferred alternatives.

This enables the decision-maker to link the available information to his/her political priorities and translate it into an individual ranking of the alternatives. In all cases, a good graphical presentation of results is possible and recommended.

Applicability and restrictions

- All choice processes have a subjective character. Thus, the MCA cannot objectively define a best alternative. It cannot replace but, rather, supports a judgement.
- A number of software tools are available to conduct MCA and to support effective decision-making with multiple objectives as well as discussions and negotiations between stakeholders.
- A significant disadvantage is that the technical nature of the method can make it inaccessible to non-experts, who therefore see it as a “black box” (this also applies to the determination of criteria and their weightings.). This can be partly offset by using a simple, transparent method and explaining all the steps clearly.
- A consistent evaluation framework is crucial when using an MCA. If no clear objective is defined prior to the evaluation framework, the whole process will slow to a crawl.
- Strategic behaviour by the participants should be avoided as far as possible. Techniques are available for minimising their effect on the result.
- MCA is not suitable for proving that a particular alternative should be implemented or that it is also the best alternative. The ultimate choice of a particular approach depends on the characteristics of the problem and the decision-makers, the institutional setting and partly on public opinion.

Approach:

The main elements of a MCA are:

- *Define and explore the problem*
- *Define project alternatives*
- *Define the criteria*
- *Score the effects of the alternatives on the criteria*
- *Weigh the criteria*
- *Combine weights and scores*
- *Analyse the results*

ANNEX 4: METHODS FOR VALUATION OF EFFECTS

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- 4.1 Travel Cost Method
- 4.2 Hedonic Pricing Method
- 4.3 Contingent Valuation Method
- 4.4 Production Factor Method
- 4.5 Prevention Cost Method
- 4.6 Shadow Project Method
- 4.7 Benefit Transfer Method

These methods are the most commonly used methods to value effects. 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 which 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 which 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).

Brief overview of methods for valuation of effects (from the State-of-the-art report of Messina Component 3 [1]):

Effects		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	No 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

** e.g. entrance fee, and/or estimated expenditure by visitors

4.1 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).

4.2 Hedonic Pricing Method (HPM)

A method that 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 but with one important difference in environment variable (cross-section data: the same type of housing in comparable environments with and without the environment effect).

4.3 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 good did exist. Only the Contingent Valuation Method can capture both use and non-use values. However, the surveys have to be carefully designed.

4.4 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 waste water 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).

4.5 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.

4.6 Shadow Project Method (SPM)

The restoration cost method calculates the cost of measures required to restore or compensate for a 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 a deterioration in or loss of nature and environment.

4.7 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.

ANNEX 5: CASES

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5.1 Coastal erosion Ystad Sandskog (Sweden)

General description

Sandskogen is an important part of the city of Ystad. The coastline of Sandskogen consists of sandy beaches and the area is well visited for different kinds of recreational activities. It is vital for Ystad that the erosion (50 metres 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 (option 1) is to main the existing seawall and groins and to establish new breakwaters. The second alternative (option 2) 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 *Preliminary Cost Benefit Analysis (PCBA)* 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 (the municipality is currently maintaining the shore protecting structures at place, option 1) in order to see if it is worthwhile or not. The efficiency of an alternative (beach nourishment, option 2) is analysed.

Type of information

The estimated total damage and loss of the “base case”-alternative is used as the benefit (or avoided damage) for the investigated options of preventive actions. The costs of implementing the options are estimated. There is still risk of damage for the investigated options; the costs of this are calculated.

The effects table for the Ystad Sandskog case:

	Alternatives		
	Base case	Option 1 Maintain & repair	Option 2 Beach nourishment
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 about the costs, damage and losses are (in contrast to the table above) of a quantitative nature and 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 CBA, 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 PCBA 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 and calculations are summarised in a table.

Summary table of Ystad sandskog case study evaluation. (Values from Appendix B has been rounded to two digit precision) (PV=Present Value)

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		
Incremental benefit/cost ratio			0.24		
Highest b/c					
Brief description of options:					
Option 1	Minimum investment, maintain existing seawall				
Option 2	Beach nourishment				

The table 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 “Base case”-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, and 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 PCBA is suitable in this case to evaluate the present strategy of the municipality.

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

It could be considered to apply a MCA in this case. However, the role of other stakeholders is not explicitly mentioned, it appears there was no role either in providing the information or 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 measures.

5.2 Coastal erosion the Lido of Sète (France)

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 1990s 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 visiting rates by tourist. 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 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.

Type of information

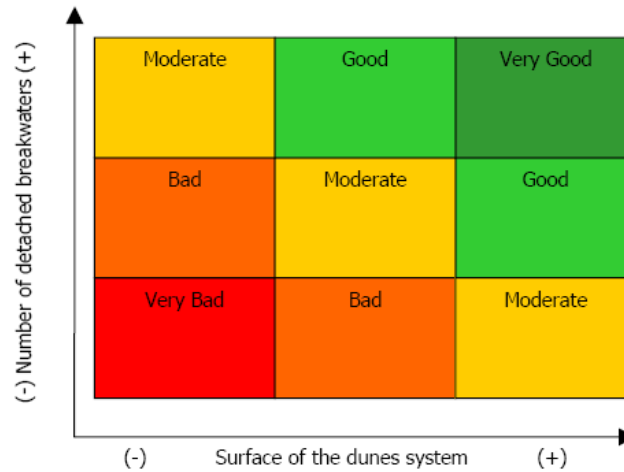
Only the investment costs and maintenance costs are measured in quantitative and monetary terms. The other criteria (security, long-term effectiveness, visual impact, impact on marine environment, fragmentation and regional impact) are described in qualitative terms.

A brief overview of the evaluation criteria:

Dim	Criteria	Index
Social	Security	Qualitative, based on: <ul style="list-style-type: none"> • Number of access to the road for vehicles • Easiness of access to the beach for pedestrian
	Long term effectiveness	Qualitative, based on: <ul style="list-style-type: none"> • 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
Ecologic	Visual impact	Qualitative based on: <ul style="list-style-type: none"> • Degree of interference between an observer on the road and the horizon line.
	Impact over the marine environment	Qualitative, based on: <ul style="list-style-type: none"> • Number of constructions into the sea • Level of intervention into the sea in the future.
	Fragmentation (longitudinal, transversal and regional)	Qualitative, based on: <ul style="list-style-type: none"> • Longitudinal cuts in the dune system • Access to the beach • 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 the figure below).

Figure 13. Graphic for evaluating Longevity



As it was said before, the long term effectiveness is based on: the surface of the dune system and the number of detached breakwaters. The figure can be read as follows. For example, when the effect of an alternative on the surface of the dunes system is low (–) and on the number of detached breakwaters moderate (+/-) the long term effectiveness of the alternative is bad.

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 moment of this study, the pre-operational phase is almost finished.

Means

A considerable amount of time is required to apply the methodology.

The whole study 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.

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 administration 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.

	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	...

	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	Fouth	...
Regional impact	First	Eighth	Eighth	Second	...

With the so-called NAIADÉ 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, 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 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.
- Because some criteria are evaluated considering two sub-criteria, the multi-criteria method must consider at least the use of weights; no compensation between criteria and qualitative or ordinal valuations. By means of the graphics (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 scientists’ advice and for politicians’ choices.
- The time frame and human resources for applying the methodology can be a drawback. Feedback 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 to be aware about the diversity of impacts, and the different views that have been considered for evaluating the alternatives.

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 decision-making process.
- Social effects were relevant (financial CBA is not appropriate).
- Information is available on different measurement scales, MCA manages qualitative information 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.

5.3 Coastal extension in South Holland (The Netherlands)

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 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.

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 precise.

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.

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
Unforeseen	17-25	46-63	51-71	96-136
Total	352-534	969-1333	1075-1499	2028-2868
Nature compensation	<i>Not yet vakued</i>			
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.

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 cooperation 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. This expert meeting was organized 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.

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 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 PCBA could have been considered. With a PCBA the financial as well as the social aspects of the issue could have been taken into account in general terms.

5.4 Beach nourishment in Ostia (Italy)

General description

A beach nourishment has been carried out in the Levant sector of the Ostia Beach. The beach nourishment has been carried out to protect the shore from natural forces and to 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).

The intervention in Ostia was based on a CBA to choose between a 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 m³ 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 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 Ostia main economy is concerning services linked to tourism. Some examples of these services are lidos (bathing establishments), hotels, bed & breakfast, dressing-rooms and campings. The used benefit value indicator is 25,20 €/m² (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.

- 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 intertemporal 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 m² beach) will significantly influence the final values calculated, the decision-maker must ensure that the values chosen by the 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 base 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.

5.5 Beach drainage in Procida (Italy)

General description

The Ciraccio and Ciracello beaches are sandy beaches used for bathing tourism, and they suffer from erosion. The beach drainage intervention was carried out in 2002. They are sandy beaches used for bathing tourism and suffer from erosion. 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 little collecting well for the drained waters and a lifting pump for the discharge: two little wells release the water into the sea and other two, linked each other, send out the water into Chiaiolella port.

Information is available to evaluate the intervention with a *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. The most important economical activity in Procida is the tourism. 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 €/m² (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 euros and the Benefit/Cost ratio is 2.28.

It's interesting to compare the beach drainage intervention with a pure nourishment one, aimed to produce 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 €/m³. This is a really hardly achievable value 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. That is really remarkable in this case, because 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 intertemporal 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 m² beach) will significantly influence the final values calculated, the decision-maker must ensure that the values chosen by the 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 base 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.

5.6 Quick scan of economic optimisation of protection level of coastal areas outside the dike (The Netherlands)

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 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 damage on businesses, 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. Goal is economic optimisation by minimizing 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, the 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, 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. 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 was assumed that there are no buildings seawards of the 1/300 erosion line (so the economic value is zero), and also assumptions are 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

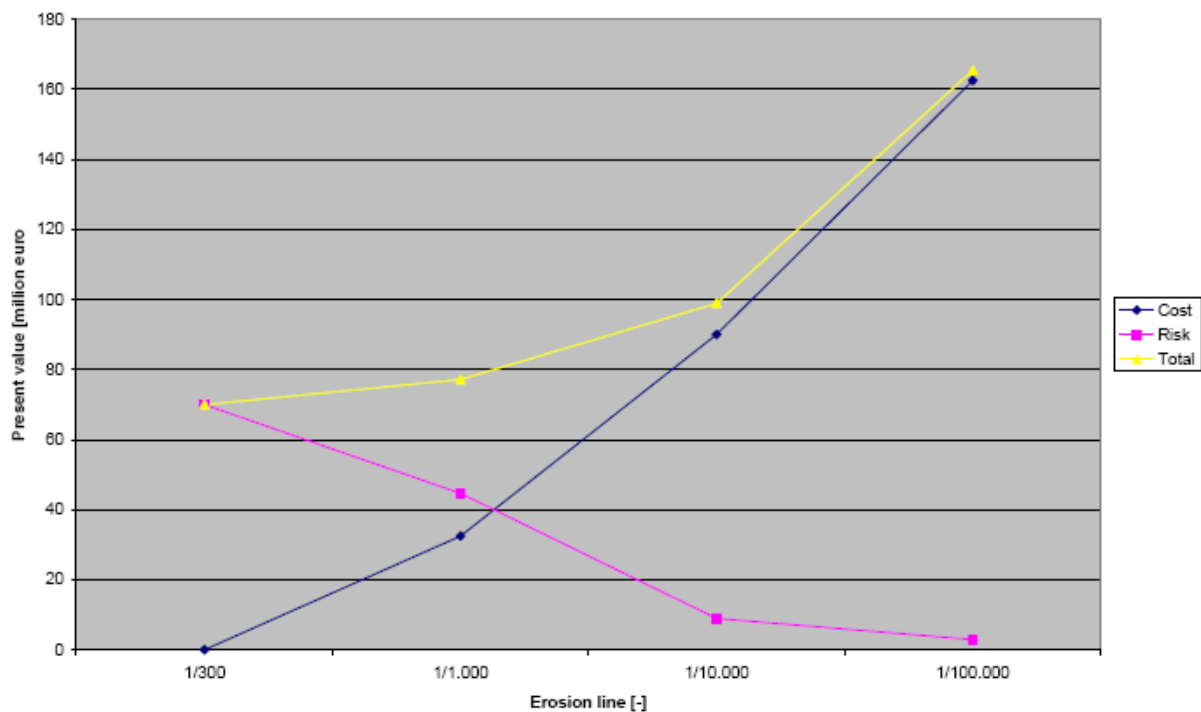
No information available.

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. The figure below 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.

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 (some) social aspects were relevant.

5.7 Weak Link Noord-Holland (The Netherlands)

General description

In the not too distant future, some Dutch coastal defences will no longer meet safety standards. The most vulnerable parts of the dikes are called Weak Links. Possible solutions are consolidation or landward reinforcement of the coastal defence line or seaward based solutions like sand nourishment or defence structures.

The Province of Noord-Holland has set up an Integrated Evaluation for the Weak Links as a basis for administrative decision-making. A *Preliminary Cost Benefit Analysis (PCBA)* of the various project alternatives is part of this Integrated Evaluation.

The objective

There are two project objectives: meet the safety standards in terms of flood prevention, and improvement of spatial quality. The first project objective is fixed (safety standard), the second is not. The PCBA is part of the integrated evaluation and ranks the alternatives from a social and economic point of view.

The alternatives are dimensioned to guarantee safety for at least 50 years. All the alternatives meet the safety standard and are not differentiated at all in that respect. Within the alternatives, safety measures are combined with spatial quality measures. The over-dimensioning of coastal defences as a result of the spatial quality measures is included in the PCBA as a direct effect.

Type of information

The effects are expressed in quantitative terms using monetised indicators. Some effects are in a range (upper and lower limit). Some effects remain as a pm- item not defined. The direct effects are quantified and valued in more detail than the indirect effects. The indirect effects are assumed to be 20% of the value of the direct effects.

Table of effects:

Direct costs

- Investment costs (2010) (€)
- Investment costs (2060) (€)
- Maintenance costs (€)

Direct effects

- Recreation and tourism (number of visitors)
- New space for recreation (hectare)
- Safety guarantee after 2060 (p.m.)
- Chances for development after 2060 (p.m.)

Indirect effects

- Value of market for houses (p.m.)
- Labour market (p.m.)

External effects

- New nature (hectare)

It became clear during the process that on a number of vital points there was a lack of the knowledge required to arrive at unambiguous conclusions. In particular, information on benefits is limited and difficult to access. More research is needed into the valuation of nature effects and the number of domestic and international recreation visitors.

Little or nothing of the risks of flooding and related costs are included in the analysis. Because the contribution to safety and the contribution to spatial quality are not treated as separate project effects, confusion arises as to the nature of the projects and the project effects.

Phase in decision-making process

A PCBA was carried out because it fitted in well with the Integrated Evaluation's level of detail and the phase in the decision-making process.

Means

Because time and resources for fieldwork (e.g. a study of the value of new nature) were not available, values from other studies and evaluations were used to estimate effects.

Role of other stakeholders

No information available.

Summary results

The research concludes that none of the alternatives produce a positive monetary balance (balance of all costs and benefits). In other words, the additional measures to promote spatial quality (above and beyond the minimum safety measures in the No project alternative) do not recoup all of their costs. There are several options for optimising the alternatives.

Lessons learned

- For a CBA with unambiguous conclusions, information on benefits can be limited and difficult to access.

- Because all the alternatives meet the safety standard and are not differentiated at all in that respect, little or nothing of the risks of flooding and related costs are included in the analysis. Confusion arises as to the nature of the projects and the project effects.
- Because there is no focus on the effects of the alternatives on safety and only on spatial quality, this CBA is more like a Cost-Effectiveness Analysis (CEA).

Analysis: choice of the evaluation method

A Preliminary CBA is a suitable method for this project, mainly because it fitted in well with the Integrated Evaluation's level of detail and the phase in the decision-making process. No means (time and resources) for fieldwork were available, so in the study available information has been used. As said above, this CBA looks like a CEA because there is just one fixed objective (no focus on the effects of the alternatives on safety).

5.8 Weak Link West Zeeuwsch-Vlaanderen (The Netherlands)

General description

It is foreseen that in the near future, some Dutch coastal defences will no longer meet safety standards. The most vulnerable parts of the dikes are called Weak Links. Possible solutions are consolidation or landward reinforcement of the coastal defence line or seaward based solutions like sand nourishment or defence structures. A more detailed plan study for strengthening the North Sea coast of West Zeeuwsch-Vlaanderen has been launched. The *Preliminary Cost Benefit Analysis (PCBA)* is part of this study.

Three solution directions are distinguished: (1) consolidation (maintaining the basic coastline and improving the existing coastal defences), (2) landward reinforcement of coastal defences and (3) a seaward-based solution (e.g. sand buffers or moving the sea dike in a seaward direction).

The objective

There are two project objectives: meet the safety standards in terms of flood prevention and improvement of spatial quality. The first of these is fixed (safety standard), the second is not.

A proper evaluation of the different alternatives at this stage requires an (broadly based) understanding of the costs and social effects of the solution directions.

The differences between the alternatives for each sub-area were studied based on the analysis carried out. Initial choices can be based on this. Remaining options will be explored further in a follow-up project.

Type of information

Only the direct effects were quantified for the CBA. The attention paid to the indirect and external effects is mainly qualitative in nature.

The effect of safety measures against flooding was not quantified in more detail. Because every alternative must meet the statutory standard, this effect does not serve to differentiate the alternatives. The safety benefits are included but not defined. Differences in spatial quality are difficult to quantify. An approximation is given based on what turned out to be the maximum consumers were willing to pay for land.

It was not possible to reliably quantify the indirect and external effects due to a lack of relevant information.

Table of effects:

<p>Costs</p> <ul style="list-style-type: none">- Technical measurements (€)- Maintenance costs (€)- Costs to acquire land and buildings (€)- Compensation temporarily losses (€)- Costs pull down houses (€)- Compensation nature (€) <p>Direct effects</p> <ul style="list-style-type: none">- Safety<ul style="list-style-type: none">o Avoided damage (p.m.)o Victims (p.m.) <p>Indirect effects</p> <ul style="list-style-type: none">- Spatial quality<ul style="list-style-type: none">o Value of use for direct neighbourso Valuation other users- Economic strengthening of the structure (p.m.) <p>External effects</p> <ul style="list-style-type: none">- Value of nature (p.m.)

Phase in decision-making process

The Preliminary Cost Benefit Analysis is part of the plan study phase.

Means

No information available.

Role of other stakeholders

No information available.

Summary results

The outcomes show that the alternatives are more expensive than the reference alternative (the situation that will occur if no measures are taken).

The report also indicates which parties will pay the costs and enjoy the benefits. It shows that the advantages and disadvantages of the project are not distributed proportionately.

Lessons learned

- Because there is no focus on the effects of the alternatives on safety, this CBA is more like a Cost-Effectiveness Analysis (CEA).
- There is little material available for determining a project's profitability related to nature, spatial quality and water.

Analysis: choice of the evaluation method

A Preliminary CBA is chosen, mainly because it fitted in well with the level of detail and the phase in the decision-making process. As said above, this CBA is more like a CEA because there is just one fixed objective (no focus on the effects of the alternatives on safety).

5.9 “Space for the Rivers” (the Netherlands)

General description

The aim of the Space for the Rivers project is to improve the safety measures against flooding. A secondary aim is to improve spatial quality. A *social Cost-Benefit Analysis (CBA)* and a *Cost-Effectiveness Analysis (CEA)* have been carried out, for different purposes.

Cost-Benefit Analysis

The objective

As part of the Space for the Rivers project a package of measures has to be chosen to meet the national safety standard in the region of the major rivers. The CBA is looking at what the optimum safety strategy is, without taking the national standard as fixed objective. The result of the cost effectiveness analysis is a ranking of measures based on the costs for answering to the targets for safety improvement and spatial quality.

Type of information

The costs (of investment and maintenance) and benefits (reduction of anticipated damage) are both expressed in monetary terms.

Phase in decision-making process

Strategic orientation phase.

Means

This has been a project of long duration, with many working-people involved.

Role of other stakeholders

No information available.

Summary results

The optimum safety strategy is defined as the smallest difference between the investment required to develop additional safety measures (raising dikes) and the remaining cost of anticipated damage during floods. The analysis shows that in 16 of the 22 dike rings the optimum safety level is higher than the national standard.

Analysis: choice of the evaluation method

This is a good example of how a social CBA can be used. The method has well been chosen because the aim of the project is to determine the social desired objective. For that reason CBA and PCBA are most appropriate. Regarding the size of this project, a CBA has been chosen.

Cost-Effectiveness Analysis

The objective

As part of the Space for the Rivers project a choice has to be made from a package of measures that will enable the safety level of the region of the major rivers to meet the national standards. The result of the cost effectiveness analysis is a ranking of measures based on the efficiency with which safety improvement and spatial quality are combined. The target was the optimum combination of measures. The measures are compared and ranked.

The CEA supports the compilation of measurement packages and to define the line of reasoning for the choices made.

Type of information

The intended effects of measures are not measured in terms of money, but in physical units or value judgements.

Phase in decision-making process

Strategic orientation phase.

Means

No information available.

Role of other stakeholders

No information available.

Summary results

The analysis shows that there is generally no cost advantage in combining safety improvement and nature development.

Lessons learned

In this case there were three reasons for choosing a CEA:

- The most important reason for choosing a CEA rather than a CBA can be found in the project's secondary aim: spatial quality. It is extraordinarily difficult to express the non-priced social benefits of spatial quality in monetary terms. The versatility of the concept makes it difficult to identify all the possible factors, let alone quantify them or even put them in order. A CBA would lose considerable significance if these important project effects could not be expressed in money terms and only figured as pm- items.
- The second reason for choosing a CEA was the impossibility of formulating a manageable set of project alternatives in advance. The number of possible solutions is huge. The method was designed to help compare measures with one another and rank them.
- The third reason was the availability of the information required to enable an economic evaluation. This was sufficient to carry out a CEA.

Analysis: choice of the evaluation method

On the base of the results from the CBA (the most the social desired objective) this CEA is used to determine the most cost-effective alternative(s). One fixed objective, so a CEA is the most appropriate method for this case.

ANNEX 6: FURTHER INFORMATION

1. Socio-economic methods for evaluating decisions in coastal erosion management – *State-of-the-art* (Messina, component 3, September 2005)

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32. Case study Socio-economic study - Ystad Sandskog (Messina, component 3, December 2005)
33. Cost-benefit analysis of soft engineering techniques for coastal defence (Juli 2005)
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