RECLAMATION PAYS

ASSESSING THE SOCIO-ECONOMIC EFFECTS OF RECLAMATION PROJECTS

Marco Gatto
November 2nd, 2014
International Association Dredging Companies (IADC)

Abstract
Table of Contents
INTRODUCTION

Port cities have long been struggling to accommodate urban growth, given the difficulties of finding space within geographically constrained and densely populated coastal areas. However, thanks to the innovative dredging techniques introduced over the last few decades, land can nowadays be reclaimed at relatively advantageous economic conditions [1]. Having to cope with pressing urbanization trends, port cities have a lot to gain from more competitive costs of reclamation. Waterfront reclaimed areas can in fact be used to accommodate the demand for new housing, employment, transport and other urban facilities, enabling cities to allay congestion, to enhance urban services, and so to remain attractive locations for both people and businesses.

By securing land to spatially congested coastal areas, reclamation makes strategic spatial development plans feasible in areas that are relatively saturated. This function is of relevance for the entire local community, since the enhancement of infrastructures such as transport facilities, housing, parks, etc. have positive returns not only on investors and users, but on the whole city’s quality of life and competitiveness. However, despite public and private stakeholders are increasingly concerned with the impacts of reclamation projects, there seems to be a lack of knowledge on how such effects can be evaluated in practice. This is an important deficiency, since it is often in the light of social or indirect impacts that reclamation projects has comparative advantages over other plans that compete for public investments. Examples are the advantages of avoiding decentralized, geographically dispersed interventions (reduction of transport costs, environmental savings, etc.), and the benefits generated by reinforcing existing urban agglomerations (scale economies, knowledge spillovers, etc.). Considering the full socio-economic value of reclamation projects is therefore a fundamental step for guiding investors and public bodies towards efficient choices resource allocation.

The aim of this article is to contribute to a better understanding of the different types of socio-economic effects produced by reclamation projects, and hence to a more appropriate assessment of the overall value of reclamation based investments. Both these aspects are very important for recognizing how reclamation can favour the spatial-economic development of coastal areas, and in perspective for obtaining more support from private and public investors.

When dealing with socio-economic implications of reclamation projects, it is important to acknowledge that in fact the impacts can vary substantially by nature, magnitude, social significance, and time of occurrence. This complicates substantially the evaluation of a project’s consequences on social welfare, given that it is hard to weigh against each other effects that are heterogeneous. Relevant questions that need to be answered are therefore: how can the socio-economic effects of reclamation be defined, identified, and possibly measured? How are the cost and benefits of reclamation projects distributed among several stakeholders? Can costs and benefits be comprehensively weighed, so as to assess whether the project is profitable from a social-economical point of view?

With such issues in mind, a model for the evaluation of reclamation projects is proposed following a Cost-benefit analysis (CBA) approach. CBA is the appraisal technique most commonly used for economic project appraisal and, founded on a broad welfare-economic approach, it provides an analytical framework that is well suitable for conducting a comprehensive study on heterogeneous socio-economic effects. The framework is then used for the examination of two case studies: Maasvlakte-2, a major port development project undergoing in Rotterdam, the Netherlands; and Amager Strandpark, a beach reclamation project realized in Copenhagen, Denmark. The inclusion of the case studies is useful to show how an economic evaluation of RP can be made in practice, and also to give insights into the various types of socio-economic effects resulting from projects with different purposes. The report is structured as follows: section 1 presents the CBA model, illustrating a theoretical pattern for project appraisal, and describing the different types of effects generally identified in infrastructure projects. Section 2 focuses on the analysis the two case studies. Section 3 reports the general conclusions.

1. CBA MODEL FOR PROJECT EVALUATION

Economic project assessment represents one of the core tasks within decision processes regarding spatial development plans, and more in general public investments. Among other things, it involves the elaboration of important information on the project plan and its social and economic consequences, allowing decision-makers to base investment choices on sound economic considerations. Appraisal works can be useful at different stages of a project’s implementation. Ex-ante, in that they provide information about the welfare impacts that can be expected from the existing investment opportunities. Ex-post, in that they allow seeing whether a project has performed as expected, as well as to learn what did and what did not contribute to social welfare. Cost-benefit Analysis (CBA) is arguably the technique most commonly used for economic project assessment. Thanks to its flexibility and the straightforward results it provides, CBA is applied to projects from a broad range of sectors (from healthcare to transport, from education to energy and other industrial productions), and national and international institutions increasingly recommend its use in investment appraisal.

There are various advantages generally ascribed to CBA:

- Being based on a broad welfare-economic approach, it promotes the assessment of all social impacts resulting from a project, with positive and negative effects that are consistently identified and weighed for all relevant groups in society. Complete information on project effects is precondition for optimal investment choice, so the fact that CBA leads to a comprehensive consideration all project impacts makes this technique a key tool for socio-economic evaluation of projects.
• CBA entails the assessment of project effects in a common unit of measurement, i.e. *money*. This allows weighing against each other effects that are heterogeneous and not immediately comparable. Then, once they are all expressed in monetary values, all effects can be easily added together, so CBA facilitates a straightforward determination of the overall social return of the project (Net Present Value).

• CBA illustrates how a project’s costs and benefits are distributed across different social groups, an aspect relevant especially with respect to non-marginal projects, i.e. those with a relatively large and socially dispersed welfare impact. Looking at the distribution of benefits and costs is important for example to define the financial contribution to be given by public and private stakeholders, or to determine a fair compensation to parties that experience some project’s negative consequences.

In the light of these aspects, CBA appears well suitable for investigating the effects and the welfare value of reclamation projects. Therefore, following the principles and the methodology typical of CBA, we propose a conceptual framework for evaluation of land reclamation projects. The main objective is to develop a tool that facilitates a consistent and comprehensive analysis of the social impacts of reclamation projects, meaning the impacts they produce not only on the specific sector for which land is being provided, but on the whole socio-economic context that is influenced by the project. Naturally, what produces value for society are not reclamation activities themselves, but the type of services and infrastructures that are developed on reclaimed land. Reclamation activities only provide an input – land- to the project. So the focus of the analysis is rather on the spatial development plans reclamation make possible, and the impacts that generate directly and indirectly from such plans, see Figure 1.

![Fig.1: Logical steps: flow from reclamation of land to project impacts](image)

Eventually, by evaluating alternative investment options under a common structure of analysis, it becomes easier to recognize the comparative advantages offered by reclamation-based investment projects, and hence the economic values reclamation is able to provide to coastal regions. Note however that the emergence of certain impacts largely depends on the activities that take place on the reclaimed area, as well as on the social, economic, and technical circumstances under which the project is built up. Consequently, the advantages of reclamation, as of any investment option, are not unconditionally available, but they rather tend to be project-specific. Looking at real case studies can therefore be very useful for attempting some general conclusions on the positive implications that reclamation has on coastal economies.

The model proposed in this report is developed on the base of guidelines that various organizations have issued for promoting the use of a common methodology within project assessment practitioners [2], [3], [4]. In its general conceptualization, our model closely draws from Eijgenraam et al. (2000a, 200b), particularly in the way project effects are classified into typologies. Similarly to Eijgenraam et al., our model is tailored mostly to the appraisal of large transport infrastructure projects, as suggested by the consideration given to the effects on the transport network, and to the indirect effects (which are relevant only when the project is of relatively “large” dimensions). However, the framework can be applied equally well to projects of a smaller scale or with a different purposes by laying more or less emphasis on certain types of effects.

The economic assessment of investment projects is a complex and extensive exercise, which require an in depth analysis of a number of elements on which the determination of the project value depends on. The diagram in Figure 2 illustrates the logical steps leading to a socio-economic evaluation of RP. These are represented as a flow of consequent, interrelated issues to be considered during the evaluation. The analysis starts with the formulation of the CBA, i.e. by examining the aspects needed for carrying out the overall evaluation. Defining the project alternative, the base case, and the future demand for project services allows elaborating information later necessary as inputs for assessing the effects and the social value of a project. Following the CBA formulation, we look at the outcomes that reclamation projects deliver in terms of services, namely the way the interaction of supply and demand of project services determines new conditions within relevant market sectors. The focus then shifts to the description of a project’s socio-economic effects, where different types of effects are identified and characterized into categories.

The identification and the valuation of a project’s welfare effects constitute the basis on which a social CBA is developed, and also the core topics of the present research. So this part of the analysis will be treated more extensively. On the other hand, the parts on the CBA formulation and the project services will be addressed more shortly, concentrating on some basic notions and on the element that are most critical within CBA. For a broader and more detailed description of CBA, however, readers may refer to the numerous texts and guides published on the topic.
1.1 CBA FORMULATION

Problem Analysis
The preliminary phase of an appraisal study consists of formulating the problem, the aims of the project and the preconditions with which the project must comply. A project might consist of a series of operations and activities that seem separate from each other, but that are however functional to a common, well defined objective. The definition of the project objectives is essential in order to determine which activities the project comprises, and hence the elements to include in the CBA. A clear statement of the project objectives is important also for defining fair alternatives to the project. Project alternatives are indeed necessary to define the option that will stand as the base case, as well as to make an inventory of the possible ways the project can be implemented. In ex-ante CBA, indeed, it might be necessary to consider different scenarios for the project implementation, for instance with respect of timing (phasing) of construction, technical possibilities, legal or environmental constraints, etc.

Socio-economic context
This step of the project appraisal aims at understanding the social, economic and institutional context in which the project will be implemented. In fact, the possibility of achieving credible forecasts of benefits and costs depends largely on the accuracy in the assessment of the economic and social conditions in which the project is implemented. It is thus important to make sure that assumptions, e.g. on GDP, traffic or demographic growth, are consistently made. Central within the examination of socio-economic context is the demand analysis, which consists of forecasting the demand for the goods/services the project will generate. Among other things, the forecast for service demand is a key indicator for the estimation of the future revenues of the project and consequently its financial performance (EC, 2008). For determining in advance what the demand for project services will be, the behaviour of potential users and competing operators must be described and analysed fully. Therefore, two types of analysis are carried at this stage of the CBA: the market analysis, and the competition analysis. The market analysis looks at how the total demand for services offered through the project will develop in the relevant region. The relevant regions comprise of the entire area within which the supplier of the new project service can sell his services, i.e. where he can compete. The competition analysis should show which part of the total demand the project would be able to obtain in the relevant region. It is likely that also other operators undertake measures to gain from the expected market developments, in which case it is necessary to consider strategic responses implemented by competitors. A broader range of estimations of on future demands can be obtained by carrying out the market and the competition analysis for more than one future socio-economic scenario. Eventually, this allows seeing the extent to which the results of the evaluation are sensitive to different levels of service demand (Eijgenraam et al., 2000a).

Project Identification
The definition of the project involves the description of the elements that form a functional part of the project, i.e. the investments and efforts that contribute to the realisation of the project objectives. The project must be clearly identified as a self-sufficient unit of analysis. The activities included in the project must lead back to a unique objective as well as to a coherent and co-ordinated entity of actions and roles. For example, a new railway project is not only about new railways and train stations, but also the availability of particular trains and operative transport services. Similarly, a new port area cannot function without adequate access roads, company grounds and other facilities. Some variants can also be considered within a flexible plan design, for example in case there is a phased construction, or decisions that are postponed at later moments. Along with the project, also the corresponding time horizon must be opportunely defined. The time horizon will tell how far...
into the future the project impacts will be estimated, so it should be set according to the economically useful life of the project. As it becomes hard to extrapolate reliable benefits estimates beyond a certain point in time, after that the (net) benefits can be aggregated in the residual value of a project. The residual value, or project liquidation value, gives an estimate of the net present value of all project yields beyond the time horizon, and is usually incorporated in the CBA together with the other project costs and benefits.

In order to determine the effects of a project, a base case is required in addition to a project alternative. Without the project, serious inefficiency will probably develop, so the base case is not necessarily the status quo, but can also correspond to an alternative intervention that can reduce future problems. If the base case is not adequately defined, there is the danger of seriously overestimating the profitability of the project. At least three scenarios could be considered as counterfactual base case (EC, 2008): the do nothing alternative; the do minimum alternative; the do something alternative (sometimes called reasonable alternative). For example, in order to link two areas the do nothing alternative could be to use the old ferry service, the do-minimum alternative could be to renew/improve ferry service and the do-something option could be to construct a bridge.

1.2 PROJECT SERVICES

Project services can be defined as the services derived directly from the use of the project. As investment project generally aims at generating additional supply or quality improvement in some services. The sale of these services will then translate into welfare impacts, typically in the form of higher efficiency and larger availability in some production or consumption activities. Based on that, the provision of project services result as the factor on which the project effects mostly depend, and the preconditions for some project benefits to exist. A question that naturally follows is: which are the services that reclamation projects offer?

The purpose of land reclamation is essentially to provide capital good (land) that is necessary to accommodate demand for certain goods/services. As such, reclamation involves the construction of an area that has to be equipped for specific economic activities (transport infrastructures, production, housing, recreation, etc.). In relation to that, is the project service identifiable in a number of hectares suitable for specific activities, or rather an estimated increase in infrastructure or production capacity, housing supply, recreational opportunities, etc.? In the first case, space provision appears as the core objective of the project, with land rents that would represent the main return from the investment. In the second case, the creation of space remains central in the project, but new land is to be considered more as a project input. The project outcome can indeed be seen further, namely in the way the reclaimed land is used by developers to supply additional goods/services to their costumers. Taken from this perspective, an investment in reclamation finds its sense in the services that are ultimately delivered on reclaimed land, with the project effects that will largely depend on the effective consumption of these services. Given that, it is fundamental to know in detail how the reclaimed area will be divided and used among the different functions, so as to see what activities will take place, and which type of markets and stakeholders will be affected by the investment.

Once services become available to the market, the interaction between supply and demand will result in a given market equilibrium, characterized by a certain quantity of services, and a corresponding price. On the supply side, the provision of services is determined by the project operator, which decides on the base on the internal feasibility and profitability of the project (business case). Note that market dynamics are highly influenced by what was previously described as “socio-economic context”, so the eventual market equilibrium strongly depends also on the way demand for services develop over the project life span.

1.3 PROJECT EFFECTS

Point of view
Cost and benefits can be examined from different perspectives (e.g. regional, national, supranational, etc.). The choice of the perspective will dramatically influence the overall CBA value. Taking a regional perspective would imply that effects experienced outside regional borders will not count for the CBA. Consider for instance a situation where additional employment is created in the region where the project takes place. By extending the perspective to the national scale, it might be that workers just shifted between regions. As the national employment level remains stable, the observed effect on employment would actually be nil.

The choice of the point of view is not completely arbitrary. When the project has very localised effects, one might want to see how the project contributes to regional wealth and GDP, in which case the analysis can be focused on the effects produced at the local level. Nonetheless, it is always recommendable to consider where/who are the users or beneficiaries or the project services. Indeed, if the project serves a large area, limiting the evaluation within regional borders would imply that most benefits would not be counted, so the project benefits risk to be underestimated. Finally, it is important to consider who is participating to the investment. For instance, if the national government contributes to the investment, the country taxpayers are indirectly financing it, so it would be interesting to measure what are the benefits that the nation will gain as a whole.

Project effects can be defined as the difference between the situation with the project (project implementation) and the base case (Eijgenraam et al., 2000a). This means that anything that occur as a consequence of the project, and that would not have occurred in the base case, must be regarded as a project effect. Deducing whether or not a certain change is caused by the project or not is a key point for the identification of the project effects, which is the reason why the problem of attribution is central in appraisal exercises.

There are various ways project effects can be categorised. To determine whether an effect constitutes a cost or benefit, for instance, one should see if the effect leads to a decrease/increase in economic welfare, and hence determine whether the
effect is negative (cost) or positive (benefit). Another distinction usually made is between quantifiable and unquantifiable effects, depending on whether is possible or impossible to measure them according to market prices. Such distinction is relevant especially in practice, since when an effect is related to a good for which market or market prices do not exist (e.g. air pollution, noise, travel-time, etc.), specific valuation methods need to be used so that the effect can be included in the CBA calculations. Moreover, as illustrated in Figure 2, effects can be distinguished between direct effect, and indirect effects. This is the classification to which we will mostly refer throughout the report, so the rest of this section is assigned to the description of these two categories. Direct effects are examined by looking at the parties and stakeholders that are directly affected by the project, while indirect effects are classified into different typologies. Table 1 presents an overview of the various categories of effects, providing some compact definitions along with intuitive examples.

**Direct effects** are those arising from the construction, use and presence of project services (Eijgenraam et al., 2000a). Different types of stakeholders are directly influenced by the project:

- **Operator.** In the first place, the project involves the owner/operator of the project services. From the owner point of view, the stream of costs is weighed against revenues, resulting in the (net) operating profit. The internal feasibility of the project is normally assessed in the business case, an instrument through which the operator compares construction, maintenance and operating costs with all revenues estimated over the project life.

- **Users.** The provision of project services is at the core of infrastructure development, so the users of such services are normally those enjoying the larger benefits from the investment. By investing in infrastructure, indeed, the service supplier might be able to sell project services at larger amounts and/or at more efficient conditions. This will lead to a welfare improvement, which is typically measured as “Consumer Surplus”. As the unit price of the service decreases, for instance, users benefit by paying relatively less than what they would pay in the base case. On the other hand, if the producer will continue to sell at the same price, he will keep for himself the unit cost reduction, earning extra-profit. In general, the degree at which efficiency gains in production are passed over to consumers depends on the level of competition existing in the market. The more competitive the market, the more the producer is forced to sell at the lowest possible price.

- **Third parties.** These are agents other than the owner and the users of the services. Third parties may be directly influenced by the construction, use or presence of the infrastructure even though they are not involved in the project operations, or are not making use of the services. Relevant third parties are for example residents, who directly experience negative project effects in the form of e.g. pollution, noise, etc.

**Indirect effects** are represented by the consequences of a project that are not directly related to the project, but which instead flow from the direct effects (Eijgenraam et al., 2000b). Indirect effects are commonly seen as advantages that spread from the project service sector through the rest of the economy by mean of market transactions. However, it is important to notice that such transfer mechanism leads only to a redistribution of welfare within the society, so (except from specific cases) it should not to be included in the count of the project effects [2]. Redistribution occurs e.g. when an investment in infrastructure leads to lower costs for users, and users in turn decreases the price of their product, and so on until the final consumers. Or when the construction of a new park or station impacts property prices in the surrounding areas. Summing these effects to those experienced upstream by direct users of infrastructures would imply crediting the same impact twice (double counting), an error often made in project assessment. By offering an in-depth analysis of the project impacts and the relationship existing among them, CBA helps to separate welfare effects from all redistributive effects, and so to prevent double counting. The impacts generally included in CBA as indirect effects are:

- **Network effects.** These typically arise from transport infrastructure projects. Transport infrastructures are indeed part of a broad network, of which they represent a part (e.g. a line connection between two places, or a hub that is connected with multiple routes). As routes are interconnected, when an infrastructure is developed, the network as a whole is influenced. Therefore, the traffic by the project, i.e. the extra volume of goods or passengers using the new infrastructure, will necessarily flow either downstream or upstream the network to reach the final destination. As a consequence of the induced traffic volumes and capacity usage, the new network equilibrium can also entail redistribution across transport modes, and therefore a different modal share. Depending on how the existing network capacity can accommodate the extra volume, network effects will be either positive or negative: positive, if the extra volume leads to a better or more efficient utilization of the existing capacity; negative, if there is already nearly full utilization of capacity. In the latter case, indeed, new users cannot be efficiently accommodated, so the increase in transport flow will result in congestion, causing time-delay to all other infrastructure users. Alternatively, when traffic is managed through congestion pricing mechanisms (toll), users do pay the full cost of transport, in which case externalities from induced traffic are avoided. In the long-run, to prevent congestion, capacity needs to be expanded through new investments. If the users do not pay for the expansion cost, this would be considered as a negative project effect, because the transport operator cannot cover the extra investment required.

- **Strategic and locational effects.** Efficiency improvements generated through new infrastructures help increase the competitiveness of an economic system, with positive consequences on investment inflow and international trade. In some cases, indeed, infrastructure projects generate location advantages for businesses, contributing to attract new activities and investments from abroad. This is more likely to happen when the project involves hub infrastructures, which, being connected to many other points in the network, becomes more convenient for businesses relatively to all other places (by improving a line connection - the connection between two places - it might happen instead that firms decide to move their productions in one place and serve the other from there, in
which case it is uncertain who benefits and who is disadvantaged from the investment). There exists a vast economic geography literature postulating a positive relationship between market size and economic growth (the so called agglomeration economies or external economies of scale), see WB (2009). The inflow of new players can have number of positive consequences on the local economic system. For instance, producers can benefit from increase in market size because they have access to more efficient and specialized suppliers, or because they can share and exchange with others factors such as capital inputs, workers (labor pooling), information (knowledge spillovers), technologies, etc. Households also have specific preferences with respect to type of housing, urban amenities, etc. Therefore, intervening on the urban environment may help attract specific types of households (e.g. the better educated), with positive effects possibly generated on the local economy.

- **Employment.** As the project becomes operative, new workers are needed in the activities directly or indirectly related to it. If there is full-employment, the increase in job demand can be fulfilled only by shifting workers already employed in other companies or regions (redistribution), which means no additional employment is created. On the other hand, if there is structural unemployment because of imperfections in the labour market, a positive effect might result from the project. Positive effects on employment typically involve low-skilled workers, which unlike the higher educated, are more largely available and present relatively higher unemployment rates. For assessing whether a permanent effect on employment is created, both the induced demand for jobs and the underlying labor market need to be analysed in detail. Considering the influence that labour market institutions often have on employment and wage formation, it results that in the long-term infrastructure investments lead more to a mere spatial redistribution of jobs than to an increase in emploment (Eijgenraam et al., 2000b). Positive macroeconomic impacts may however result as consequences of higher disposable income (wages increases when labour demand goes up), and the related macroeconomic benefits and multiplier effects.

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<thead>
<tr>
<th>Tab.1 Classification and short description of project effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Direct effects</strong></td>
</tr>
<tr>
<td>• Operator</td>
</tr>
<tr>
<td>• Users</td>
</tr>
<tr>
<td>• Third parties</td>
</tr>
<tr>
<td><strong>Indirect effects</strong></td>
</tr>
<tr>
<td>• Transport network</td>
</tr>
<tr>
<td>• Strategic effects</td>
</tr>
<tr>
<td>• Employment</td>
</tr>
</tbody>
</table>

### 1.4 CONCLUSIVE TASKS

**Assessment and valuation of project effects**

Once identified, the project effects need to be expressed in monetary term. Monetary evaluation allows expressing in the same dimension heterogeneous effects, and is required to calculate an aggregate indicator of net benefits (Net present value). In CBA, this is done on the base of the willingness-to-pay (WTP) that firms and households have with respect to each specific impact. Market prices are supposed to be a good indicator of the relative value that goods have for suppliers and customers. Therefore, the WTP can normally be accurately estimated in respect to those goods and services that are exchanged on the market, and so the change in producer and consumer surplus connected to the project. On the other hand, when goods not traded in actual market are involved (air quality, leisure/travel time, natural resources, etc.), the value of such goods need to be estimated trough specific methods such as surveys, experiments, etc., see e.g. EC (2008), Pearce et al. (2006)

**Final assessment**

Once all effects are quantified, a cost-benefit set-up must be produced, with the stream of cost and benefits described over the entire investment horizon. These must be first expressed in constant prices (i.e. prices adjusted for inflation and fixed at a base year), and eventually discounted to determine the **net present value** of the project (NPV). The project NPV is the present value of the net benefits (NBt = benefit minus costs in period t) measured over the entire project life span (t = 0, …, T), and discounted at the discount rate (i):

\[
NPV = \sum_{t=0}^{T} \frac{NB_t}{(1+i)^t} = NB_0 + \frac{NB_1}{1+i} + \ldots + \frac{NB_T}{(1+i)^T}
\]
The NPV is the ultimate outcome of CBA, as it expresses in monetary terms what is the project overall contribution to social welfare. For decision-making, a positive (negative) NPV indicates whether a project is profitable (unprofitable) from a social point of view, i.e. whether or not it should be implemented. Note that at the final year considered (t=T), the project normally continues to have an economic relevance. Therefore, by taking into account values beyond the final year (standing assets, standing debts, operating income, etc.), the residual value of the investment is usually included in overall calculation.

For computing the NPV, values are to be discounted to a particular point in time, which is generally the time of the analysis, or the starting time of the project. The discount rate reflects the relative valuation placed on costs and benefits occurring at a different point in time. The choice of the discount rate will naturally influence the NPV resulting from a project (the lower the discount rate, the more valued future benefits and costs are against present one), which implies that the value of the discount rate needs to be appropriately selected for the analysis. In principle, with perfect financial market the level of the discount rate can be set according to the opportunity-cost of capital, i.e. the return that would be obtained from investing in the international capital market, see e.g. EC (2008), and Eijgenraam et al. (2000b). With imperfect financial markets, however, the society may value future values differently than financial markets. Since CBA is a social evaluation, a different rate must then be used for discounting (the so called social discount rate).

### Risk and uncertainty

The outcome of economic appraisal of projects is usually characterized by some degree of uncertainty. This has to do with the difficulty of deriving reliable cost and benefit estimates over relatively long periods of time, and more in general in forecasting how a situation develops after a project is implemented. To deal with uncertainty, it is recommendable to analyse in depth the level of risk connected with the prediction of some critical variable. This can be done e.g. by constructing different scenarios for economic growth, market demand, etc., or by determining a reasonable range of values for key variables. Once a range of plausible estimates is found, sensitivity analysis allows examining how the results change in response to variation in parameters. For instance, sensitivity analysis can be conducted by calculating the NPV with respect to different values (min, max, expected value, etc.) of a variable presenting high volatility. Or by repeating the NPV computation for different values of key variables such as discount rate, service demand levels, etc. Analysing how the CBA calculations are influenced by uncertain factors is an effective way to incorporate uncertainty into the evaluation, and allows making more robust and reliable conclusions on the overall performance of a project.

1.5 FINAL REMARKS

This chapter outlined the various types of effects related to infrastructure projects, giving some indications on how they can be assessed on the base of welfare economic theories. Following the CBA structure, moreover, it has been described how the examination of the effects leads to an integrated analysis of the project’s results (NPV). However, it is interesting to see how the consideration of specific impacts leads to a diversified evaluation of the project performance. By considering the project as a normal investment, for instance, the analysis is restricted to the effects for the operator, and the evaluation would be focused on determining the financial return from the project. The owner/operator of the project calculates the cash-flow expected over the project life, and decides to implement the project only if the returns are higher than the costs of the project. A CBA limited to the effects on the operator/investor is what is generally called business profitability analysis, or financial analysis, and informs the extent to which the project is attractive as a private investment.

It might be however that the financial returns from the investment are not sufficient to cover the project costs, but that positive effects the project generates on other stakeholders (external effects) justify the project from a social point of view. In that case, as the operator carries out a financial analysis to assess the internal profitability of the project, the society (or the government) carries out a CBA to assess whether the project is profitable from a social point of view. CBA forces a comprehensive consideration of the broader social impacts, i.e. the impacts the project has on all relevant parties in society. It represents an instrument to determine whether social welfare increases by realising the project, which is the reason why social cost-benefit analysis is often used as synonymous for CBA. As it will be demonstrated later, distinguishing private and social interests can lead to different conclusions on the desirability of an investment project.

Before looking at the case studies, it is important to evidence some drawbacks generally connected to the use of CBA:

- **Feasibility.** The wide range of effects to be considered implies the risk that the overall analysis becomes excessively long and costly. Moreover, it is in many cases very difficult to derive reliable estimates of all effects. For example, because of the impossibility to attach a value to unpriced goods, or to make accurate predictions for some critical factors (demand levels, firms and citizens behaviours, social context, etc.) over relatively long periods of time. These aspects call into question the practical feasibility of CBA works, and limit its usability in project appraisal, especially for large-scale investment projects. To overcome these problems, often analysts need to combine quantitative and qualitative evaluations of project effects, or limit the appraisal to only part of the effects (partial CBA).

- **Equity.** In CBA the value of the effects is assessed based on individuals’ WTP, and the social valuation (NPV) is obtained simply by summing the individual monetary amounts. However, neglecting distribution issues may undermine the actual desirability the project has for society. For example, it might not be considered fair assuming that costs and benefits are weighed the same across social groups (an Euro has not the same value for a high- and a low-income household); or that a project is to be implemented even though benefits and costs are socially or spatially concentrated. Distributive effects on different social groups can be incorporated into CBA e.g. by using different social weights when accounting for costs and benefits for specific stakeholders; or by designing compensation mechanism between who benefits and who looses. That said, the government plays an important
role as intermediary between the interests of all social parties, and is eventually the entity responsible for finding a fair political compromise between winners and losers.

- **Acceptability.** The rationale based on which CBA is implemented might result “opaque”, and its outputs difficult to interpret by people. The fact that effects entailing redistribution of welfare should be disregarded to prevent double-counting is not always obvious to someone who attaches relevance to specific benefits. The creation of employment, the impact of infrastructure investment on property values, and the forward effects of improvements in transport facilities that are passed on through the market, are often used as arguments in favour of projects in public debates. Although CBA do not count impacts that are just from redistribution of the direct effects, project promoters, politicians or other stakeholders may rather consider them important with respect to their specific industrial sector, jurisdiction, or circumscribed “segments” of society.

2 CASE STUDIES

The case studies were selected by looking at the main drivers of reclamation projects: port development, residential development, and recreation. Availability of data was a key issue for the analysis of real projects. Maasvlakte-2 and Amager Beach Park could be investigated thanks to the public availability of information on the project, and the support of administrative companies. On the other hand, the project on residential development was finally excluded because the access to relevant information resulted problematic.

2.1 MAASVLAKTE-2

The Port of Rotterdam is the largest port in Europe. In 2012, its total throughput reached 440m tonnes per annum, and a market share of almost 38% within Northwest Europe (PRA, 2012). The Port has a very strong position both as global hub and industrial cluster. Thanks to its favourable geographic location, quality of hinterland connections, and efficiency in port services, handles very large volumes of cargo across all main sectors (containers, drybulk, liquidbulk). The Port of Rotterdam Authority (PRA), a government corporation jointly owned by the Municipality of Rotterdam and the Dutch State, is the manager, operator and developer of Rotterdam port and industrial area. PRA is strongly committed to reinforce the market position of the port complex, and continuously invests in the development of the existing port area, new port sites, public infrastructure and the handling of shipping. Aware of the considerable challenges and opportunities the port sector will face in the next decades, from 1998 PRA supported the realization of a huge reclamation-based development project: the Maasvlakte 2 (MV2). Given the shortage of space characterizing the existing port area, MV2 allows PRA to provide room to new businesses and existing clients who wish to expand their activities. As such, it enables the PRA to continue to develop and to maintain its competitive position as a logistics hub and world-class industrial complex.

2.1.1 CBA FORMULATION

**Problem analysis**

PRA predicts that by 2030 throughput will reach a level between 675 and 750 millions tonnes (over 50% larger than 2012 level), which implies that facility upgrade and port capacity expansion are necessary. Albeit a share of the extra-throughput can be handled in the existing port complex (e.g. by making a more efficient use of land), the remaining part has necessarily to be accommodated on new land. Specifically, PRA reckons that along with an increase in land productivity up to 45%, a 20% expansion of the port area is necessary to fully meet handling capacity demand for the next 30 years. MV2 is the answer PRA designed to implement such expansion.

**Socio-economic context**

Relevant developments in port-related sectors are expected to have huge implications for the port industry. For what concerns future cargo flows, which is the key element based on which investment and port development strategies are made, the most influential are factors such as economic growth, volume of world trade, oil prices and environmental policy. Based on different combinations of these factors, PRA considered four different economic scenarios for forecasting the development of cargo handling. As shown in Fig. 3, by 2030 the Port of Rotterdam is estimated to grow in total throughput in all four scenarios. Both container/break-bulk and liquid-bulk appear as the main growth markets. In the container sector, in particular, thanks also to the possibility that MV2 would offer to handle the largest vessels, container handling could possibly pass from 25% to over 40% of total freight. For demand analysis see section 2.2.

MV2 is part of a broader policy plan aimed at fostering economic growth and quality of life in the Rijnmond region (Rotterdam Mainport Development Project). MV2 is expected to have substantial impacts on the economy and the environment at both regional and national level. Therefore, governments, environmental organizations, and other stakeholders were committed to promote sustainability criteria for the design of the project. This led to agreements concerning the realization and the use of MV2, environmental compensations and the creation of new nature and recreation areas.

**Project identification**

The project alternative (MV2) consists of reclamation of a 2000 ha area in front of the existing port. Half of the area is for commercial use, offering allocable sites for three main sectors: container handling, chemical industry, and distribution sector. PRA operates as landlord port. Therefore, it will be responsible for the construction of 2000 ha, along with seawall, port facilities (roads, pipeline, tracks, quay walls, embankments, etc.) and other infrastructures. The clients themselves will
construct facilities like paving, buildings, cranes and installations. To compensate for project-driven natural loss, the project involves also the institution of a seabed protection area, and the creation of a new dune area near Delfland.

As base case, a do-something scenario appears most appropriate for a CBA of MV2, since PRA would arguably take some actions in order to respond to substantial market developments, namely to increasing cargo flows. For example, based on a series of investments and infill measures that PRA took into consideration before the MV2 option was proposed, CPB (2001a, 2001b) considers as base case a sort of alternative spatial development plan that could have been implemented in the existing port area. Note that this alternative plan would allow PRA to accommodate only a share of future demand, so the net effect of MV2 is to be weighed considering only the part of demand exceeding the one that could have been received in the base case. Among other things, this well exemplifies the relevance of the base in CBA.


Figure 3: Total throughput in 2030 Port of Rotterdam. Source: PRA (2011)

2.1.2 PROJECT SERVICES

Based on the prospected area land use, MV2 provides room for additional transport services (container handling, distribution, etc.) and industrial productions (chemical goods, energy, etc.). Container operators or chemical industries provide these services from MV2 to companies outside the port area. These other companies demand such services for example as shippers and receivers of cargo, or companies that need chemical or energy inputs produced at MV2. The welfare impacts of MV2 largely depend on the type of efficiency gains derived by the use of new infrastructures. These impacts will be analysed later in the report. In this paragraph the focus will be on supply and demand of land. The land use of MV2 will indeed indicate what sectors and stakeholders will eventually be influenced by the development of MV2.

Supply of service

Decisions on land supply are difficult to be taken by PRA. A quick development of MV2 implies the risk of vacant land, i.e. paying for construction and maintenance without earning rent, so vacancy rate should always remain as low as possible. A slow development, on the other hand, brings the risk of not having land available when required by companies. Companies might not want to wait for the land to be developed, in which case they go somewhere else. That said, it is good to maintain a wide offer of different types of sites, for instance by reserving some land for future potential settlers. Efficiency is then somewhere in the middle between a quick and a slow development.

Aware of that, PRA will phase construction and investments out over 30 years time, adopting a flexible development design for MV2. This strategy entails a flexible, market-driven development of the area. The basic idea is to minimize the risk of vacant, unprofitable sites by developing areas and facilities suitable for specific activities only when demand materializes, so in the moment when a type of land is actually required by interested businesses. This allows implementing MV2 more efficiently, as PRA can adapt land use and investment decisions based on future market conditions.

Demand of services

As demand for goods or services is expected to increase, companies invest to expand production. When defining their location decision, firms will then opt for the place that allows them to serve their costumers at the lowest cost. As shown in the analysis of the socio-economic environment, there are several factors that concur to determine how the sea transport and chemical sector will develop in the next decades. Consequently, it is quite uncertain how demand for sites at MV2 will develop over time. A market analysis is thus necessary to forecast demand for space across market segments. Demand forecasting is complex exercise, which can be done by mean of different approaches. As in MV2 land supply is focused on three main sectors, it is straightforward to implement a forecast for each specific sector. This type of study, which was used e.g. for the market analysis in CPB (2001a), can be simplified as follows. First one obtains the figure of growth trends in the sectors that use port facilities. The sectorial growth can then be translated in demand of inputs and hence in a corresponding throughput of the commodities that are needed in those sectors (container and breakbulk, drybulk, liquid bulk). Once the future flow for categories of cargo is estimated, the share of throughput in the LeHavre-Hamburg range is to be determined.
The Port of Rotterdam will then take a part of this throughput, depending on the relative competitiveness of the port and its hinterland connections. Market shares are continuously evolving over time, so to determine the Rotterdam’s potential share of future throughput one needs to consider strategies and investments made both by PRA and by its foreign competitors. Based on modal share within cargo categories, it is then possible to determine the share for each mode (container, Ro-Ro, etc.). For each mode, the freight volume can then be translated in demand for land on the base of the mode-specific land productivity (e.g. tonnes of cargo handled per hectare). Land productivity is also subject to variations, due e.g. to technological innovations or environmental restrictions that are introduced over time. For deriving reliable demand estimations, it is thus important that the chosen value of land productivity reflects the factors influencing sector-specific production technologies. Once the growth in throughput for cargo categories is determined, the same rationale can be applied for estimating space demand in the chemical and distribution sectors.

Equilibrium

Although forecasts can give a fair idea on what to expect in the future, space demand will in fact fluctuate greatly from time to time depending on economic cycle, unexpected market development, etc. Whatever the market developments, the interaction of supply and demand will determine the equilibrium in the land use at MV2. In compliance with the initial Master Plan, such equilibrium will eventually result in a certain land allocation, with a corresponding rent to be paid by companies to PRA. When defining its pricing policy, PRA tries to maximize its return from the investment, so it will set prices based on its market power, and on sector-specific demand elasticity. Large commercial sites located directly on deep water are scarcely available in Northwest Europe, so companies, particularly in the container sector, have strong interest in settling in MV2. PRA can take advantage of its market position when fixing land rents, as well as port dues and wharfage. Of the 1000 ha of allocable area, PRA expects the following land use: container handling (60%), chemical industry (30%), and distribution (10%). The possibility for PRA to change such allocation exists, but legal and physical constraints limit deviations within relatively small ranges. As for timing of construction, only two-thirds of the eventual 1000 ha surface area is rounded off in the period until 2013 (phase-1). The remaining part will be constructed after 2015 (phase-2), based on how demand for newly granted sites will arise over time. In the container sector, three big players have reserved already 414 ha: Rotterdam World Gateway (154 ha), APMT (176 ha), Euromax (84 ha). Securing important contracts with such clients substantially increases the project financially feasibility, facilitates commercial and physical planning of activities, and attracts spin-off activities in the area. Therefore, having a contract with “launching customers” was proved fundamental for starting the construction of MV2.

2.1.3 PROJECT EFFECTS

Point of view. Rotterdam is the largest port in Europe, and serves a vast region in the hinterland. Around 80% of total cargo throughput is destined for or originates from countries outside the Netherlands, though for container traffic the share staying in the Netherlands is higher (above 50%). As the users of cargo or chemical products are located for a large part abroad, the project effects spread over the national borders. Nevertheless, the local and national government have strongly supported the project politically and in part also financially, so it is interesting to see how MV2 can contribute to development of the Dutch economy. A national point of view will therefore be taken during the evaluation. This however implies disregarding the project’s forward effects that are passed on to foreign agents.

Direct effects

- **Port operator.** For PRA, the core effect of the project is represented by the net profit earned over the investment horizon, integrated with the expenses (investment in existing port, maintenance of the original seawall, etc.) that PRA avoids with respect to the base case. Fig. 3 shows the distribution of costs and revenues from MV2 for the period 2006-2040. The figure reflects the estimations that PRA made in the 2003 business case for MV2. On the cost side (negative quadrant), there are investment, maintenance, and operating costs. Altogether, these sum up to € 2.9 billion (2007 price level). On the revenue side (positive quadrant) is reported the income PRA receive from port dues, rents, and wharfage. For each year, the difference between costs and revenues is summarized by the annual cash-flow (black line). Applying a certain discount rate, the annual cash-flows can be discounted to a base year so as to derive the Net Present Value that MV2 has for PRA. This type of NPV represents the net profit that PRA earns through MV2, and does not include the MV2’s impacts on the rest of society.

As expectable, the cash-flow develops over time from quite negative values, which are due to the considerable investments that are initially made for constructing the area, to positive values, which PRA starts obtaining as commercial sites become operative. Revenues grow especially after 2020, that is the period where the container sector is expected to get closer to full market potentials. Investment costs appear distributed over more than 20 years, reflecting the phased plan for construction designed by PRA. PRA does not disclose information on revenues, applied discount rate, and NPV, so it is not possible to determine the exact impact that MV2 will have for the project operator. Although PRA is confident in that revenues will greatly outweigh the costs of MV2, forecasts on future market demand have been recently revised downward, reducing the expected financial profitability of the project. In the light of that, we will assume that MV2 has a (moderate) positive affect for PRA.

- **Users. Container sector.** With the introduction of larger ships, and the expected rise in international trade and sea transport, enormous growth potentials are prospected for the container sector. Some 600 ha of MV2’s industrial sites are earmarked for container terminals directly located on deep seawater. With the gradual development of three new terminals (Rotterdam World Gateway, APMT, Euromax), PRA (2008) reckons that thanks to MV2
capacity could be expanded by some 21m TEU, passing from a 2013 container transhipment of 17m TEU up to 38m TEU by 2035. To determine the welfare effect that MV2 has in the container sector, CPB (2001a, 2001b) looks at how consumer and producer surplus differ between the project alternative and the base case. The change in consumer surplus would reflect the extra benefits that shippers and receivers of containers obtain from quality improvements in terminal operations (time gains, more frequent connections, etc.), and from avoiding an increase in the price of container handling due to the capacity shortage that is supposed to happen in the base case. With respect to the producer surplus, MV2 would instead have a negative effect in that terminal operators give up the extra revenues that they would earn in the base case, i.e. by charging a higher price while facing excess demand of handling services. Respectively to optimistic growth forecast scenarios in the container sector, for instance, the overall welfare effect (consumer surplus net of loss of producer surplus) is estimated to range between €16m and 63m (CPB, 2001b). Resulting from a national CBA, this welfare estimate is made up of the impact that MV2 has only on Dutch suppliers and users of container handling services. Since a good share of container freight involves foreign parties, considerable welfare benefits (€210m and 790m) go beyond Dutch borders. Albeit not counted in a national CBA, considering these other effects can however be important when assessing the overall economic relevance of the project.

**Chemical sector.** The benefits from the settlement of chemical companies in MV2 are of two types: cost advantages enjoyed by customers of settling companies; cluster benefits. Cost advantages occur because transportation of chemical products (raw materials, intermediate inputs, end products, etc.) to Dutch users is cheaper from Rotterdam than from other location. Without MV2, indeed, chemical companies would have to divert to other ports (Antwerp, Terneuzen, etc.), imply higher transport costs for Dutch companies. However, CPB (2001a, 2001b) argues that South Holland, that is the region where Dutch consumers of chemical end products are mostly concentrated, can be reached comparably well also from Antwerp. This implies that the transport benefits for Dutch users may result of relatively limited size CPB (2001a, 2001b). Cluster effects, on the other hand, are the effects that companies enjoy from being close to each other. Examples are shorter inter-firm transportation of chemical goods, exchange of waste heat, knowledge spillovers, etc. CPB (2001b) quantifies cluster benefits with a 5% of the value added of companies settling in MV2. Summarizing, the advantages for the Dutch chemical sector appear not to be highly dependent on locational factor, so the benefits in the chemical sector are predicted to be much lower than those predicted in the container sector. Whatever environmental scenario is assumed, CPB (2001b) reckons that the overall positive effect is not estimated to be higher than €130m.

**Other sectors.** The economic effects that MV2 has on the other sectors are marginal with respect to the chemical sector, and to the container sector in particular CPB (2001a, 2001b). Sectors that are likely to demand space in the MV2 are for example offshore decommissioning, iron direct reduction, and those other sectors other than container and distribution for a total amount not higher than € 165m CPB (2001b).

- **Third parties.** Being a large-scale infrastructure project, MV2 may imply significant effects also for parties that are not users or suppliers of project services. In a national CBA, this category of stakeholders fundamentally refers to local residents or Dutch citizens negatively influenced by activities directly related to the construction, presence and use of MV2. Effects on third parties usually entail unpriced welfare impacts (there is no market transaction reflecting them), so actors responsible for them do not take them into consideration in their decision-making (external effects). The Environmental Impact assessment provides the most information on MV2’s external effects. Important to consider are the consequences the project has on: landscape (view of industrial plants), recreational services (destruction/creation of beaches and other recreational areas), nature (coastal ecosystem services), and environment (pollution of air, water, sound, etc.). In total, external effects could amount to some €110m, that is little compared to other effects included in the CBA. This is due partially to the large distance separating MV2 from urban and residential settlements. However, it is important to remember that nuisance for people would take place also in the base case. Indeed, pollution and other negative effects would occur at similar levels also in case activities were located in other ports or locations in the Dutch territory. This makes the net external effects much lower than e.g. those one could estimate simply based on the EIA reports made for MV2.

**Indirect effects**

- **Network effects.** As port capacity is expanded, an increase in cargo flow through the port will take place. How this extra-flow will distribute over the transport network the port is connected with? From total throughput, 30% continue on sea (transhipment), while 70% is transported to the hinterland. For 2030, PRA wants to make hinterland transport more efficient and sustainable. For the modal split in container transport, for example, their objective is to pass from the current distribution (road 47%, water 40%, rail 13%) to a new one (road 35%, water 45%, rail 20%). An increase in transport may result in three types of cost: variable cost (labor, maintenance, etc.); fixed cost (investment in capacity expansion to avoid congestion); externalities (traffic-driven congestion, pollution, noise, etc.). How these effects are included in CBA? No welfare effect has to be included in case users fully pay for transport cost (congestion pricing), while there is a welfare loss if they do otherwise. For what concerns environmental externalities, the negative impact that the increase in transport flows has in terms of nuisance experienced by Dutch citizens can be valued through a methodology similar to that used for direct environmental effects. Altogether, in spite of bottlenecks possibly occurring in the most used links (A15, Betuweroete, etc.), network effects are estimated to be almost nil by CPB (2001b). This is because, thanks to the quality of hinterland connections to and from Rotterdam, the significant increase in hinterland transport due to MV2 can be
accommodated relatively well over the investment horizon. Moreover, external effects related to the increase in transportation within the Netherlands are not a notable issue, given that without MV2 transportation of cargo would take place anyway, and would probably cover longer origin-destination distances.

- **Strategic and locational effects.** Thanks to port development, Dutch economy, and particularly the Reijmond region, become more accessible and competitive. This improves the business climate, favouring new investments and attracting new companies. As these new activities are highly competitive and innovative, they might generate positive external effect also on the existing businesses. A structural improvement in business productivity can be expected.

- **Employment.** CPB (2001b) argues that there is structural unemployment of low-skilled workers in the Rijnmond region. Arguably, this is due mostly to a problem in the supply side: companies are willing to hire, but low-skilled workers do not have the skills that they require. Hence, the labour demand induced by the project will face the same sort of problem. So unemployed low-skilled workers from Rijnmond will constitute only a small share of the labour demand deriving from MV2. For the rest, workers from other region will start working in MV2 and its spin-off activities, in which case there is no welfare effect for the Netherlands, as that would mean only redistribution across regions. Despite small, a positive effect on low-skilled employment in Rijnmond can however be included in the CBA.

### 2.1.4 FINAL ASSESSMENT

Once identified, the various effects can be weighed and expressed in monetary terms, so as to calculate the project net contribution to social welfare (NPV). The study from CPB provides a thorough investigation of the project effects, but their measurements may result not fully consistent considering the changes occurred meanwhile in relevant project-related factors (demand for space, PRA pricing strategy, utilization of the existing port, market developments, etc.). For this reason, the present evaluation is limited to a qualitative analysis of the MV2 welfare effects. When effects cannot be quantified, indeed, a qualitative analysis of the various impacts can be an effective way to approach an overall evaluation of the project’s outcomes. Thanks to the various information gathered on the investment’s drivers, the PRA business strategy, and the expectable project effects, interesting conclusions can reasonably be inferred about the relative sign and magnitude of each specific effect. Table 2 provides an overview of the various impacts, along with their direction and relative magnitude. For the port operator, the net effect is specified on the base of PRA’s internal business case.

<table>
<thead>
<tr>
<th>Tab. 2. Socio-economic effects of MV2</th>
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<tr>
<td><strong>Welfare effects</strong></td>
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<td><strong>Direct effects</strong></td>
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<td>• Operator</td>
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<td>• Users</td>
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<td>• Third parties</td>
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<td><strong>Indirect effects</strong></td>
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<td>• Transport network</td>
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<td>• Strategic effects</td>
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<td>• Employment</td>
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Note: The table shows the direction (positive or negative) and magnitude of the different types of effects.

Starting from the direct effects, we have seen that PRA expects MV2 to be a profitable investment, i.e. that the operating revenues will be large enough to sustain the investment. Given the large costs afforded for construction works, this conclusion is largely dependent on the extent to which future throughput and demand for port infrastructures and facilities will correspond to the market forecasts considered by PRA. Nevertheless, as long as enough returns are prospective, the project will be judged positively by the markets, such that funds can be collected from private investors. As such, MV2’s financial feasibility is precondition for the project to be undertaken and supported during its various implementation stages.

For what concerns users of project services, they appear as the stakeholders for which the project provides the largest benefit. After all, investments are typically made with the aim of providing more competitive services to customers, so this finding is generally common to all infrastructure investment projects. In this specific case, however, it has been shown that the core issue for the port is that the existing port area does not have enough capacity to accommodate an increasing demand of cargo handling services. Therefore, economic surplus is generated mostly thanks to the new container terminals, which allows avoiding the deterioration of quality in port operations that would occur as consequence of future capacity shortages.
The size of the surplus is proportional to the increase in cargo flows that will materialize in relevant market sectors, so the very positive sign of the effect for users is explained by the considerable expansion expected in the container sector. A negative effects is assumed for third parties, due to the to the negative consequences that are generated by new port activities on local residents and Dutch citizens. However, the PRA’s strong commitment to sustainability has led to the imposition of strict environmental requirements on settling companies. That would entail a suitable level of externalities coming from new port operations, and so a relatively limited nuisance affecting local residents. Moreover, it is important to notice that nuisance from industrial processes would occur wherever these activities are located. Hence, MV2 could actually lead to environmental savings with respect to development projects taking place in alternative, less efficient port locations. Given the role that the Port of Rotterdam plays as a transport hub, the effect on the transport network can be an important factor in the overall evaluation. The construction of new container terminals at MV2 will lead to a substantial increase in cargo throughput and freight flows. However, thanks to the Rotterdam’s relatively good hinterland connections, extra cargo flows can be well accommodated by the network. Without MV2, on the other hand, freight flows would be rerouted, in part resulting in longer, less efficient trips towards their final destinations. As a result of increasing traffic volumes, many transport links may improve their performances thanks to scale economies and most frequent connections, while others could suffer from congestion because of capacity constraints. Albeit the efforts made in terms on investment in transport infrastructures and more intense use of cleaner modes, the overall sign of network effect and the related environmental externalities remains uncertain.

Given the strategic role the Port of Rotterdam has for the Dutch economy, MV2 is also expected to have a positive impact on the business climate both at the local and the national level. By strengthening its industrial and logistical functions, such infrastructural investment makes the national economic system more efficient and accessible. The potential growth in the container sector is a key driver for attracting new enterprises and for stimulating investments and innovations in both maritime and inland transport facilities. This is likely to boost competitiveness especially in the logistic sector, one of the top sectors in the Netherlands. Also the chemical sector is expected to prosper thanks to cluster benefits and induced technological developments. Together with the creation of employment for low-skilled workers, such factors prefigure positive macroeconomic implications from MV2.

2.1.5 CONCLUSIVE REMARKS

Summarizing, MV2 proves profitable both from a private and a social point of view. Returns from the investment are high enough to make the project financially sustainable for PRA. The possibility to expand port capacity is crucial for the port industry to grow and remain competitive. But given the fundamental role that transport infrastructures plays in the Dutch economy, also direct users of project services, particularly in the container sector, receive substantial benefits from the port capacity expansion. Despite hard to quantify, indirect effects contribute to make the investment attractive also for the positive effects generated on the regional and national economy. Various additional indications are provided by this case study:

- When demand of infrastructure is expected to grow over time, avoiding future bottlenecks through anticipated investment is largely beneficial for the users of the infrastructure.
- Observations on the negative effects generally ascribed to the intensification of industrial activities and transport facility developments (pollution, induced traffic, etc.) need to be opportunely contextualized. If economic development is to be pursued, the focus should be more on the location that is relatively more efficient rather than on the absolute increase in environmental impacts. From this point view, reclaiming land in the proximity of central transport nodes and industrial conglomerations often result in substantial environmental and cost savings.
- The distribution of effects across stakeholders is relevant for defining compensation measures across groups (e.g. natural compensation) and possible governmental interventions (financial contribution, regulation, etc.). Negotiations and dialogue among stakeholders leads to a more balanced project plan, and increases social acceptability of the project.
- Large-scale infrastructures project such as MV2 have normally a great impact on the whole economy. Overlooking direct and indirect societal effects risks to lead to incomplete evaluation of the project profitability, and to wrong estimations of the project performance.
- Infrastructures typically have relatively long life-span, over which is difficult to make predictions on relevant economic trends and demand dynamics. Lack of relevant information and data jeopardizes the reliability of the impacts’ assessment, and makes the overall appraisal less consistent.
- Indirect effects are relatively hard to investigate and monetize. Despite their social relevance can be easily understood, it is in practice hard to straightforwardly include them in CBA.

2.2 AMAGER STRANDPARK BEACH RECLAMATION

Copenhagen, capital city of Denmark, ranks among the best world capitals for quality of living environment. The local government is keen to further enhance quality of life, and has set ambitious environmental policy plans for the years to come (City of Copenhagen, 2007). Among others, leisure activities are seen as a key contributor to residents’ health and well-being. Hence, improving the accessibility to quality blue and green recreational areas stands very high in the policy agenda. For this purpose, new parks, beaches and sea swimming pools are being created and improved within the Copenhagen metropolitan area.

Amager Strand, a 25 ha beach located about 5 Km from the city centre along the shore of the Øresund Strait, was originally
created in the 30’s. But because of its poor conditions, the beach never really became an attractive place for recreation for people other than close-by dwellers. Moreover, the beach continuously experienced losses caused by the tide and waves from the Øresund. So costly replenishment works were periodically needed to prevent coastal erosion. In the 80’s, local clubs and associations formed a working committee that came out with the idea of a new beach park. Their proposal to create an island and a lagoon full of activities finally persuaded local politicians to develop a new beach park in that area.

2.2.1 CBA FORMULATION

Problem Analysis
The original Amager beach did not result attractive to residents because the original shallow shore face resulted in relatively poor sand and water quality, onshore presence of grass roots, etc. Through this waterfront development project, the city government seeks to promote recreational activities at the local level. More specifically, the objective of the project is to transform Amager Strand into a quality recreation coastal park available to the Copenhagen’s urban population. Amager Strandpark is a protected area, so commercial development stands outside the scope of the project. As it is normally observed in environmental projects, flood protection and ecosystem services could also be considered within the project objectives. However, the project designer did not pursue these two functions in their planning, respectively because they wanted to secure a view of the open sea (short seawall), and not to attract birds in the vicinity of the city airport (which is located some kilometres south of the beach). Therefore, these two functions do not fall within the objectives of the project.

Project Identification
The project alternative consists of reclamation of a 34 ha island in front of the old onshore beach, and the creation of a 35 ha artificial lagoon located between the two components, see Figure 4. The project was implemented in 18 months during the years 2004-2005, and cost a total of DKK 200m (€ 26.9m). The investment was jointly financed by two Municipalities and the Copenhagen Region. A public company, Amager Strandpark A/S, was founded to administrate the entire Amager Strandpark area. The beach landscape was designed so as to combine higher beach quality standards (obtained through increasing recreational opportunities, safety, water and sand quality, facilities, accessibility, etc.) with natural sustainability (Mangor et al., 2011). As for the latter, littoral transport is minimized through creation of a stable beach profile, and the installation of terminal structures, so replenishments are no longer necessary to obviate beach erosion. Overall, the Amager Beach Park now consists of the old beach (approx. 25 ha), the new artificial island (approx. 35 ha), and the lagoon. With the construction of the artificial island, about 3.5 Km of additional quality sandy beach became available to visitors. As base case, the present study will be referring to the do-nothing scenario, which corresponds to the situation existing before the project implementation. Therefore, the base case is characterized as a 25 ha onshore beach equipped with basic facilities (restrooms, little nature, and a bathing structure). Visitors amounted to approximately 300,000 per year. The area functioned more as an urban park than as a beach, given that water recreation was restrained by low-quality shallow water. Before the Amager Strandpark A/S’s foundation, maintenance of the beach (namely of restrooms, cleaning, nature and replenishments) was under the responsibility of the municipality of Copenhagen. In respect to replenishment works, few hundreds cubic meters of sand were added roughly every second year to preserve the beach.

Time horizon: 30 years (2005-2035), according to EC (2008).

Socio-economic context
The social relevance of the project is essentially related to additional recreational opportunities offered to residents. To analyse the demand for recreational services, one can look at the number of people visiting Amager Strandpark in a certain time period (day month, year, etc.), see section 2.2.2. The analysis of the socio-economic context can then be focused on the factors influencing people’s consumption of beach recreational services. The factors most relevant for the analysis of the flow of visitors to Amager Strand include: the amenities offered by the beach, the preferences people have for these amenities, the accessibility of the location, the presence of alternative recreational areas, and the population that lives in the relevant geographical area (e.g. population of surrounding neighbourhoods, or population of Copenhagen metropolitan area). For what concerns demographic trends, a consistent increase is estimated for the Copenhagen population’s level (Statistics Denmark predicts that inhabitants of Greater Copenhagen will increase up to 30% increase by 2014). Based on that, also the demand for leisure and urban recreation is supposedly going to increase in the future. For what concerns accessibility, the
beach can be considered highly accessible for people of Copenhagen. Public transportation (metro and bus) provides good connections with the rest of the city. Biking is also very popular in Copenhagen. Except during seasonal peak hours, reaching the beach by car is also relatively easy since traffic is low and there is large parking available in the area surrounding the Amager Strandpark. Recreational amenities, and preferences will be discussed in the following sections. Relatively to the competition analysis, what have to be considered are fundamentally the sites that could potentially “compete” for visitors in future years (present observations on visitor flows already account for existing competing sites). The policy plan to increase recreational areas in the city does not contemplate further beach locations, so no similar sites will reportedly be developed in the near future.

2.2.2 PROJECT SERVICES

Service supply

The beach development project entailed the creation of the artificial island and the lagoon. This new area offers numerous recreational opportunities to visitors (sporting, bathing, fishing, etc.). Popular activities at the beach include jogging, swimming/diving, rowing and kayaking, kite/wind surfers, skating, and various ball games. Both high water quality standards and safe swimming are ensured by a moderate wave and tidal exposure, and by sufficient water depths around the reclaimed area. A natural beach environment was reproduced on the island through the creation of winding paths, broad sandy beaches, and low dunes. Moreover, the island is equipped with recreational and service facilities such as a small marina, bathing structures, free parking space, lifeguards, restrooms and showers, picnic sites, and catering services (restaurants and cafes).

Service demand

A park or a beach can be seen as a single heterogeneous good characterized by a number of attributes, typically represented by the recreational and environmental services available in that location. Based on that, the “consumption” of a recreational area can as well be exemplified in a single act, namely a trip made for recreational purposes. In other words, the demand of recreational services can be describe as recreational trips, i.e. people moving from their house to reach the public beach and enjoy the various amenities there available. This approach is useful to study the value of non-market goods that are the focus of recreational trips. As it will be shown later, indeed, such approach is the theoretical foundations on which the “travel cost method” is developed to analyse demand of non-market goods such as natural parks, beaches, etc. As previously argued, the demand of recreational services will be analysed in terms of number of people visiting Amager Strand.

Equilibrium

The equilibrium flow can be described as a number of dwellers that, being willing to pay for the travel cost, decide to visit the beach. The figure can be summarized as average number of visitors per year. Extrapolating visitor flows over decades necessitates substantial efforts in demand modelling and data collection. Therefore, to simplify the analysis, a level of visitor flow that remains roughly constant over time will be assumed. More specifically, the visitor flow is set on the base of up-to-date information on yearly number of visitors provided by Amager Strandpark I/S, the beach administrative organization. The equilibrium “quantity” is therefore set to 1 millions visitors per year (for the equilibrium price, i.e. the economic value of each visit, see the section on final assessment). Having said that, considering the growth in number of visitors observed in the last years, and the positive projections of Copenhagen population, a time-increasing number of visitors would probably be more realistic. That would certainly have a positive impact on the estimated welfare impact of the project, so our estimation of the project social value appears conservative in this sense.

2.2.3 PROJECT EFFECTS

Point of view. The park was financed by local governments, and receives visitors mostly from the Copenhagen metropolitan area. A regional point of view will thus be considered for the evaluation of the Amager Strand project.

Direct effects

- **Operator.** Amager Strandpark I/S is owned by Copenhagen (96.4%) and Frederiksberg Municipalities (4.6%). The organization is responsible for maintaining and developing the overall Amager Strandpark (old and new part) and its facilities. The operator’s net profit is calculated on the base of project costs (investment, maintenance and operating cost), and revenues (concessions and rents). Considering the base case, extra-benefits from the project are the avoided cost of replenishment works.
- **Users.** Users benefit from the project when visiting the beach park and enjoying the recreational services the park offers to them. The resulting use-values are related to the consumption of “goods” such as open space, natural landscape, outdoor recreational activities, etc. These goods do not have a market value, so a non-priced effect is involved here. With the construction of the island and the lagoon, the visitor flow increased up to more than 1 million visitors per year, making Amager Strand the first Copenhagen beach for number of visitors.
- **Third parties.** Non-users could enjoy from the presence of the new beach in their city/region even without visiting it. Residents may derive satisfaction for example from the mere possibility of visiting the park that is acquired by their-selves (option value), by others (altruism), and by future generations (bequest value), see [4]. The area surrounding the beach may also be positively influenced, e.g. because of an increase in income for the local tourist sector and other commercial activities. Note that since the travel cost method is used for the benefit estimation, to avoid double counting the increase in house values following the investment should not be included in the CBA.
Despite not relevant in this case, it is interesting to mention that flood protection and ecosystem services would also be examples of impacts generated to non-users.

**Indirect effects**
The project is of relatively small dimension in terms of both investment size and economic spillovers generated on the rest of the economy. The modal split for visitors is distributed equally across car (37%), bicycle (30%) and public transport (33%), so the effects on the local road network are expected to be rather inconsistent. No significant effect on the regional economy and employment are foreseen for such a marginal project.

2.2.4 FINAL ASSESSMENT

**Direct effects:**

- **Operator.** The effect for the operator is calculated as the stream of the Amager Strand I/S’s operating profit. Apart from the initial investment occurring in the first year, the yearly net profit is determined on the base of historical data from the company’s financial statements. An average (time-constant) negative balance of DKK 8 millions will be considered in the evaluation. The avoided cost of replenishment is rounded to DKK 100.000 (frequency equals two years).

- **Users.** The travel cost method is the methodology mostly used to determine the use value of non-market goods such as environmental and recreational services (EC, 2008). This technique seeks to measure the willingness to pay to consume such goods based on the costs people incur to consume it. Since in general there is no entrance-fee to access public parks, the cost of travel to a site (cost of transport, time, etc.) is used as a proxy for the price of visiting that site. Also in this case the WTP estimates can be based on the relationship between cost of visiting the beach (travel time, travel cost, on-site expenses, etc.) and number of visitors. The underlying idea is that the frequency (or probability) with which a person visits the beach is indirectly proportional to the costs he has to pay to travel there. In empirical travel cost studies, demand analysis is typically carried out by estimating a demand curve for recreational services on the base of information on visitors’ origin location (visitors’ address, neighbourhood, etc.). Hence, the average WTP for a visit resulting from the demand curve can then be translated into a welfare value, typically into average consumer surplus per visit. Once an average value is found, an annual stream of benefits can be defined by multiplying it for the yearly number of visitors.

A study on visitors travel expenses would substantial effort in demand modelling and data collection, so the present analysis will rely on WTP values found in relevant studies and publications made on the topic. When primary valuation cannot be undertaken, the use of estimations from different sources is common practice within economic analysis of non-market natural resources. This technique, generally called benefit transfer, involves the transfer of a value estimate (in our case person-WTP to visit a public beach) from the original study to a different context of evaluation. For avoiding biased results, however, it is important that the transfer occurs between two homogeneous contexts. In this specific case study, that would imply that both the beach and the analysed population present similar characteristics.

Relevant estimates for beach recreational values, average WTP and consumer surplus are provided in Reybold et al (2011) and Blackwell (2007) for Australia, and, and in King (2002) for California, USA. For a review of the literature available on the topic, see e.g. Pendleton (2008) and Reybold and Lazrow (2009). Considering natural landscape, recreational services and beach facilities, accessibility, as well as population socio-demographic characteristics, Amager beach appears and the related context of analysis appear dissimilar under various aspects with respect to Californian and Australian beaches. Nonetheless, given the lack of valuation from contexts closer to Copenhagen (Northern EU, Denmark, etc.), the mentioned studies represent probably the best available sources of values.

- **Third parties.** Non-use value connected to recreational areas are among the most difficult to estimate. Although many authors have speculated that they constitutes a significant part of the total economic value of environmental goods (see e.g. Lookwood and Tracy, 1995), conclusions on their magnitude remain quite controversial. Therefore, they will not be included in the calculation of the NPV attempted in this report.

The assessment of the overall social value is not straightforward in this case. If on the one hand the beach park constitutes a financial burden for the community (which through governmental spending pays large amount of money for its construction and maintenance), it also provides substantial welfare returns thanks to the quality recreational services it makes available to the local population, see Table 3. Therefore, despite hard to quantify, use and non-use values related to the beach may well outweigh its costs.

Considering the availability of detailed data on visitor flow and beach operating costs, I then attempt the calculation of the project NPV. To do so, I focus on the interaction over time between the costs society bear to construct, maintain and operate the park, and on the benefits arising from the consumption of beach recreational services. The welfare benefits are determined based on values found in studies on the value of recreational beach visits. Despite the relatively broad range of values resulting relevant publications, the literature review suggests that most findings stand between 1,5 and 30 (the welfare value in US$ of a day trip to a beach). Based on results from Pendleton (2008) and Reybold and Lazrow (2009), that range, which roughly corresponds to DKK 12-240, will be taken as reference in this study. It is important to mention that the sources considered do not include non-use type of values, implying that the benefit estimate attempted here reflects only the use value of the beach.
For the determination of the NPV as reported in Figure 5, an arbitrary value of DKK 30 per visit will be considered. Multiplied by 1 million (the average visitors per year), the annual welfare return corresponds to about DKK 30m. It is important to mention that a relatively low value has been chosen for the value of a recreational trip, so such figure of benefits can be considered quite conservative. In respect to the other input variables, moreover, an intermediate value for the discount rate (5%) is chosen based on Danish standards (Doubgaard, 2004), while the time horizon is set to 30 years following the EC (2008) guidelines for CBA of parks and forests. Note that for the sake of simplicity we make the strong assumption that all cost and benefit components remain constant over time. This is certainly a quite restrictive assumption, which however does not invalidate the basic rationale inspiring this illustrative example.

Input data for NPV calculation

<table>
<thead>
<tr>
<th>Costs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment costs</td>
<td>200.000.000 DKK</td>
</tr>
<tr>
<td>Net operating costs Amager Strandpark I/S per year</td>
<td>8.000.000 DKK</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Benefits</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided replenishment (every 2 years)</td>
<td>100.000 DKK</td>
</tr>
<tr>
<td>Average N. of visitors per year</td>
<td>1.000.000</td>
</tr>
<tr>
<td>Average Consumer Surplus per visit</td>
<td>30 DKK</td>
</tr>
<tr>
<td>Average Consumer Surplus per year</td>
<td>30.000.000 DKK</td>
</tr>
<tr>
<td>Investment horizon</td>
<td>30 years (2005-2034)</td>
</tr>
<tr>
<td>Discount rate</td>
<td>5%</td>
</tr>
</tbody>
</table>

For the determination of the NPV as reported in Figure 5, an arbitrary value of DKK 30 per visit will be considered. Multiplied by 1 million (the average visitors per year), the annual welfare return corresponds to about DKK 30m. It is important to mention that a relatively low value has been chosen for the value of a recreational trip, so such figure of benefits can be considered quite conservative. In respect to the other input variables, moreover, an intermediate value for the discount rate (5%) is chosen based on Danish standards (Doubgaard, 2004), while the time horizon is set to 30 years following the EC (2008) guidelines for CBA of parks and forests. Note that for the sake of simplicity we make the strong assumption that all cost and benefit components remain constant over time. This is certainly a quite restrictive assumption, which however does not invalidate the basic rationale inspiring this illustrative example.

Figure 5 shows that, accounting for project costs and benefits over 30 years, the beach park results in a positive NPV of about DKK 134 millions. More specifically, the figure indicates that the NPV breaks even 12 years after the initial investment was made. Overall, the attempted evaluation demonstrates the Amager Strandpark beach reclamation project is highly beneficial from a social point of view.

However, to see how the overall project value is sensitive to important inputs, the NPV calculation is repeated using different values of both the discount rate and the individual consumer surplus per visit. In Fig.4 (Appendix A), the discount rate is varied from 0% to 12%, while the consumer surplus per visit is varied from 0 DKK to 100 DKK.
Moreover, some issues are:

- Economic performance of reclamation projects. In particular, the most important issue is that following the principles, important conclusion that can be made from this exercise is that the NPV results positive in all scenarios but the one with a very low visit-CS. Considering the high quality of the beach park, however, a DKK 20 welfare value per visit (among the lowest possible value indicated in the literature) does not seem appropriate for Amager Strand. Therefore, the conclusion of a positive socio-economic impact of the beach development project appears robust to changes in relevant parameters.

2.2.5 CONCLUSIVE REMARKS

This case study well exemplifies a situation when a reclamation-based investment project contributes to enhance quality-of-life at the urban level. Access to open spaces and leisure opportunities play an increasingly important role in individuals’ well-being, so reclaiming land for recreational purposes can be an effective solution to implement green policies within coastal areas. When opportunely designed, moreover, artificial beaches allow developing a wide range of recreational services while minimizing maintenance costs. As in the case of Amager Strand, this may result in highly appreciated public beaches that can be developed by using relatively low amounts of governmental funds.

On the top of that, there are other interesting issues that can be deduced from the evaluation of this case study:

- Project effects can be highly relevant for society even though they do not involve market transactions. When there is a clear contribution to quality-of-life, the assessment of the investment’s return should focus on welfare analysis of the project effects rather than on its financial profitability.
- Non-market valuation methods are key instruments for a meaningful evaluation of the welfare impacts of public goods such as recreational resources and green infrastructures. However, the costs and difficulties associated to the valuation of non-priced effects makes such methodologies hard to be implemented in practice.
- When non-priced, unquantifiable effects are substantial, investments may result beneficial for society even if they are not financially sustainable. When that is the case, governments are called to ensure an optimal provision of public goods through a direct involvement in the investment funding.
- As demonstrated with the sensitivity analysis, the assumptions made on critical factors strongly influence the final results of the appraisal. A thorough examination of the most relevant aspects concerning the project is therefore necessary for the CBA outcomes to be credible and straightforwardly usable.

3. CONCLUSION

The report proposes a framework for the evaluation of reclamation project using CBA methodologies. The main expectation is that following the principles of economic appraisal would contribute to a more appropriate assessment of the socio-economic performance of reclamation projects. In particular, the most important issues to consider for a sound evaluation are:

- A clear definition of project effects, which can be obtained by looking at the groups of stakeholders influenced the project, and by a meaningful classification of impacts into general categories.
- A comprehensive consideration of all socio-economic impacts of the projects, including those on third parties (environmental externalities), on the transport network, and on the broad local and national economy.
- The use of specific data and valuation methodologies, which lead to an appropriate measurement of the various impacts, and hence to a reliable overall appraisal of the investment.

Moreover, some important conclusions can be made also on the base of the two case studies analysed in the report:

- Land reclamation projects, especially those functional to large-scale infrastructure projects, generate a wide range of socio-economic effects.
- Project effects are largely dependent on the underlying context in which they are implemented, so clear evidences on the performance of reclamation projects can be derived only by evaluating specific projects. A common framework of analysis is however useful to improve consistency in the assessment of different type of effects.
- Investing in reclamation can be socially beneficial even if the project does not generate sufficient financial returns. Impacts on project-related sectors or quality-of-life can legitimize the implementation of the project better the mere dividends that can be provided to private investors.
- Land reclamation offers the possibility to undertake spatial development plans (potentially) anywhere within congested coastal regions. This flexibility offers large opportunities to the project planners, as the new area can be located so as to be well connected to existing transport networks and economic agglomerations, but if necessary also far away from residential settlements. That would entail substantial environmental savings and more effective industrial strategies with respect to plans implemented in more peripheral, disconnected areas. Therefore, disregarding environmental and other external effects may cause underestimation of the value of reclamation, with
the risk that investors prefer cheaper but less socially advantageous projects realized on existing land.

Environmental, strategic, and other social effects deserve particular attention when dealing with reclamation projects. A comprehensive consideration of all socio-economic effects allows the identification of the comparative advantage of reclamation, and can therefore contribute decisively to increasing interest and financial support from potential investors. The existence of relevant socio-economic effects, moreover, justifies an active role of the governments. For example, projects with substantial positive socio-economic consequences would imply financial support by mean of public spending, while negative impacts would call for governmental interventions such as policy regulations or imposition of compensation measures.

Another important issue pertains to the actual feasibility of CBA. As shown in the analysis of the case studies, indeed, the difficulties generally encountered in making long-term forecasts, and in monetizing the impacts (especially non-market effects), can seriously undermine the practical usability of CBA for reclamation projects’ evaluation. The framework of analysis proposed in this report can therefore be seen as an initial contribution to greater awareness of the wide range of impacts at stake, and hence of factors that could be potentially omitted from an evaluation. Through the support of experts, appraisal models and methodologies specifically tailored for reclamation projects’ appraisal could be developed. Important steps towards a better understanding of reclamation project’s impacts and evaluation methodologies can also be made by considering further case studies and primary appraisal works made by professionals.

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**APPENDIX A**

![Figure 4](attachment:image.jpg)

**Figure 4**: NPV Amager Strand respectively to 3%, 5%, 7% discount rate (CS=30)

![Figure 5](attachment:image.jpg)

**Figure 5**: NPV Amager Strand respectively to 30, 50, 20 CS (EUR/visit) (discount rate=5%)