Planning and design phase

Planning and design phase

Where the Initiation Phase focused on the problem definition and project scope, the more detailed Planning and Design Phase deals with developing alternative strategies within this given scope and handles the selection of the preferred alternative(s).

Building with Nature approach: focus on the system	Traditional approach: focus on the function
The BwN approach focuses on utilising natural processes and stimulating nature development as an integral part of the strategies to be developed. Key questions are what the project can do for nature, as well as what nature can do for the project. Foci of attention are the longer term, incremental development and adaptive management. Financing strategies may be an integral part, as ecosystem services may open doors to potential funding sources.	The Planning and Design Phase aims to develop strategies to achieve the objectives described in the Initiation Phase. Traditionally, strategies focus on solving a narrowly defined problem within a given timeframe. Opportunities for adaptive management, incremental development and nature inclusive designs are seldom considered.

Introduction

The activities undertaken in the phase of Planning and Design are in general similar to those in the Initiation phase: identification, optimisation and selection of alternatives. The phase also ends in a transition to the next phase. The major differences from the Initiation phase are in the amount of detail in design, effect assessment and alternative valuation. In brief, the most important activities in the Planning and Design phase are:

- Communication and interaction with actors, stakeholders and experts
- (Better) understanding the system
- Generation of alternatives based on BwN-principles
- (E)valuation and selection of the most promising strategy
- Embedding of the preferred alternative
- Creating possibilities for BwN in the next phases of the project.

The added value of BwN-strategies compared with traditional approaches is the focus on the project's potential to make use of natural processes and /or stimulate nature development. Good examples of Building with Nature design in the Planning and Design phase are:

- Mega-nourishments versus incremental nourishments of sandy coasts: The economic benefits of scale enlargement and an increased freshwater reserve in the dune area can be combined with the ecological benefits of a less frequent ecosystem disturbance and the generation of nature and recreational areas, albeit temporary.
- Soft versus hard dike designs: In certain cases, soft solutions may be cheaper than hard ones and have additional benefits in the realm of habitat creation and strengthening ecological relations.

Ideally the Planning and Design phase is preceded by an Initiation Phase that results in a project scope based on the BwN-principles. It is however possible that the eco-dynamic designer enters the process only in this phase. In that case, it is advisable to evaluate the problem definition and project scope from a BwN-perspective.

This chapter provides guidance on the development of BwN-strategies in the phase of Planning and Design. Wherever appropriate, useful methods and tools are suggested.

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Process

The Five Steps Approach, as defined in the Introduction chapter of this guideline, is also used in the projects Planning and Design phase:

- **Understand the system:** gain a thorough understanding of the ecosystem in which the project is planned. The focus is not only on comprehending the impacts of possible alternatives, but also on how the ecosystem can serve the project and conversely.
- **Identify realistic alternatives:** as compared with the initiation phase, more information is available to select realistic alternatives. Financial engineering also becomes important.
- **Evaluate the qualities of alternatives and pre-select an integral solution:** with more information, assessments will become more quantitative and can also be expressed in monetary terms.
- **Embed the solution in a project scheme:** problem definition and envisaged system functions will gradually become more clear, and so do stakeholder positions. Financial arrangements need to be set up.
- **Prepare the solution for implementation in the next phase:** at the end of this phase, the preferred alternative has to be ready for transfer to the Construction phase.

Get the relevant stakeholders involved

Although stakeholders were (probably) already involved in the Initiation phase, the interaction with them will become more intense in the Planning and Design phase. Since at the end of this phase a preferred alternative is chosen, also the communication with politics and public administration is of concern.

Step 1) Understand the system

During the Planning and Design Phase the focus on system understanding shifts from general system knowledge towards more concrete impact assessment of the functioning of different alternatives. More information becomes available; assessments will become more quantitative and can also be expressed in monetary terms. Operational questions can gradually be handled as well as adjustments to accommodate stakeholders' wishes. Furthermore potential funding of the project, including related criteria, will be dealt with.

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In many countries the Planning and Design phase coincides with the start of a formal procedure. In the Netherlands this comprises of the elaboration of a Strategic Environmental Impact Assessment (SEIA), determining location and system choices to be followed by an Environmental Impact Assessment (EIA) that focuses on generating a concrete alternative. This procedure requires rounds of information and consultation of the public for both the SEIA and the EIA. This public consultation enhances the input of information from the socio-economic system.

Building with nature requires a project to be approached as an integral part of the environment. Ecosystem services are part and parcel of the project definition. Understanding the ecosystem is necessary, but might still be incomplete at the beginning and even at the end of the planning and design phase. It is however vital that understanding is sufficient to distinguish between alternatives and to ascertain whether the project will meet important requirements. Generic knowledge derived from other projects can be used. It will help identifying key aspects and processes for the design, together with key priorities for further study.

In each phase of the project more information will become available. The understanding of the ecosystem will increase, and so will the insight into how the project is linked to the ecosystem, which ecosystem services it provides and what position the relevant stakeholders take. In the Initiation Phase possible alternatives are generated, subsequent studies should further elaborate these alternatives and see how they function in their environment. Basically the same steps of the System Analysis Tool can be followed:

- Mapping of the system's functions, including ecosystem services (the functional dimension);
- Identify location specific characteristics (the spatial dimension);
- Specify relevant eco-dynamics (the temporal dimension).
- Determine the related relevant system boundaries and constraints;
- Define knowledge domains for testing and design (the objective dimension).

All aspects may lead to criteria that may be part of a design and decision framework.

Mapping ecosystem services

The value of an ecosystem to the (local) economy can be expressed in terms of ecosystem. In general, the following groups of services are distinguished (refer TEEB):

(a) Production services (e.g. wood, fish),
(b) Regulating services (e.g. filtering, denitrification),
(c) Cultural services (e.g. landscape), and
(d) Supporting services (habitat functions).

Groups a, b and c directly deliver services to human beings and can be valued in economic terms. Supporting services sustain critical ecosystem processes that create the possibility of production and regulation. Soil formation, but also population dynamics are examples of processes that determine the vitality and resilience of ecosystems, hence their potential to deliver direct services. Understanding of an ecosystem therefore includes the supporting services. For further reference is made to the TEEB reports and….

Identify project and location specific characteristics

One should always look for tailor made solutions that cater to local ambitions and needs and use local potential for integrating nature and natural processes. Only tailor-made solutions can be cost-effective. For many BWN concepts but also for many ecosystem services there is a wide range in performance and related added value and cost-effectiveness. For example a natural defence alternative using salt marshes works best within a specific range of wave and storm surge conditions. Its costs largely depend on locally available materials and are much lower in case dredging materials can be used. If conditions are not favourable and suitable materials not available on short distance, a natural defence system may be much more expensive than a traditional solution. Important location specific aspects are:

- **Driving forces,** such as wind, waves, currents and related thresholds, carrying capacities and so forth.
- **Availability of “building” materials,** such as sand, clay, dredging materials, rest-products such as discarded shells (e.g. for building ecoreefs).
- **Specific ecosystem services,** such as spawning areas that are important to local fisheries or natural water purification processes that are important to local aquacultures.

Important local aspects can be mapped on an opportunity map which will help the planning process

Often planners refer to the Genius Loci, to emphasize the importance of location specific conditions in de planning process. Often the term genius loci is used to refer to physical and ecological characteristics but also local culture is important. Physical and ecological characteristics can be specified on maps, showing where specific processes or habitats are present that may favour the application of specific concepts and designs, such as the use of salt marshes in a coastal defence system.

Important cultural characteristics in BWN projects may relate to:

- **Risk perception:** a culture may be risk adverse but there may also be a large tendency towards the acceptance of risks. Risk perception gives very different views on safety and the use of adaptive management.
- **Traditional use:** especially of the ecosystem, or of specific parts of the landscape, that is used for recreation.
- **Cultural identity:** most explicit is the presence of holy places, but also monuments, cultural historic qualities may be of importance.
- **Responsibility and roles:** in several countries (like the Netherlands) flood safety and water management are the exclusive domains of the authorities, which inevitably leads to a tendency towards centralized solutions.

But also other cultural traits may be of importance. For example, the province of Zeeland was reclaimed from the sea over many centuries. This province also faced several catastrophic floods, the last one in 1953. Overall, giving land back to the sea, for example in the form of nature restoration is not easily accepted in this area. Alternatives that promote this are technically possible but often fail to reach sufficient acceptance by the population. Cultural resistance may to a certain extent be overcome by proper information, since often traditions and resistance are based on old and no longer valid arguments.

Knowledge Domains for testing and design

Several domains are important for the design and optimization of an alternative. One may distinguish the following aspects, although other categories are also possible:

- **Technical feasibility:** in an early stage of the Planning and Design phase one should consider the possibilities of testing the design and adaptive management and optimization of the design process, i.e. incremental development. A bias towards proven technology may form an obstacle to innovative alternatives that make (more) use of nature and natural processes. Some creativity may be required to convince people of the feasibility of natural and soft solutions.
- **Financial feasibility:** government institutions tend to start from a set budget, whereas for private investments a business case approach is needed. In the former case, the costs of alternatives are important, in the later also the benefits and the internal rate of return of an investment plays a role. Ecosystem services need to be expressed in economic terms. The potential to make a design more cost-effective by using natural processes should be given special attention. Co-financing potential may be enhanced if one aims for multi-functionality.
- **Legal permissibility:** this is an increasingly important domain, as ever more legislation is enacted to safeguard the environment. Preliminary assessments may be required to test whether an alternative is a potential problem from a legal point of view. These preliminary assessments usually indicate the need for more information and more in-depth studies. They may also be used, however, to identify the conditions to be met by a both legally possible and nature-positive design. Because of their inherent nature dimension, compliance of BwN-projects, especially with European environmental legislation, is likely to require extra attention. The environmental standards applicable to a project should pertain to the ecosystem at hand. Too often, general standards are applied, regardless of the prevailing ecological conditions and the temporary nature of the exerted stress. Such standards can be too strict or not strict enough. Setting tailor-made standards, however, requires a lot of ecological information, understanding and time, each of which may not be available in the project.
- **Socially acceptable:** the acceptability of an alternative is determined by the effects on the interests of the various stakeholder groups. The impact on economic functions is important, but also issues such as risk perception may play a role. Both rational economic considerations and emotions may play a role. Presentation and visualization are critically important. Positive perception and acceptance of alternatives can best be achieved by providing stakeholders, policy makers and decision makers at the right moment with the right information in the right form and involving them in the critical choices to be made.

An example is the borderlakes of the Veluwe for which the municipalities of Zeewolde and Harderwijk proposed slightly different coastal development plans. The different ways information is presented and interpreted and underpinned proved to be very important for its acceptance.

- **Economically viable:** depending on the source of funding, this aspect requires information on the costs only or on costs and benefits, also in relation to the systems functions. Depending on the situation, ecosystem services may determine whether or not an alternative is economically viable. It is important to take a lifecycle perspective, since it is the combination of construction, operation and maintenance that determines the costs, whereas the benefits of nature development may become manifest only after some time.

A soft defence may cost more initially but have substantial benefit later in the form of reduced maintenance, increased robustness, cost-efficient upgrading and more. An example is the soft defence for Nieuwvliet Groede, which is more cost-effective on the long run, than strengthening the existing dike.

- **Ecologically preferable:** this aspect requires information on ecosystem state, functioning and functions. Much legislation concerns the state of the ecosystem (habitats, species, diversity), rather than its dynamics or its self-sustaining potential. The definition of the preferred ecological state is partly subjective and normative. It includes the following aspects:
  - Is nature restored to its former state, and which point in time defines this?
  - Does nature develop that is essentially similar to that in this former state?
  - Does nature develop that contributes to the nature already present?
  - Is biodiversity enhanced?
  - Does the system remain / become self-sustaining?

Step 2) Identify realistic Building with Nature alternatives

Elaborating a BwN alternative involves more than its physical design. Other dimensions and aspects need to be addressed, refined and integrated into the design. A plausible BwN design includes financial engineering, for instance, and it meets all the requirements listed above. Elaborating a BwN alternative therefore goes beyond meeting preset prerequisites, defining and testing additional prerequisites is part of the development process of BwN solution.

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Alternatives as relevant choices

Every planning and design process involves making choices. A good decision depends on having a relevant set of choices or alternatives. Alternatives should therefore be instrumental in making important choices more explicit. Alternatives may therefore focus on:

- System choices: very different ways of tackling a problem or opportunity. A choice between a soft or a hard defence is a system choice, which determines a cluster of related effects, options and more. But there are many more important system choices that relate to the use of natural processes, related time-paths and more.
- Ambition levels: introducing different sets of objectives, often to see if the incremental costs are met with sufficient additional benefits.
- Timing and deadlines often present critical choices that may need further exploration. Using natural processes may require more time, but may lead to better results in the long run. Additional short-term measures may be used to complement such projects in the meantime.

The Sand Engine, for instance, is expected to take a couple of years before supplying sand to all coastal sections it is supposed to nourish. To overcome this period, smaller additional foreshore nourishments were included in the overall design.

Iterate design with effect assessment

Especially in more complex situations, the effects, costs and benefits of a project are not easily identified. In-depth effect studies and cost-benefit analyses are needed to map all possible consequences a certain alternative. Clearly, intermediate effect assessments and analyses provide essential information to the design process. Such studies must fit into the decision framework and should ideally have been made in an earlier stage of the process.

A good environmental assessment will show the most relevant interactions with the environment, positive or negative. Such an assessment goes further than e.g. a formal EIA, which often focuses on the adverse effects only. A wider environmental assessment will indicate also possible win-wins for nature that can be explored further. It will also give insight into costs and benefits to the different user groups, thus initiating a process of negotiation and balancing. Furthermore, it will show adverse effects and risks that need to be handled in the design, in adaptive management or in commitments between organizations. Note that in dynamic environments it is impossible to predict all effects, especially in the longer run. It is however possible to underpin the potential of adaptive management, thereby showing that unpredictable effects can in fact, if required, be handled.

Preferably the selection of a preferred alternative is done after possible alternatives have been optimized with respect to costs, benefits and risks. The description of an alternative comprises of the project initiation and subsequent phases of operation and maintenance and related costs and benefits and risks and opportunities.

Step 3) Evaluate and select alternatives

The Planning and design Phase encompasses a similar approach as the Initiation Phase. There is however a shift in focus and in detail. The Initiation Phase focuses on system choices, for example comparing hard with soft solutions. The Planning and design Phase focuses rather on different alternatives for a specific solution. Costs and risk assessment and handling are more important in this phase, as is the embedding of the physical design into a context of socio-political commitments and agreements.

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The alternative evaluation is based on the following activities:

- **Develop a design and decision framework.** The first step to any assessment is the establishment of a decision framework. Usually, this framework is already in development since the first stages of the planning process, as it also contains explicit project objectives and other design parameters.
- **Asses the effects on the (eco)system.** Assessing the (ecological) effects of the project, positive or negative, is the starting point for comparing alternatives. This assessment should involve all relevant criteria and related ecosystem services and nature valuation.
- **Assess the effects on biodiversity.** Assessing the effects on biodiversity and on protected species is a normal procedure in most countries. The use of a biodiversity index indicates whether there is a net gain in biodiversity, for instance in the case of a habitat transformation.
- **Assess the effects on ecosystem services.** The allocation of costs and benefits determines the project's economic feasibility and potential for financing. In addition to the (socio-economical) valuation of services and effects, one may want to valuate the effects on nature using dedicated instruments (see tools).
- **Quantify costs on the basis of a life cycle approach.** Preferably not only capital investments, but also capitalized maintenance and operational costs are taken into account. Depending on the kind of project, also the functional performance under different scenarios should be assessed; this may involve important future cost components.
- **Assess the functional, financial and ecological risks and opportunities.** In order to see what risks and opportunities are important, this can be tackled in design optimization or in adaptive management, or may need the formulation of adequate contingencies
- **Assess the potential for design optimization and adaptive management.** Taking care of major risks and elaborate opportunities that are relevant to stakeholders and therefore the decision making process. Assess the adaptive management perspective, which focuses on those risks or potential benefits that can not be handled by optimizing the design.
- **Select the preferred alternative.** With a complete overview of the costs and benefits, the risks and opportunities and the options for adaptive management, a preferred alternative can be selected.
  In the following paragraphs we will further elaborate several of these actions.

Develop a decision and design framework

A decision and design framework is an important tool to compare alternatives and to identify design criteria. Various possibilities exist.
Every design and planning process is implicitly and explicitly a decision making process. It already starts with defining project objectives. These can be concrete and detailed but also of a general nature, such as stimulating economic development. As indicated before it is important to widen the project scope in order to scout for win-win opportunities. In essence there always are criteria related to people, planet and profit. In practice EIA's are often accompanied by economic, or socio-economic effect studies. In addition criteria have to be added that address the project performance on the long term, such as the need for operation and maintenance, but also its robustness to withstand major incidences and flexibility to adapt to environmental changes and social preferences.

Ideally, most decision criteria work as design criteria as well. Often the relation between both is obvious, such as in the case of safety standards. The objective of environmental restoration or economic development requires detailing in order to identify relevant design parameters that will serve these overall goals.

A decision and design framework will develop over time, when objectives become clearer, effects become more concrete, acceptability more explicit. So refinement and detailing will take place in order to assure that the criteria truly represent objectives and relevant effects, and are accepted by stakeholders and decision makers.

It is not possible, nor desirable, to set up a "one for all" decision framework. Dedicated frameworks often perform better, as they integrate site-specific objectives, constraints and key indicators. Nevertheless, generic elements exist that are worth considering in every decision framework for BwN projects. They are:

- **From nature-neutral to nature-positive.** It is important to shift the focus from minimizing negative impacts to optimizing positive effects on nature. A design and assessment framework is needed that makes this explicit. This can be done by valuing nature benefits in different ways, emphasizing the formal (protected species and habitats), economic (ecosystem services that are provided) and biodiversity dimension (using a biodiversity index, see also nature valuation). Jointly striving for designs that go beyond 'greenwashing' also adds to the communication between engineers and ecologist. Focus should also be on "in built" guarantees that the nature positive elements will be implemented. The best guarantees are vested in the design itself, in cost-effective implementation and in laws, regulations and related licenses.
- **Effects on people, planet and profit.** BwN always aims for Triple P designs, balancing the needs of society, economy and a sustainable environment. The design and decision framework should incorporate these dimensions. (link to BwN decision framework).
- **Sustainability.** Sustainability requires special attention, in terms of performance of the design on the long term, as well in terms of net (C2C) resource consumption. In this category the focus is on environmental opportunities and risks, associated with the design, but also with adaptive management. In-depth knowledge of the project, its effects, the uncertainties involved and the possible scenario's is required to fill in this part of the assessment (see also BWN decision framework).

Assess the effects on the ecosystem

Ecological effect studies are standard procedure in larger engineering projects and their environmental impact assessment. Studies are driven by the decision framework. Most effects may have already been studied as part of former project phases (see project initiation), but need further specification, detailing and the most important may also require extensive modelling. Such studies tend to focus on key indicators, such as protected species or species of commercial interest, but effects at the level of non-use functions should also be considered (see below). As BwN designs work with key drivers, these too are part of the assessment. The work can be organized in intervention-effect chains, but possible feedbacks should be taken into account. In the European context DSPIR is an often used method. From a lifecycle perspective, long-term eco-system effects should also be considered.

So far, most of the steps in the analysis were based on generic key-figures. In this phase more site-specific figures are required. Usually, generic key-figures result only in rough estimates of the economic effects. A more in-depth analysis, for instance with models of hydrodynamics, morphology and ecology, should focus on the site-specific quantification of economic indicators and ecosystem services. This is the only possibility to generate the information needed to fine-tune and optimize alternatives. It is also the only way to support further detailing of the project and to prepare for the next phase.

The assessment of effects is framed by the decision and design framework, which will indicate relevant effects that need to be studied and possibly be quantified as well. The merits of nature and natural processes, including ecosystem services, should be quantified when possible and be justified and accepted. Experiences show that nature valuation that can not be justified leads to contraproductive discussions that may even hamper ecological design processes because of lack of trust. The aim is to identify key effect chains that relate the effects of a project intervention on project objectives and stakeholders, via its effects on the environment.

There are a number of tools and methods that can be used to evaluate alternatives. They can also serve as instruments of design by integrating critical costs, benefits and financial parameters into the design process. To that end, a direct relation between design parameters and benefits is required. Most of the tools and the instruments may apply in various phases of the process. The level of detail and importance of costing and risk assessment increases, however, as the understanding of the ecosystem increases.

Furthermore, the understanding of the socio-economic system increases, as it becomes more apparent what is desired and accepted by stakeholders. The aim of any integrated planning process is an evaluation on the basis of a social cost-benefit analysis. This SCBA may be complemented by business cases (to explore the financial dimension), nature valuation assessments (to explore the effects on biodiversity, link), formal nature effect assessment (to identify adverse effects on protected areas and species).

Assess effects on biodiversity

Some projects lead to a shift in the existing ecosystems, provoking changes in habitat and biodiversity. Shallow coastal waters, for instance, may be replaced by salt marshes that have a function in coastal defence. The basic question is whether these changes in habitat can be considered as positive from a perspective of biodiversity (e.g. nature protection). This kind of comparisons can be made on the basis of a Biodiversity Index (BI). The value of an area is expressed as its contribution to the biodiversity, usually at different scales. In the Netherlands, but also within the European Community, progress has been made on valuing biodiversity at different levels, taking into account the extent to which specific species and habitats are endangered.

A BI is not suitable to assess the merits of an alternative with respect to environmental laws and regulation. Such assessments require more specific assessment at the level of individual species. Another drawback at the moment is that a BI does not take into account factors as uniqueness, completeness and robustness. One may value species diversity without understanding the risks of loosing this diversity because the ecosystem is not functioning properly. EDD-NV may add more ecosystem understanding into the index (see Nature Valuation and Biodiversity Indices).

Asses the effects on ecosystem services

In a Societal Cost-Benefit Analysis, a complete overview of costs and benefits and their allocation to different stakeholders is presented. Investment costs are often an important part of an SCBA. In addition, an SCBA looks into direct and indirect effects of a project. These comprise use and non-use functions. Most use functions can be estimated or calculated on the basis of economic or ecosystem services (e.g. production and regulation functions, market value). A good understanding of the ecosystem and its functional relation with specific economic goods, such as fish, is a basic requirement. While production functions can be evaluated on the basis of market indicators, the value of regulating functions is often estimated on the basis of a prevented or alternative cost analysis.

On top of this, there is a large group of non-use values, mainly the cultural services that need to be addressed. For these benefits there is no market, so their value has to be estimated using indirect parameters. One way of quantification is based on stated preference, where people attribute via interviews a value to a certain condition (e.g. clean water). In these interviews, hypothetical market conditions are simulated. The resulting stated preferences may be confronted with revealed preferences for validation. An example is the Travel Cost Method (assuming that the willingness to travel to a specific amenity is an indicator of the willingness to pay for this amenity). Other ways to assess the value of non-use benefits is hedonic pricing, usually focusing on the price difference for comparable assets with and without the additional benefits (e.g. additional nature). Choice Modelling can also be used as a method of stated preference that can tackle a combination of environmental amenities Within the BwN program, improving Contingent Valuation Methods has special attention (see Nature Valuation). Note that descriptions of various valuation methods can be found at ecosystemvaluation.org or Wikipedia).

It should be noted that most methods aim for output parameters, both for use- as for non-use functions. However all ecosystem services depend on a proper functioning of the ecosystem. There is a set of supporting functions that safeguards this ecosystem functioning. As indicated, these supporting functions are also incorporated in the design and decision framework. Important (categories of) supporting functions are:

- **Self-resilience** or the ability to withstand incidents and larger inter-annual fluctuations. It is a capacity that goes beyond regulation. It depends on biodiversity, via checks and balances between organisms (also under other than average conditions), on the presence of refuge conditions, historic seed banks but also on abiotic processes, such as natural dune formation. Many of these processes are not well understood and not easily identified. Only recent studies showed the importance of biodiversity as an important factor in the ability of ecosystems to adapt to climate variability and change. Self-resilience may be detected by the assessment of historic events (major floods, fires, storms, epidemics, disruption in food chains), looking for factors and organisms that determine successful restoration.
- **Self-development** or the ability of autonomous growth and quality improvement. Natural dune formation is an example of a self-developing process, but so is the development of a mangrove forest, a salt marsh, a sandbank. It is important to know what initial conditions will propagate self-development, so these conditions can be met in the design. Mangrove forests or reed beds can only sustain a certain level of wave energy.
- **Self-recycling, resource efficiency.** The total combination of processes that enable cradle to cradle within the natural environment. Self recycling requires that there are no losses, for example of sand within morphological cells, or nutrients. Dredging tidal channels will have less impact, if the dredged material is deposited within the same morphological system.

Together these functions ensure that an ecosystem can continue to deliver the identified output functions. For this reason some environmental economists value this capacity as an insurance premium. The valuation of these supporting functions requires in depth knowledge of their capacity to maintain the other ecosystem services, and therefore a good understanding of the related processes.

Lifetime costing

Costing of alternatives is required in this phase to scope the need for investments, to compare these needs between alternatives, to assess the costs-efficiency ratio and to value the risks involved in each alternative. Most of these indicators are generated through a costing process. Costing becomes progressively more detailed in subsequent stages of pre-feasibility, feasibility and detailed design.

Any project or intervention should aim to provide merits on the long term. In order to quantify and compare the costs of project alternatives a long-term view is needed, especially in case of substantial maintenance and operation costs and related uncertainties. A life cycle approach is not a standard method for calculating the costs. The focus shifts from project investments, to costs that are related with project performance over a much longer period. On the long term also robustness, flexibility and sustainability of the design can be assessed and be integrated into the cost-calculation (link with BWN budgeting tool).

In the Netherlands and many other countries, budgeting of infrastructural projects is standardized. A BwN-alternative, however, has some inherent characteristics that are not part of the usual budgeting procedure. Inherent qualities such as robustness and resilience are often not expressed in budgetary terms. This can be done to a certain extent, but it requires the performance under certain scenarios to be tested and the related costs and benefits to be estimated. Take, for example, the comparison of a rigid, difficult-to-modify dike and a soft defence structure that can be adapted at little additional costs. Here the quality of the soft defence structure will come to value in a scenario with a higher sea level rise than anticipated in the design.

Within the BwN program, new and better methods to budget BwN-alternatives will be developed. BwN-budgeting will mainly consider the benefits that directly accrue to investments and costs of operation and maintenance (see EDD-budgeting and PRI).

Uncertainties with consequences to investments are usually taken into account in project budgeting procedures. Not accounted for are uncertainties related to external scenario factors that determine the performance of projects. Contingencies and related commitments often have a budgetary nature and should be put into the total valuation.

Select the preferred alternative

At this stage, alternatives can be compared by taking into account all effects considered. A decision, however, remains to be made and an overview of the possible effects is only a first step in that direction. Not all effects are equally important, but different actors and stakeholders will give them different weights (see section on BwN decision framework).

On the basis of a comprehensive description of the alternatives and associated effects a decision can be made regarding the preferred alternative. At this stage one may still see room for further optimization, or the need for further research or cost-effective implementation strategies. These need to be properly addressed and embedded in the next steps.

There may be a bottom line in terms of prerequisites (conditions that need to be met in absolute terms), such as the safety standards that have been laid down in law. The same may apply to the effects on protected species in case a significant negative impact is not acceptable. Most conditions, however, are not that clear-cut. Maybe a positive result is only met after some time (e.g. needed for vegetation to grow), but without intermediate risks. Also, the required safety levels may be met, but the system (e.g. a soft defence system) may be so robust that its probability of failure is lower than the required safety.

For the weighing of the different criteria, a multi-criteria analysis (MCA) may be used. This is a clear-cut method that also allows for a sensitivity analysis, but on the other hand it is mechanistic and does not allow for less explicit arguments, such as perception, power or political trade-offs. Especially in the case of innovative, non-traditional alternatives there may be doubts that are difficult to substantiate, but nevertheless may influence the opinions of actors, stakeholders and public (link to perception and discourse/transition management). Therefore, MCA's cannot be expected to directly point to decisions.

Step 4) Elaborate selected alternatives

Selecting the preferred alternative is not the last step in the design process. The decision may be based on an 'if—then - else' assumption that needs further consideration in the design. These assumptions may concern functions and prerequisites, the allocation of benefits and funds, risk management and other related issues. All of them need to be addressed, if they were not yet considered in the overall planning process or as part of the decision making process.

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Elaborate the preferred alternative

The elaboration of a preferred alternative may involve:

- **Further detailing of the design for contracting purposes.** Depending on the kind of contract a higher level of detail is required. In many BwN projects there is a big component of adaptive management that is relevant to the contract, as well. Certain effects depend on the occurrence of events during the construction. These aspects may act as focal points in innovative contracting for BwN-projects (link with innovative contracting).
- **Further detailing of the effects.** Licensing will require sufficient information and proof that the project will meet the licensing conditions. It is however wise to scope for the possibilities that go beyond what is legally required, for example to offset uncertainties, increase acceptance of the project, identify additional benefits.
- **Further detailing of the costs.** Also budgeting requires more detailed study. It will provide the possibility to identify specific cost components that either determine the risks and the functional life time or are related to adaptive management.
- **Optimizing the design.** Conditions have to be met, cost-efficiency needs to be improved, risks reduced, etcetera (see also optimizing).

Optimise with respect to prerequisites

An alternative shall be tested against the 'knowledge domains' (link to knowledge domains); it will be realistic if it has perspective, is technically feasible, ecologically preferable, economically viable, legally permissible, socially acceptable and financially feasible.

Technically feasible. Generally various forms of "green technical" designs exist. The first group consists of nice, futuristic pictures of floating islands and green skyscrapers, mostly unrealistic, but they may inspire more down-to-earth solutions. Clearly, focus should ultimately be on alternatives that are realistic, but include innovative elements.
To explore the technical feasibility of an alternative approach, the following questions are relevant:

1. Do the proposed ecological innovations offer sufficient perspective within the given time frame of the project? Or, the other way around: what is a realistic time frame for this kind of project? Is it possible to phase the project, such that it provides for the necessary functions at the moment these are needed?
2. Is proper functioning sufficiently guaranteed, given the uncertainties in (our understanding of) the processes involved and our limited ability to predict these processes? What are the possibilities to adjust the design via low-cost alterations or adaptive management?

Ecologically preferable: BwN seeks to create opportunities for nature by improving environmental conditions and processes or by giving more space to the development of nature. This needs to be incorporated in the design and taken care of in the operational management. Sometimes it is a matter of debate what is ecologically preferable. In general, nature restoration and continued development of existing nature tends to be preferred above the development of new nature. One should, however, consider that especially marine engineering structures already lead to profound changes in key environmental conditions, such as flow patterns and velocities. It may sometimes be better to optimize on the newly created potentials than to try and restore or maintain the original habitat at great costs and intensive management efforts.

There is a basic discussion on whether effects of engineering works should be mitigated to avoid changes in the existing patterns and processes, or should be exploited for their own ecological potential.

This may be illustrated by the example of Maasvlakte 1, an extension of the Port of Rotterdam constructed between 1960 and 1970. It was designed to cause minimal changes in the coastal morphology. Yet, because of the size and location of the reclaimed area, morphological changes were to a certain extent inevitable. Since its construction, a shallow intertidal area has developed in the lee, which is now highly praised for it's the ecological values. It was, however, never part of the design of Maasvlakte 1. The overall design might have been very different if this potential would have been recognized upfront. Maasvlakte 2 is currently under construction. In this project the emphasis was again on the mitigation of potential negative effects rather than on the stimulation of desirable effects. This is partly due to a risk-averse attitude: measures of mitigation are a form of playing on the safe side, be it that opportunities are missed, as well.

To explore the ecological feasibility of an alternative, the following questions are relevant:

1. Will existing processes survive and keep on providing their services, or will they be altered significantly by the envisaged engineering works and will essential ecological processes be disrupted?
2. To what extent will the alternative contribute to nature and the related ecosystem services?

Economically viable: Most BwN projects have economic or social development as a major aim. Determining whether an alternative is economically viable is very important at this stage. For a BWN alternative it is important that also related ecosystem services are properly valued. An ecosystem usually provides for a wide variety of functions and services. Some of these can be valued on the basis of market prices, others cannot. In this stage of the project it is important to use site-specific data in order to value the project related ecosystem services, such as production functions (e.g. fish) and regulation functions (e.g. water quality). Also cultural services will require a site specific assessment. The site-specific information may require in depth studies, preferably a focus only major parameters and ecosystem services. Some ecosystem services may indicate the potential for co-financing that is of interest for assessing the financial feasibility of the project.

1. Are there overall net benefits to society or specific user groups? what are the major project components that determine the overall costs and benefits and are these direct economic benefits or based on cultural services?
2. Can economic benefits be optimized and costs be mitigated? In the design, how can costs and benefits be balanced (in design, budgeting, compensation agreements) between different stakeholder groups so the project is economical attractive to all?

Legally permissible: Environmental laws and regulations may hamper the development of innovative new approaches. Especially nature laws and regulations are directed to preserve the present state of the environment. It is difficult to cope with structural changes, even if these may lead to benefits for the environment. Furthermore legislation is not attuned to the dynamics of natural processes and related changes in the presence of protected habitats and species. Focus is also on the quantitative accountable site, such as the surface area of habitats and the number of protected birds, however not on the qualitative parameters. The latter are however critical, if not crucial, to the functioning of an ecosystem and its ability to cope with all kinds of dynamics and incidents.

Interpretation and jurisprudence are key factors in the process. Failing alternatives in court because they are not permissible and therefore not realistic should be avoided. A better option is to have a project that works on a nature inclusive design that ensures that legal requirements are met.

Two important questions need to be answered to be able to explore the legal feasibility of an alternative approach:

1. Are significant negative impacts on the environment expected? Can these be mitigated?
2. Is a net positive contribution to nature expected? Could this compensate potential negative impacts?

Socially acceptable: Whether or not an alternative is socially acceptable in this phase of the project can only be assessed by involving all the relevant stakeholders. Stakeholders comprise very different groups of society, e.g. users, owners, NGO's, policy makers, decision-makers and various experts. These groups differ in their knowledge, language, perceptions and expectations. Their concerns regarding the project range from a merely interested to an entire dependency for their livelihood. The different groups need to be addressed with information that is attuned to their perception and understanding at that point in time. Images are often better than tables, practical information better than theoretically founded explanations.

In this phase of the project at least the economically and emotionally involved stakeholders need to be addressed. The economical stakeholders, e.g. local fisheries, may influence the implementation of an alternative. The emotionally involved are the people that live, work or recreate in the area of interest and may adhere to the existing landscape.

Furthermore one should take into account the dynamics of stakeholder groups, since they organize and evolve during the project, sometimes shifting their position and arguments. Often the interaction can be intensified, which will improve the quality of the design and planning process and also of assessments made.

1. To what extent are facts or perception of facts (e.g. risks) the basis of acceptance? How can the effects be addressed in terms relevant to the stakeholders?
2. Does acceptance lead to specific challenges that can be accommodated for in an optimized design?

Financially feasible: The financial feasibility is based on budgets and business cases. Governmental projects are strongly budget driven, where the available budget is based on experience with traditional engineering projects. This method may work to a certain extent. However, if the scope of a project is widened, more multifunctional projects will be defined that may require additional investment. It is important to be able to screen the co-financing possibilities created by adding objectives.

Projects that involve private investments are built on business cases. Such projects are revenue-driven; a positive balance of investments, benefits and related risks is required. The benefits can only be calculated on the basis of presumptions concerning the dynamic development, use, market forces and many more. Generally this part is taken care of via a specialized economic study.

At this stage it is important whether the project involves risks that can potentially jeopardize the whole venture. If so, investors will probably look for other opportunities of investment. The relevant risks are of different types. In The Netherlands the risk of not receiving the necessary building permits because of environmental legislation is a major concern, especially nearby or in Natura 2000 areas.

To explore the financial feasibility of an alternative approach, the following questions need to be addressed:

1. Is it expected that considerable additional investments are required that cannot be compensated by additional benefits and/or co-financing potential?
2. Are there (financial) risks involved that cannot be management and contained?

Embed the preferred alternative

As indicated, a BWN project is more than a physical, ecological and technical intervention. A set of agreements is required to handle costs, uncertainties, financial details, operation and maintenance, monitoring and adaptive management and more. The content of these agreements depends on the requirements of the relevant parties and on the design itself. Basically the following forms of agreements are important with respect to:

- **The design itself.** The allocation of costs and benefits can sometimes be balanced by design adjustments, and uncertainties can be handled by making it more robust. Project components that determine nature positive results merit special attention, so there implementation is guaranteed in the design itself and not merely dependent on associated projects that may run parallel.
- **Operation and maintenance.** Agreements are needed to ensure the required monitoring and code of conduct in an adaptive management strategy. Especially what management is needed for unforeseen developments requires special attention.
- **Organizational arrangements.** These arrangements should take care of tasks and responsibilities for monitoring, operation and management.
- **Financial arrangements** that cover not only initial investments but give sufficient guarantees to handle unforeseen adjustments, monitoring and operation and maintenance.

Step 5) Bring results to the next phase

>> Read more

Scoping Document

Every phase in the Building with Nature Design process should end with the definition of a set of conditions to frame and direct the next step. An example is the "Scoping Document", the first phase of an EIA-procedure in The Netherlands. It indicates the alternatives to be studied, the criteria that will be applied and the additional research required to execute the environmental impact statement. It should be noted that not all project proceed along the formal line of an EIA procedure, but may be characterized by a more cyclic, iterative nature. Also in these kinds of planning processes it is important to keep options open for a BWN alternative. The definition of a scope that enables BwN has the similar content, but will have more focus on the process of natural development:

- How to guarantee that the nature positive elements are further optimized and “in built” into the design and its implementation?
- Which alternatives and possible variants should be studied? Special attention should be paid to the possibilities of incremental development, adaptive management and the execution of physical pilots. It will result in convergence of the design and a proper assessment of the most important effects.
- What effects are important and how are they assessed? A framework for assessment should be constructed that includes the required scenarios and the external factors to be taken into account. Uncertainty should be addressed, but also qualities such as resilience.
- What baseline studies are required to underpin the evaluation of the alternatives? Sometimes also specifications will be given on how to cope with uncertainties in the prediction of effects.

Governance arrangement

Apart from the ecological and technical values of a BwN approach in Planning & Design, the organisational aspects are always of high relevance. To get maximum benefit out of the market parties that shall ultimately perform the works, an early and high level integration, or at least interaction, with those parties must be prepared. Elements of such co-operational structure to be considered in preparing for the construction phase are discussed.

Market consultation and involvement

There are different ways in which the market can be involved in creative planning and design processes:

- **Market consultation**: this is direct consultation of the market on key aspects, perhaps in the form of open sessions and design competitions. Often market consultation is done to determine the right framework for the tendering procedure. Especially knowledge regarding the do's and don'ts and what is possible in construction and execution is normally lacking in planning and design teams. The process of involvement is very critical. The right set of incentives should be in place in order to create the win-win for both market parties and project owner (see *govern ance*). It is also vital that all relevant ecological knowledge and information is shared with contractors.
- **Market cooperation**: this involves the early selection of a contractor/consultant and the joint cooperation during planning and design. The selection takes places on the basis of capacity and capabilities and not necessarily on the basis of a project proposal. In some cases a kind of selection-competition might be held on basis of an example project design of reference concept.
  Also for market cooperation there are various options, involving only consultants or combinations of consultants and contractors.

Contracting, commitments and consortia

As has been indicated Building with Nature projects require different thinking, acting and interacting. Because of its integral nature and long-term perspective specific consortia may be better suited to implement a project in the most optimal way. Combinations of contractors and even NGO's are in principle possible or even necessary in order to combine the expertise in executing marine engineering projects with the expertise needed to manage resulting nature areas. It is best to start cooperating early in the process, preferably already in the Initiation and Planning and Design Phase. This ensures the optimal integration of relevant knowledge and experience but also of necessary commitments. An example of this is the nature compensation measures for Maasvlakte 2 Port of Rotterdam extension. Only after an intensive consultation process was started with public and stakeholders, general acceptance and also further optimization of the project was achieved.

BWN incentives and requirements

Whatever form of consultation and contracting is being used, finding the right incentives is always essential. This implies that BWN qualities and opportunities are made concrete and smart, by setting clear opportunities and selection criteria. Most BWN incentives will be set in terms of project objectives and functional specifications.

Finding better solutions requires a balance between requirements and an open project scope. Requirements should not work as restrictions to possible solutions since it may hinder the development of better innovative solutions.