



BwN Business Case and Finance

Experiences from EcoShape

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1 Introduction

1.1 Objective

In the past decade, public-private consortium EcoShape has developed knowledge via pilot projects, in which a Building with Nature (BwN) approach is realised and monitored. With a mission to gather knowledge on processes, implementation, now is the time to look back at lessons learned. As we move from innovation to mainstream application of BwN, key topics are the business case, how to convince investors, how to arrange procurement procedures and contracts. The objective of this document is, therefore, to present the lessons learned from EcoShape projects regarding business cases, funding/financing¹, procurement and contracting.

1.2 Method

The information is gathered from a document review, questionnaires filled in by (EcoShape) project leaders, follow-up interviews and correspondence with these project leaders for more in-depth information and results from a Grand Finale meeting². Due to the limited amount of interviews, however, it is not the aim of this document to give a complete story. This document shows the experiences from nine EcoShape projects: The Mud Motor, Houtrib Dike, Marconi, Clay Ripening Project, Soft Sand Engine IJsselmeer coast, Marker Wadden, BwN Indonesia, Hondsbossche Dunes and the Delfland Sand Motor. The majority of these projects are initiated as a pilot, with knowledge development as one of the main project objectives. The Hondsbossche Dunes, Marker Wadden and Houtrib Dike can be described as mainstream projects, based on a BwN approach with a large role for knowledge development. The experiences within these nine EcoShape projects are used to draw conclusions and lessons learned for BwN projects in general. As eight out of nine projects are situated in the Netherlands, the lessons are mainly applicable for the Dutch context. When the results are also relevant for international settings this will be stated explicitly.

1.3 Content

The results are organized along three themes: (1) business cases and decision-making, (2) funding and finance, and (3) procurement and contracting. The first section gives an overview of the applied types of business cases and their role in the decision-making. It also describes how business cases can be used to deal with uncertainties and which barriers and enablers are important for successful business cases. The second section discusses funding and finance: the type of financiers, reasons to invest and possible barriers and enablers for the funding. The third section focusses on the procurement and contracting processes. Finally, the conclusions are given based on the key lessons learned of the three themes. Appendix A and B show more detailed results of business cases and funding sources for each EcoShape project.

¹ Funding: money provided by organization or government based on an agreement, usually free of charge, and no need to pay the money back. Financing: amount of capital provided to an organization with requirement to pay money back with interest, usually provided by financial institutions. Investment: more general concept of allocating money in expectation of a benefit in the future

² EcoShape Grande Finale meeting 16 July 2020, using Mentimeter

2 Business cases and decision-making

2.1 Type of business case

Key lessons learned:

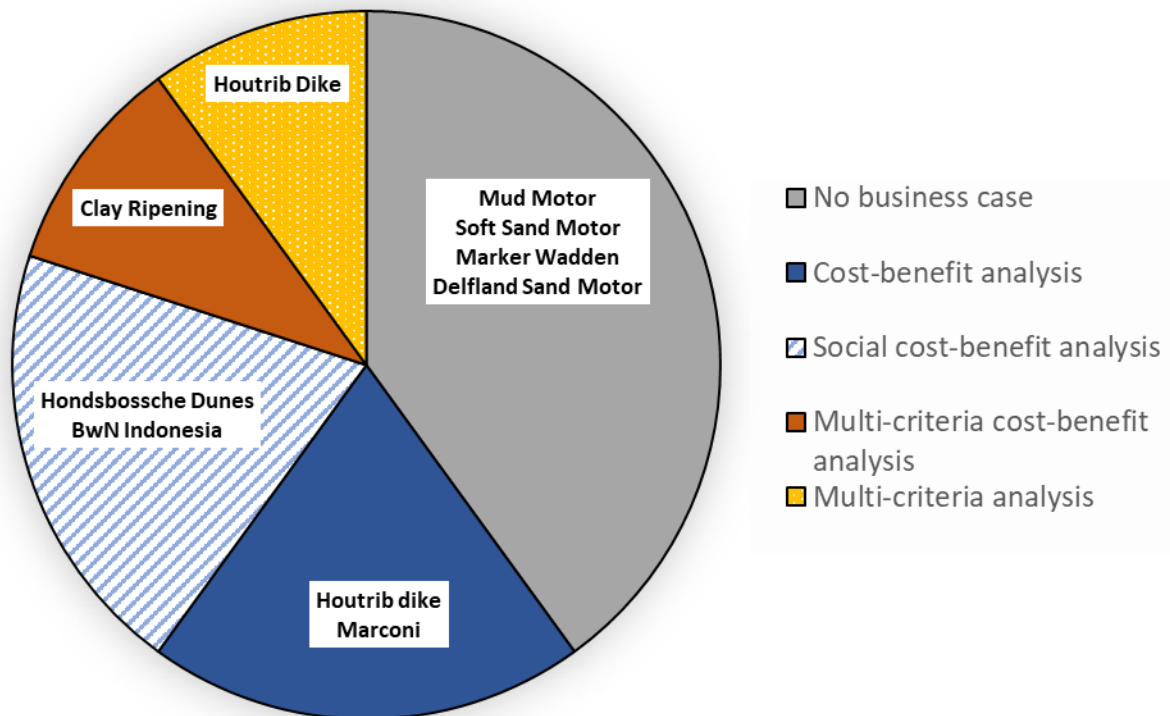
- **A business case tool is not needed in every project to support decision-making.**
- **A (social) cost-benefit analysis can successfully support decision-making, as is shown in the EcoShape projects that do use a business case tool.**

We define ‘business case’ as a presentation of arguments that outline the rationale why a public or private institution should invest in BwN. It typically includes a description of the background of the project, the rationale for investment and a financial overview including expected costs, revenues and risks for the entity or entities that will be investing. Depending on the internal decision-making criteria and process, this can include studies with supporting tools such as cost-benefit-analysis (including co-benefits), a multi-criteria analysis, or a cost-effectiveness analysis.

The results show that in the EcoShape projects, a cost-benefit analysis is the most common business case tool, sometimes in an adapted form (combined with societal or multi-criteria elements). For the Houtrib Dike case, the cost-benefit analysis has been complemented with a multi-criteria analysis, though only to match the design of the project with the available budget. It is revealing that in four of the nine projects no formal business case or tools have been used to provide arguments for decision-making. In these projects, the decision to invest in the project was merely based on the will to do it. There are reasons for these investments, such as the willingness to gain knowledge or to stimulate nature development (see also section 3.2 for reasons to invest in BwN), but they have not been recorded or underpinned with studies.

Note that in this assessment, the business cases concern the inception phase *before* the EcoShape projects were implemented. Business case documents that have been developed *during* these projects for follow-up application are not included. Overall, it can be concluded that a business case was not very important to get the EcoShape projects off the ground. The reason for this, is that most of the projects were *pilots*, and for such projects the standard conditions/rules and regulations do not always apply. There was an incentive to execute a BwN project, with reasons such as knowledge development and stimulating nature development. That is a different starting point, than when there is a problem (e.g. flood risk) and different types of solutions are compared using a business case. For the EcoShape projects, that was the case for the Houtrib Dike, Hondsbossche Dunes and BwN Indonesia.

Type of business case



2.2 Dealing with uncertainties

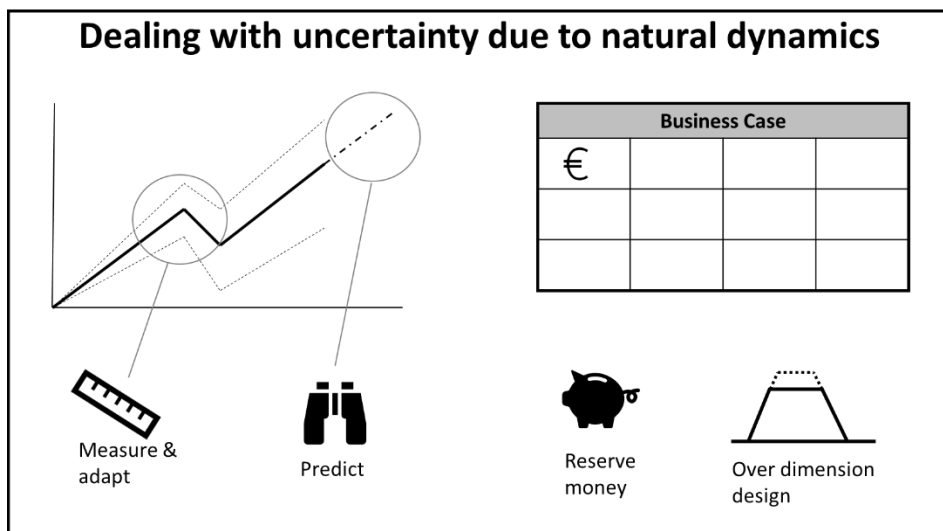
Key lessons learned:

- **Natural dynamics and dynamic governmental administration (governance) are important causes of uncertainty in BwN projects.**
- **Uncertainties caused by natural dynamics can, amongst others, be dealt with through modelling, monitoring and adaptive management; through reserving money for unforeseen costs and by having a 'plan-B' to ensure the promised deliverables.**
- **Uncertainty caused by dynamic governmental administration, e.g. due to differences in governmental mandates, can be dealt with by using a bottom-up approach.**

Uncertainties in costs and effectiveness (of benefits) of BwN projects, e.g. caused by natural dynamics or dynamic governmental administration, are a key obstacle when developing a business case and arranging funding and/or financing. Investors want to make sure that their money is spent in an effective way and want to keep the risk of unforeseen (future) costs to a minimum. In EcoShape projects, the uncertainties caused by natural dynamics were dealt with by predicting them where possible (based on literature and models) to inform the design. After construction, measurements were used to monitor the natural dynamics to improve future projects and to adjust maintenance and management when necessary. These activities should thus be included in the budget for the project and a funding source should be found to cover the expenses. Also, budget should be arranged for the maintenance and monitoring after construction (including a budget for unforeseen expenses). The monitoring results might indicate that unforeseen adjustments have to be made in the maintenance and management.

For example, the erosion rate after the sand nourishment at the Hondsbossche Dunes was higher than predicted, so an additional nourishment was executed shortly after construction. On the other hand, monitoring can show that less maintenance is needed. For example, the Sand Motor was expected to 'last' for twenty years, but research suggests that the lifetime will easily exceed twenty years and could be as much as forty to fifty years³. This can be described as adaptive management. At the Clay Ripening project, in-depth monitoring investigations were performed yearly to assess the status of ripening. A group of experts within the EcoShape consortium uses the monitoring results to define the activities, adaptive management, for the coming period. An initial small-scale pilot can be used to gain knowledge, that is used to adapt a larger follow-up project and as such reduces uncertainty. This approach was taken in the BwN Indonesia project.

The way of addressing uncertainties in the projects' business case varied between reserve money for maintenance or over-dimension the design. For the Houtrib Dike, Soft Sand Engine IJsselmeer coast and salt marsh Marconi project, one of the project objectives was to learn about the effect of natural dynamics and their uncertainties. The Mud Motor Project reserved money for the uncertainties and did not record goals in the contract they might not be able to reach. This approach maximizes the projects flexibility and leads to innovative solutions. The Hondsbossche Dunes was the only project that used over dimensioning of the design due to the fear of inhabitants of increased sand nuisance. This was done to ensure sufficient trapping of sand.



(Figure by S.D.

IJff)

Besides uncertainty based on natural dynamics, dynamic (governmental) administration can also cause uncertainty. This was the case for the BwN Indonesia project, where uncertainties revolved largely around engaging governmental and policy stakeholders. Changes of government administrations and jurisdictional overlaps between governmental agencies posed an obstacle for the project. This uncertainty was a barrier in financing and support for the project. Bridging the gaps between governmental mandates was most effectively tackled by creating greater local support and pushing the implementation process from bottom up, even though there was top down support for the BwN concept overall.

2.3 Barriers in developing a business case for BwN

Key lessons learned:

³ Luiendijk, A. and Van Oudenhoven, A. (ed.) 2019. The sand motor: a nature-based response to climate change. 204 pp.

- **Lack of knowledge on the costs for construction and maintenance of BwN versus conventional solutions can act as barrier in developing a business case for BwN.**
- **The business case might depend on boundary conditions that are beyond the scope of the project and that cannot always be predicted, such as socio-economic developments in the region or physical processes such as subsidence. These conditions might change after initiation of the project and could negatively affect the business case.**

Project leaders of the EcoShape projects shared their lessons regarding the business cases. In this section we describe what they think could have been done differently to strengthen the business case. In the Soft Sand Engine IJsselmeer coast, the lack of understanding regarding costs for construction and maintenance of BwN solutions in comparison to conventional solutions was experienced as a barrier in developing the business case.

The BwN Indonesia project has, in the latter stages of the project, developed an elaborate business case on mangrove belt restoration during the project. In hindsight, that information would have been useful to realize additional financing the project at the start. In addition, avoided land loss was a crucial element in the initial (quick scan) business case of mangrove restoration. In the course of the project it became clear that subsidence was much more severe than previously thought and addressing that was beyond the project scope. The social cost-benefit analysis assumes for specific alternatives that subsidence will be halted, e.g. through policy roadmaps that we have initiated. However, it is not clear whether that will happen. Here, an important barrier turned out to be that some boundary conditions are beyond the project's business case, and/or that the boundaries expanded during project implementation. Since BwN approaches make use of natural dynamics, the BwN business case might be more susceptible to unforeseen (physical) developments because it relies more heavily on the natural system in its functioning.

So overall, barriers to develop a business case for BwN are, based on the EcoShape projects: predicting the costs for construction and maintenance of the BwN project; and predicting socio-economic and physical developments that affect the business case but cannot be influenced.

2.4 Enablers in developing a business case for BwN

Key lessons learned

- **Proof of concept (including risks and uncertainties) should be included in the business case and can lead to more investments.**
- **Show-case projects could act as proof of concept.**

An evidence base for the effectiveness of a BwN approach, including risks and uncertainties, is an enabling factor for developing a BwN business case. The project leader from the Soft Sand Engine IJsselmeer coast responded that a possible enabler is to have more evidence regarding the effectiveness of BwN approaches, including its risks and uncertainties, to include in the BwN business case.

The success of an initial small-scale pilot can provide proof of concept which facilitates investments in larger follow-up projects: by having more showcase projects and understanding and valuation of co-benefits. This point is recognized in the BwN Indonesia case. There, they used a pilot outside of the project as a 'proof of concept', which led to more interest and investments. This was experienced in the BwN Indonesia project, but the approach also worked for the Houtribdike and Marker Wadden.

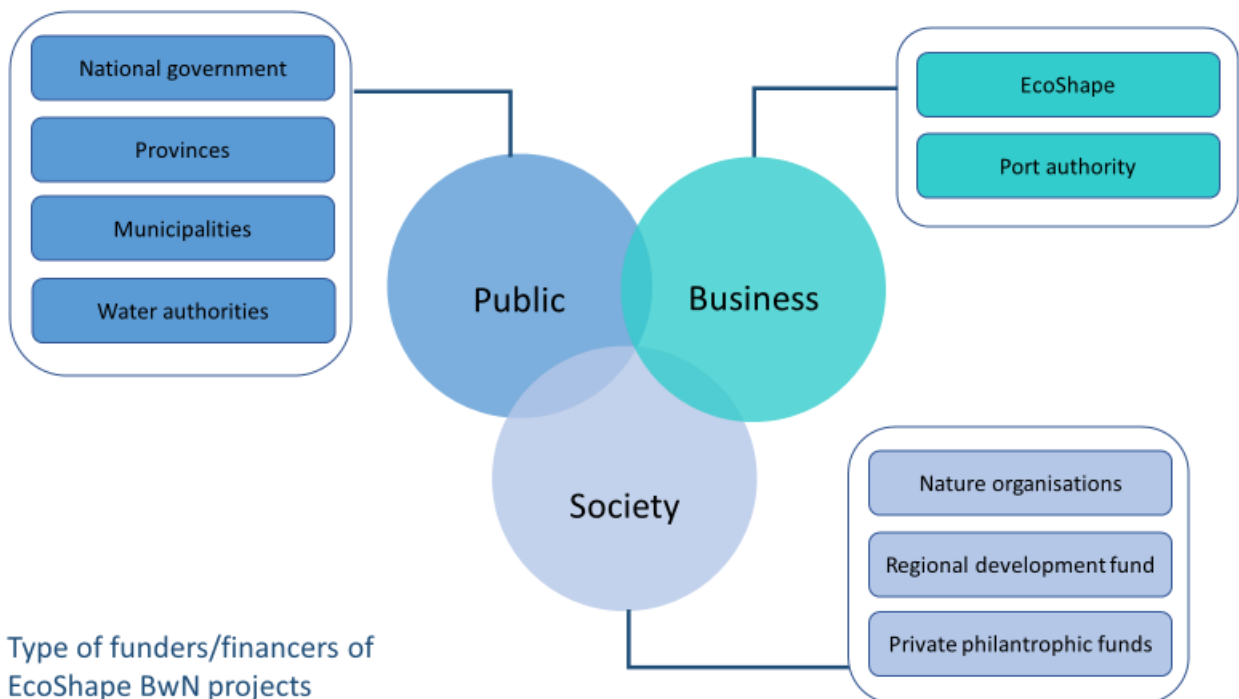
3 Funding and finance

3.1 Type of financiers

Key lessons learned

- **EcoShape BwN projects can have multiple sources for investment, but the majority of these sources come from the national government.**
- **It appears to be difficult to attract private funds from business actors, as shown by the EcoShape projects of which the private (business) funds are limited to those of ports and the financial contribution of EcoShape itself.**
- **Because many BwN projects improve natural value, they can often partly be funded by nature organizations and/or nature funds.**

The projects that EcoShape initiated or was involved in often had more than one investor. As stated in the introduction, these projects are mainly representative for the Dutch context of hydraulic infrastructure (except for BwN Indonesia). Looking at them together, the range of funders is quite large. Since the EcoShape projects often focus on flood risk reduction, Rijkswaterstaat and the Ministry of Infrastructure and Environment (which can be seen as one financier) are often one of the (major) funders of the project. Also, other governmental funds are used such as funds from the province, municipality and/or water authorities. This is typical for the Dutch situation, where the government is a key player and has the responsibility for not only flood risk protection, but also to invest in innovation and knowledge development. For international projects, development funds are an important source of funding. The BwN Indonesia was mainly funded by IKI (a German development fund) and the Dutch Sustainable Water Fund. The figure below shows all the different types of financiers that have contributed to the EcoShape projects.

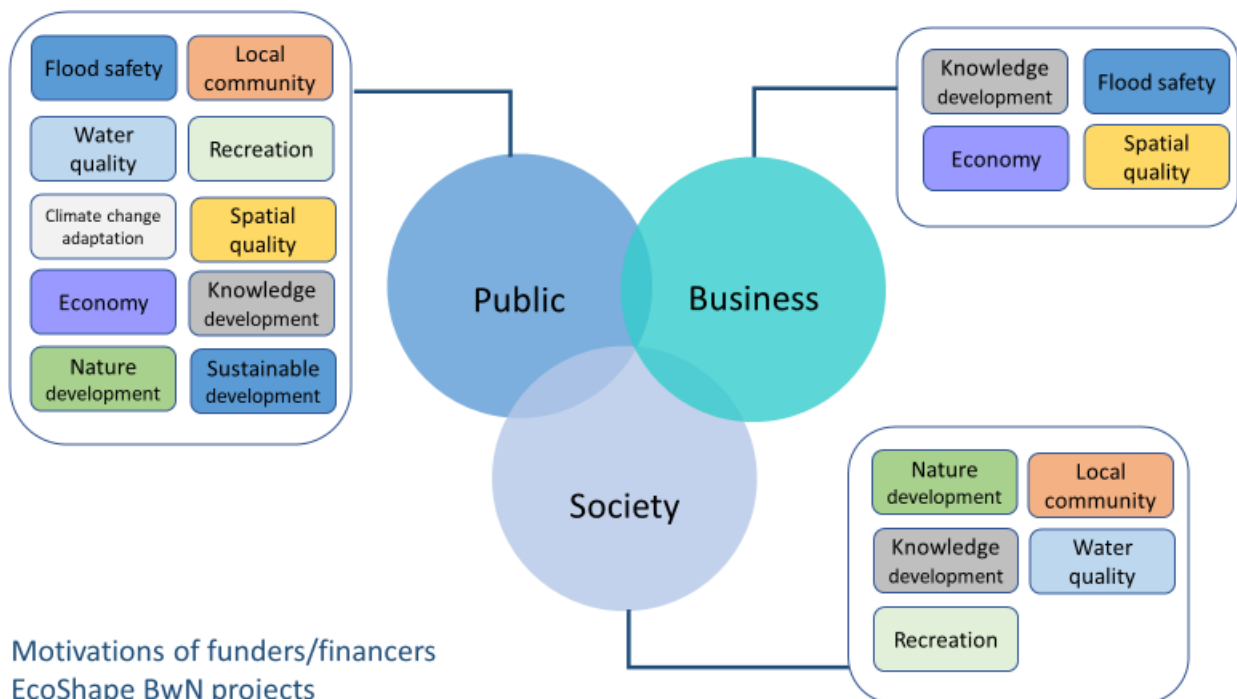


3.2 Reasons to invest in BwN

Key lessons learned

- There was a large range of motivations for the largely public funders to invest in BwN EcoShape projects: flood safety, knowledge development, nature development, spatial quality and recreation, economy and water quality.
- Ecological gains, the innovative approach and knowledge development have been important arguments to convince stakeholders to invest in a BwN approach.
- The business case can play an important role to realize project funding, but the preferred business case type differs per (potential) investor.
- When the urgency to reduce flood risk is high, a business case seems not so important to secure project funding. But it does play a role in selecting the preferred alternative design.

Investors have different reasons to invest in BwN. The EcoShape projects show the diversity of their motivations: flood safety, knowledge development, nature development, spatial quality and recreation, economy and water quality. According to the project leaders, flood safety policy was often (one of the) motivations for the government (ministries, Rijkswaterstaat) and water authorities to invest in BwN projects. Knowledge development and innovation was a motive to invest for both business actors (including EcoShape) and government (Rijkswaterstaat). For public authorities involved in the BwN Indonesia project, “being the first” was an important enabler to get them on board. This motivation can be described as ‘innovative stimulant’ and using the project for positive publicity. Nature development was mentioned for governments, nature organizations and nature funds as one of their motives to fund BwN. This makes sense, since these organizations have an important role and even obligations in nature development and nature protection. Governmental obligations are linked to (European) policies such as water framework directive and Natura2000. Recreation and (local) economy are one of the motives for investment for municipalities and provinces, together with increasing spatial quality. The results show that the government (national, regional and local) has the largest range of reasons to invest in BwN, whereas for the water authorities only flood safety was named as argument to fund the project.



Another question was what factors were crucial or important to convince investors to fund BwN. Ecological gains and taking an innovative approach were mentioned most often as arguments to convince funders to invest in BwN. Other important arguments were knowledge development, stakeholder support and recreation, because they match with the reasons for funders to invest in BwN. It is interesting to note that cost-effectiveness and economic gain, like lower costs over lifecycle and less externalities due to BwN over grey alternatives, were considered less important factors in getting funders on board in EcoShape projects.

It seems that key factors for investors to invest in BwN project is the added value for local communities and the multiple benefits of BwN project, like ecological gain and recreation, which grey alternatives do not have. So, the lesson is to incorporate these factors into the business case for BwN, to show the added value to potential investors. In the experience of EcoShape, ecological gains were more often leading in securing funding (by nature funds) than gains in recreation opportunities (municipalities and provinces).

Sometimes the business case is not essential to secure funding, like when the urgency to reduce flood risk is high and funding from the national government for water safety projects is available. In those cases, however, the business case *does* play an important role in the next phase: selecting the most cost-effective design alternative. This is shown by the Hondsbossche Dunes, that was financed by the Flood protection programme (Hoogwaterbeschermingsprogramma, HWBP.) There, the business case (a social cost-benefit analysis) was performed to make sure that the money would be spent in the best way, to deliver an effective solution with the highest increase of societal welfare.

3.3 Barriers in funding and finance of BwN

Key lessons learned

- **Specific fund conditions can limit the scope of a project, which is a barrier to achieve multi-functional projects (a key characteristic of BwN).**
- **High level of competition for international or national funds is found to be a barrier to secure project funding.**
- **A consequence of these funding barriers can be that the design of the solution is scaled down to save expenses, making it less effective.**

To the question if there were any barriers which resulted in reducing funding opportunities, it was noteworthy to see that both Mud Motor and Marconi have experienced no barriers in funding opportunities. This could be because both projects were funded by the Waddenfonds⁴ (which funded over 60% of both projects) for the nature development goal. The mud motor project was restricted by the conditions of the Waddenfonds subsidy, because the subsidy requested more emphasis on the nature objectives rather than the win-win situation with the harbour.

There were also projects which had trouble finding funding sources, sometimes because of high levels of competition for European or national innovation/research funds, but also because private actors were not eager to invest. For example, it was anticipated that business parties would be interested to finance part of the Marker Wadden project, which turned out not to be the case. Apparently they did not see it as a beneficial investment or them, or did not see nature creation as their responsibility. In the experience of EcoShape, business parties are still hesitant regarding funding a BwN solution compared to a conventional solution. A

⁴ The Waddenfonds is a joint scheme of the Wadden provinces of Friesland, Groningen and North-Holland. The fund invests in initiatives and projects that strengthen the ecology and sustainable economic development of the Wadden area.

reason for this could be that EcoShape projects are all very research-oriented, which might not be a strong argument to convince business investors since the project has risks (uncertainties) and the benefits are not proven yet.

For research-oriented projects such as most of the EcoShape projects, research grants are an important source of funding. However, the competition for (Dutch and European) research grants is very high and can thus form a barrier for funding. For the Marker Wadden the proposal for an EU grant was not awarded, resulting in an increase in financial contribution by the national domestic government. Knowledge institutes are also restricted in how they use their finances, which makes it hard for them to join the project from the start when research grants are not (yet) secured.

A consequence of these funding barriers can be that the design of the solution is scaled down to save expenses, making it less effective. The Soft Sand Engine IJsselmeer coast had a limited budget, which resulted in sub-optimal design: a small-scale soft sand engine with limited positive effect on coastal protection. The project leader responded that lack of understanding of the business case of BwN (the understanding of valuation of co-benefits) could be a potential explanation, that funders were not eager to invest.

3.4 Enablers in funding and finance of BwN

Key lessons learned

- **A public-private partnership can be an enabler to scale up the amount of investment in a BwN project. Co-finance from a private party can act as enabler to secure public funding and get the government on board to start a project.**
- **High urgency to reduce flood risk can facilitate allocation of funds for the project.**
- **Aligning project objectives with governmental ambitions and/or legal obligations acts as an enabler to secure public funding for BwN projects.**

A public-private partnership can be an enabler to scale up the amount of investment in a BwN project. More generally, involvement of the market is seen as a key enabler to scale up the amount of investments in a BwN project is, by the project leader of the Clay Ripening Project. It is an explicit objective of the Eems-Dollard 2050 program (of which the Clay Ripening Project is part) to involve market parties in scale-up efforts. In the Clay Ripening Project, a partnership between private and public actors was formed, in which the public actors cover the larger portion of the funding and private actor take some of the risks. In the Marker Wadden project, a public-private partnership was formed between an NGO (Natuurmonumenten) and the national government. Here, co-finance from a private party acted as enabler to secure public funding and get the government on board to start a project. In total five of the EcoShape projects (Clay Ripening Project, Marconi, Marker Wadden, Delfland Sand Motor and Soft Sand Engine) combine private funds with funds from the national, regional and/or local government. This fits well with the characteristics of BwN projects, of having multiple objectives such as flood safety, recreation, spatial quality and nature development. Linking these objectives to different governmental departments and layers (national to local), enables combining multiple public funds for one project.

High urgency to reduce flood risk can facilitate allocation of funds for the project. The coastline around the Hondsbossche Dunes was designated as a 'Weak Link', which made the location a priority for funding within the HWBP. The same is true for the Houtrib Dike, here the dike was not safe enough. The urgency to secure the coastline of Demak district and the city of Semarang was a key driver in motivating the Indonesian government to seek new solutions, thus initiating this project and the partnerships.

Aligning project objectives with government ambitions and legal obligations acts as an enabler to secure public finance for BwN. In the case of the Marker Wadden, the national government experienced a barrier to improve the water quality and ecological value. In that project, the proposal and the partly financing from an NGO (Natuurmonumenten in this case) was an enabler. The fact that the project objectives met the governmental legal obligations (Water Framework Directive) played an important role in convincing the national government to invest in this project. This example shows that aligning a BwN project objectives to governmental legal obligations (like dike re-strengthening or water quality) can act as an important enabler for BwN projects.

The EcoShape community

The EcoShape community argues that a key success factor in convincing potential investors of BwN is the role of (local) ambassadors: individuals who are enthusiastic about the concept and help convince others. In the experience of the EcoShape community, in particular ambassadors coming from financing institutes and local public authorities as well as (local) civil society and NGO's are valuable, and to a lesser degree project developers themselves. To increase the required cooperation between and within public institutions for BwN, the EcoShape community recommends to demonstrate benefits to other (policy) goals of relevant public institutions. Project leaders or project proponents can enable investments in BwN by: increasing proof of concept that BwN concepts are valid in comparison with grey solutions; exchange stories about the entire project cycle/business case; and give insights in shared benefits of cooperation of BwN approaches.

4 Procurement and contracting of BwN

Key lessons learned

- **The procurement procedure depends on the technological readiness level of the BwN project.**
- **Different contract types can be used, depending on the wishes of the client. In innovative projects, agreements on sharing risks are important to include in the contract.**
- **Public authorities could facilitate investment in, and implementation of BwN through supporting rules and regulations that comply with a BwN approach.**

Procurement procedures and contract form can play a large role in enabling, or hindering, combining multiple objectives in one project and handling uncertainty through an adaptive management approach. Especially for BwN projects where innovation and knowledge development play a role, it is important to make agreements how to deal with unexpected developments and how to share the risks within the project. Also, it is important to decide to what extent the details of the designs need to be fixed from the beginning, or whether there is room for 'learning by doing'. These decisions should lead the type of procurement procedure and contract form that is most fitting to the specific context of the project. The lessons below are based on the European rules and regulations, applied to projects where the government is the client.

The procurement procedure that is best fitting, depends on the technological readiness level (TRL)⁵ of the anticipated project. If the TRL is low (4-6), and the project objective mainly

⁵ Technological Readiness Levels (TRLs) indicate the 'maturity' of a specific technology, and go from TRL 1 (unproven concept, no testing performed) to TRL 9 (full commercial application, technology available for consumers). See also the [EcoShape Platform](#).

focuses on gaining knowledge on new techniques/concepts, an innovation partnership or pre-commercial procurement can be recommended. In this case, client and bidders work together to realize the innovation and the contracts that follow the procurement procedure are not very rigid. If the BwN concept is further developed (TLR 7-9), however, a competitive dialogue (with or without negotiation) is common. Competitive Dialogue allows tenderers to submit initial solutions after being successful at the selection stage. A dialogue between the selected parties takes place to identify and define the means best suited to satisfying their needs. All aspects of the procurement can be discussed with the participants in the dialogue. This procurement procedure was used for e.g. the Hondsbossche Dunes project.

In the contract, responsibilities and allocation of risks are defined. Differences in contracts depend on what project phases they apply to (e.g. only design or build, or design-build-maintain) and the level of rigidity can differ: are all details fixed within the contract or is dialogue between the client and the contractor about the exact interpretation possible during the project? For example, the initial design of Marker Wadden was purposely held abstract to allow for natural developments to occur. Also, there was room in the contract to make changes in the construction, when the client wished so. The EcoShape projects used different contract types: the Houtribdijk contract included both construction and operation; for Marconi only the concept design was done by EcoShape, the construction, operation and maintenance were done by a contractor; and in the Clay Ripening project a design-construction- operation and maintenance contract was used, after which the roles and responsibilities were defined in the cooperation agreement. The most common contract conditions within EcoShape project are based on a UAV-gc contract form (Uniforme Administratieve Voorwaarden voor Geïntegreerde Contractvormen). The Clay Ripening project, Marker Wadden and Hondsbossche Dunes all used these conditions. The Clay Ripening Project had a contractual obligation to deliver a certain amount of clay through the Clay Ripening Project or by buying clay. This was for the Water Boards to guarantee that they would get the amount of clay they needed.

The EcoShape community

The EcoShape community finds that public authorities could facilitate the investment in, and implementation of BwN through strengthen supportive rules and regulations and to stimulate acceptance of BwN concept as a serious competitive solution and enabling environment should be created in e.g. budgeting rules, licensing procedures, project cycle and decision support.

5 Conclusions

In this document, lessons learned from EcoShape projects regarding business cases, financing, procurement and contracting were presented. As eight out of nine projects are situated in the Netherlands, the lessons are mainly applicable for the Dutch context of hydraulic infrastructure. Also, all projects had a large research/knowledge development component. As such, the lessons learned should be interpreted in that specific context.

One key lesson learned about Business cases in EcoShape projects is that not all EcoShape projects used a business case. When the urgency to reduce flood risk is very high, a business case seems to be less important to secure project funding. A business case based on a (social) cost-benefit analysis can, however, successfully support decision-making, as is shown in the EcoShape projects that do use a business case tool. Here, the business case played an important role in realizing project funding. Barriers in developing a business case for BwN are the quantification of the effectiveness and the provision of social and ecological values. As a

result, knowledge development and broadening the evidence base for BwN is one of the main enablers to facilitate and improve the business case tools for BwN projects.

Most EcoShape projects have more than one funder. Most of the funds come from the Dutch government. The funders of EcoShape projects have a large range of motivations to invest in BwN: Flood safety, knowledge development, nature development, spatial quality and recreation, economy and water quality. There are still some barriers to secure the funding for EcoShape projects, like specific fund conditions which limit the scope of a project and high level of competition for international and national funds. There are also some enablers to make sure the EcoShape projects got funded, however: high urgency to reduce flood risk can facilitate allocation of funds, co-finance from a private and public party, aligning project objectives with government ambitions and have (local) ambassadors who promote the BwN projects.

As BwN projects often have innovative components, which can be expressed with the Technological Readiness Level (TRL), it is smart to use a procurement procedure and contract type that is fitted for the specific conditions of that project. For example, decisions should be made on sharing of risks and the rigidity of the contract. To further facilitate implementation of BwN, public authorities could improve supporting rules and regulations that comply with a BwN approach.

Overall, EcoShape projects together form a valuable source of experience in implementing BwN projects. Not only in the sense of technological insights, but also in developing business cases, securing financing and selecting procurement procedures and contract types.

Appendix A) Business Cases of EcoShape projects

Table 1 An overview per EcoShape project about which BwN solution is chosen (column 3) in contrast to the conventional alternative (column 2) and which benefits from BwN come with that (column 3). Furthermore, the business case (column 4) used is mentioned, as the cost-effectiveness (column 5) of the BwN solution against the flood risk reduction/erosion control. In the last column is giving if the role of the business case played a role in the decision making.

Project	BwN solution	Conventional alternative	Benefits from BwN	Business case used	Cost-effectiveness	Role Business case in decision-making
Mud motor	Use dredged sediment to enhance salt marsh development.	Dredging and 'dump' dredged material or remove it as waste product.	Beneficial use of dredged sediment to create nature.	No business case was used.	Avoided costs transport of dredged material (depending on distance of mud motor to the dredging location).	Does not apply.
Houtrib Dike	Sandy foreshore in front of a dike.	Stone dike reinforcement.	Improves natural value, cheaper and more effective (under certain circumstances).	First cost-benefit analysis, later a multi-criteria analysis.	Positive. A sandy foreshore was found to be more cost-effective than stone dike reinforcement under the local circumstances (shallow foreshore).	Yes, played a role in realizing funding.
Marconi	Salt marsh development with dredged sediment.	Dredging and 'dump' dredged material or remove it as waste product.	Beneficial use of dredged sediment to create nature, knowledge development and improve the coast of Delfzijl	Cost-benefit analysis.	Avoided cost transport of dredged material (depending on distance of mud motor to the dredging location).	Yes, played a role in realizing funding and was used to select design.
Clay Ripening project	Use dredged sediment from the Eems-Dollard to make clay which can be used for local dike reinforcement.	Dredge the Eems-Dollard and 'dump' dredged material or remove it as waste product, and buy clay for the dike reinforcement.	Improve water quality, stimulating regional economy, beneficial use of dredged sediment for clay production	Multi-criteria cost-benefit analysis.	Positive. But depends on the shipping distance and the market price of the clay that is produced.	Yes, played a role in realizing funding.
Soft Sand Engine IJsselmeercoast	Sandy shore protection, in the form of a Sand engine.	Stone dike reinforcement.	Use natural processes for coastal protection.	No official business case was used	Does not apply	Does not apply.
Marker Wadden	Create island with local mud and sand to improve water quality and natural values.	Do nothing.	Improve natural value, improve water quality, provide recreation opportunities.	No business case was used.	Does not apply.	Does not apply.

BwN Indonesia	Use semi-permeable dams to promote mangrove restoration for coastal protection.	Do nothing/stone protection structures (sea wall or dike).	Wave attenuation, erosion mitigation, ecosystem restoration, ecosystem services and livelihood support. Sediment capture and water quality improvement	A social cost-benefit analysis	Depends on boundary conditions (subsidence).	Was part of project proposal and realizing funding.
Hondsbosse Dunes	Building of a new dune coast with marine sand for coastal protection.	Stone dike reinforcement.	Coastal flood protection, improve natural value and create opportunities for recreation.	Societal cost-benefit analysis.	Based on a social cost-benefit analysis, the Hondsbosse Dunes scored better than alternative designs (multiple objectives). Based costs and on flood risk reduction alone, a conventional alternative would be more cost-effective.	Yes, to check if the public money would be spent in a good way.
Delfland Sand Motor	Use a mega sand nourishment for coastal protection.	Use stone coastal protection constructions (dams, groins).	Use natural processes for long-term coastal protection, create recreation opportunities and reduce negative ecological impact of sand nourishment.	No official business case was used.	Negative, regular sand nourishment is more cost-effective.	Does not apply.

Appendix B) Funding sources of EcoShape projects

Tabel 2 An overview of the EcoShape project with their main funding source and what kind of source that is. Furthermore, the motivation of the main funding source is giving with any conditions of finance. In the last column other smaller funding sources are mentioned.

Project	Main funding source	Motivation	Conditions of finance	Other smaller funding sources
Mud motor	Waddenfonds- Subsidy – Public- Domestic government	Nature development in the Wadden Sea	Subsidy	Waterboard It Fryske Gea, Municipality of Harlingen and Ecoshape
Houtrib Dike	HWBP ⁶ , Rijkswaterstaat – Public- Domestic government	The project objectives of flood risk reduction contribute to the HWBP obligation for dike strengthening	Grant, with condition that project goals are achieved	No.
Marconi	Waddenfonds- Subsidy – Public- Domestic government	Nature improvement and knowledge development	Conditionally for subsidy	Ecoshape, municipalities, water boards, Province of Groningen, Groningen Seaports, Rijkswaterstaat and Groninger Landschap
Clay Ripening project	Waddenfonds- Subsidy – Public- Domestic government	Improvement of dyke with local clay and improvement of the water quality of the Eems-Dollard	Grant, with condition that project goals are achieved.	Water board Hunze and Aa's and Province of Groningen
Soft Sand Engine Ijsselmeer coast	HWBP, Rijkswaterstaat – Public- Domestic government	The project objectives of flood risk reduction contribute to the HWBP obligation for dike strengthening	Grant, with condition that project goals are achieved.	Ministry of Infrastructure and Environment, Province Friesland, Water board Wetterskip, Ecoshape and Ministry of Agriculture, Nature and Food Quality
Marker Wadden	Deltafonds, Ministry of Infrastructure and Environment + Ministry of Economic Affairs - Public-Domestic government	The project objectives contribute to the government obligation for water quality improvement and nature values in Lake Marken	Grant, with condition that project goals are achieved	Nationale Postcode Loterij, Natuurmonumenten, Province Flevoland and North Holland, Municipality Lelystad
BwN Indonesia	International Climate Initiative (IKI) and Sustainable Water Fund (SWF) - Public – International organisations	Enhancing coastal safety at the North Coast of Java & Erosion risk reduction	Grant, with condition that project goals are achieved	Indonesian government, EcoShape, Knowledge Funds (TKI, NWO), other small private funds (Waterloo Foundation, Otter Foundation, Mangroves for the Future)
Hondsbosche Dunes	HWBP, Rijkswaterstaat – Public- Domestic government	The project objectives of flood risk reduction contribute to the HWBP obligation for dike strengthening	Grant, with condition that project goals are achieved	No.
Delfland Sand Motor	Rijkswaterstaat - Public-Domestic government	Gain knowledge on innovative coastal management strategies (mega-nourishment)	Grant	Province South Holland

⁶ Flood protection program (Hoogwaterbeschermingsprogramma, HWBP)