MARITIME SOLUTIONS FOR A CHANGING WORLD

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TERRA ET AQUA

WHERE TRUST IS KEY
The importance and complexities of a Social Licence to Operate in today's fast-changing world

VALUATION OF EXTERNALITIES
Investigating asset valuation methods including externalities in maritime infrastructure projects

SAFETY INNOVATIONS
Discover the recipients of IADC's Safety Awards 2021 and their award-winning designs

NATURE DEVELOPMENT

THE IMPACT AND COSTS OF BUILDING WITH NATURE PROJECTS

HIGHLIGHT

BUILDING WITH NATURE

A REFLECTION ON THE IMPACT AND COSTS

Building with Nature projects deliver added value but often also involve additional costs compared to traditional reinforcements. This exploratory study provides an initial inventory of the impact and costs of existing Building with Nature projects in the Netherlands, including the Hondsbossche Dunes (pictured here) and the Marker Wadden project (shown on the front cover). The Hondsbossche Dunes project is a prime example of how a Building with Nature project can be used for dynamic coastal management. Instead of replenishing smaller quantities of sand periodically, a huge volume is deposited in one go meaning the sand deposits in this area are sufficient to keep pace with a rising sea level and subsidence. The study also includes an analysis of the decision-making process in choosing this type of project as well as identifying success factors. Go to page 36 to read the full article.

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A COMPROMISE DEAL ON CLIMATE IS SIMPLY NOT ENOUGH

Frank Verhoeven
President, IADC

Too little, too late' was the feeling of some when COP26, the biggest climate change summit of the last 5 years, concluded in Glasgow, Scotland. While the 10-page agreement it produced – dubbed the 'Glasgow Climate Pact' – left many activists disappointed, there were several notable achievements.

Countries committed to accelerating their decarbonisation plans and to strengthening their emissions-reduction targets for 2030 by 2022, rather than in 2025 as scheduled under the Paris agreement. Developed countries were 'urged' to increase funding for adaptation in developing countries.

Rules to create a framework for a global carbon market were approved and the need to reduce global greenhouse-gas emissions by 45% by 2030 was formally recognised.

There is a good reason why so many countries are now saying they plan to go net zero: the collapsing cost of renewables is completely changing the calculus of decarbonisation. Renewables are already often cheaper than fossil fuel power in much of the world. Concurrently, there is growing momentum to get businesses to embed climate risk into their financial decision making. The aim is to make it mandatory for businesses and investors to show that their activities and investments are making the necessary steps to transition to a net-zero world. Seventy central banks are already working to make this happen and building these requirements into the world's financial architecture is a key focus.

Financing sustainable marine and freshwater infrastructure is the focus of IADC's joint study by the same name. The report was presented at the Sustainable Development Impact Summit in Geneva in September. Against the backdrop of climate change, energy transition and loss of biodiversity, together with limited public budgets, there is a larger role available for private capital to play in bridging the infrastructure funding gap. The main conclusion is that sustainable waterborne infrastructure solutions are available, have been tested and are economically viable. Private capital could help to accelerate the uptake of such solutions and the report is an important first step in realising this. The report was shared with the dredging community at the virtual CEDA Dredging Days 2021. IADC is also planning a 1-day conference on 17 March 2022 in Dubai to address how private capital can accelerate the green transition in marine and freshwater infrastructure.

Next year marks 50 years of *Terra et Aqua*. To mark this milestone, we will be celebrating with a special jubilee edition that will be launched at the WODCON conference in Copenhagen, 16–20 May 2022. This one-off special will take the place of both the spring and summer issues, with the regular autumn and winter editions following later in the year.

As for this issue, we look at the need for a social licence to operate, the impact and costs of Building with Nature projects and an investigation into sustainable asset valuation methods, including externalities materialised in maritime infrastructure projects. Jan De Nul and Keppel FELS, winners of IADC's Safety Awards 2021, also showcase their winning innovations.

There is growing momentum to get businesses to embed climate risk into their financial decision making.

THE RESPONSIBLE PROJECT:
A VIEW ON SOCIAL LICENCE

In today's world, expectations for sustainable practices are fast becoming the norm. Countries, the public and communities are requesting transparency, the application of higher environmental standards and involvement in decision-making processes when new developments in a marine environment are proposed. Marine infrastructure projects not only require environmental permits and works licences to be in place, they also need a Social Licence to Operate (SLO). This article describes the social licence in this fast-changing context of information and technology, and explores tools that can be used to develop a 'responsible project' and provide a successful and sustainable outcome for society and the environment.

The Social Licence to Operate is a complex, dynamic and layered process that complements the legal environmental approval process.

Definition of Social Licence to Operate

The Social Licence to Operate (SLO) lies more in the realm of the social sciences than in engineering. Its development is attributed to the work of a group of social scientists. This body of work is increasingly relevant to the worldwide dredging industry as changes in attitudes has resulted in communities and governments expecting the willing application of higher environmental standards by owners and contractors in construction activities.

A social licence or SLO is not a formal licence. It is the acceptance by the wider public (community) of a project, a proposal or a new development through all phases of the project, from its inception to its operation. In contrast, a Legal Licence to Operate (LLO) is the attainment of required legal and institutional approvals that must be granted for a project to proceed. Having attained one, does not guarantee the other (Komnitsas, 2020).

While acquiring an SLO involves informal community engagements and negotiations, the LLOs require formal regulatory processes that include environmental approvals, various planning approvals and others that involve trade laws, labour usage, indigenous title licences and the like.

Both the SLO and the LLO processes can overlap but are usually not contradictory. For example, while an LLO may also require public consultation, it is mandated and monitored by the regulatory authority in some way (Komnistas, 2020). The requirement of consultation is one of those mechanisms within the formal LLO approval process that allows social licence to feed into it. This includes consultation with government bodies other than the consent body, as well as consultation with other stakeholders and local communities. Globally, there are many processes and many terms in use but most are similar or have similar meanings.

Respondents to an Australian CSIRO research paper described the legal licence as 'formal permission issued by government in line with legislated requirements' but they saw the SLO as 'something their companies needed to earn from their communities' (Moffat et al., 2015).

Project proponents should be aware of the importance of SLO and the widespread reach of modern communication techniques such as social media.

Background

The term 'Social Licence to Operate' emerged in the mining industry in the late 1990s, when community trust in governments was declining and public approval in mining had plummeted in spite of the economic arguments. It came as a realisation that communities required more than government approvals to be convinced of mining's merits. Community or 'stakeholder' engagement was also required.

It became evident that the increasingly environmentally aware public, with activist help, had used the SLO process to apply pressure on mining companies to lift environmental standards. The Social Licence to Operate has lately evolved into a strategic management and planning tool with respect to climate change, overfishing, pollution and a growing list of other impacts (Komnitsas, 2020; Kelly et al., 2017).

The responsible project

A 'responsible project' is one that is founded on sound environment science, regulatory compliance and has achieved its SLO, without suspicions of inducement. The need for both an ongoing SLO in addition to LLOs is due to a sense that responsibilities need to be shared between government and the project proponents in the face of the increasing lack of trust in governments and business (Moffat et al., 2015). This outcome to shared responsibility is 'the responsible project'. Additionally, it is a project where there is trust that businesses operate according to their attained permits and where there is trust that the permit conditions are enforced where needed. If government is not able to enforce compliance to the environmental and social requirements, the project or activities may face a premature end.

Stakeholders

Communities, individuals and groups affected by a project, form part of a large social category called stakeholders, who either:

- have a financial interest, or will receive a reward in some way;
- are directly impacted, geographically;
- have an interest or a concern for reasons ranging from the pragmatic to the ideological; or
- are seen as important to engage around questions of social acceptability.

Nowadays, stakeholders are the product of an increasingly diverse, expanding and environmentally sophisticated population. They will grant the SLO but not necessarily with unanimous endorsement.

Stakeholder communities

To make some sense of this, Voyer and van Leeuwen (2018) have categorised stakeholders as consisting of 'Communities of Place' and 'Communities of Interest'. We have added a third type; the 'Communities of the Disengaged'. The three types of stakeholder communities are illustrated in Figure 1.

Communities of Place is defined as those affected by the project through geography. Traditionally, these community's interests and concerns were local and pragmatic and their communication somewhat muted.

But increasing disquiet over negative social and environmental impacts, and the availability of social media and the internet, the Communities of Place are increasingly more vocal, influential and better equipped. However, it is not unusual for division of opinions to occur and a community to respond with polar opposite viewpoints. In high living standard countries in particular, local economic, business and employment opportunities are balanced against fears of environmental and social impacts and the Not-In-My-Back-Yard (NIMBY) attitude (Voyer and van Leeuwen, 2018).

Communities of Interest are defined by stakeholder attitudes towards the project and not geographical location. It will include those in support and against the project, but often from a wider and even a global perspective. An effective transnational community in opposition to the project may arise that is financed and led by sophisticated activist organisations.

If the project profile is elevated to the national or transnational dimension, project proponents may be obliged to shift their SLO focus more towards these communities of interest, leaving local communities side-lined (Voyer and van Leeuwen, 2018).

Communities of the Disengaged are the wider community or public opinion, whose recruitment is sought by both proponents and activists to their cause. If the proposed or existing development becomes contested, without the community of the disengaged being informed and taking a particular viewpoint, public opinion will not shift in support of either side. In case a project proponent loses its 'good' reputation, it will be extremely hard to attain approval nor for the same proposal in another location.

Conflict

The SLO is not simply a collection of 'feel good' principles. Many projects are contested by opposing stakeholders. It is expected that project proponents and contractors will at times have to robustly advocate for their projects and work methods as is shown in Figure 1.

Depending on the size and nature of the project, stakeholders can oppose to one another from the local to the global level (Voyer and van Leeuwen, 2018). Activist organisations at the global level are sometimes referred to as 'TANs'

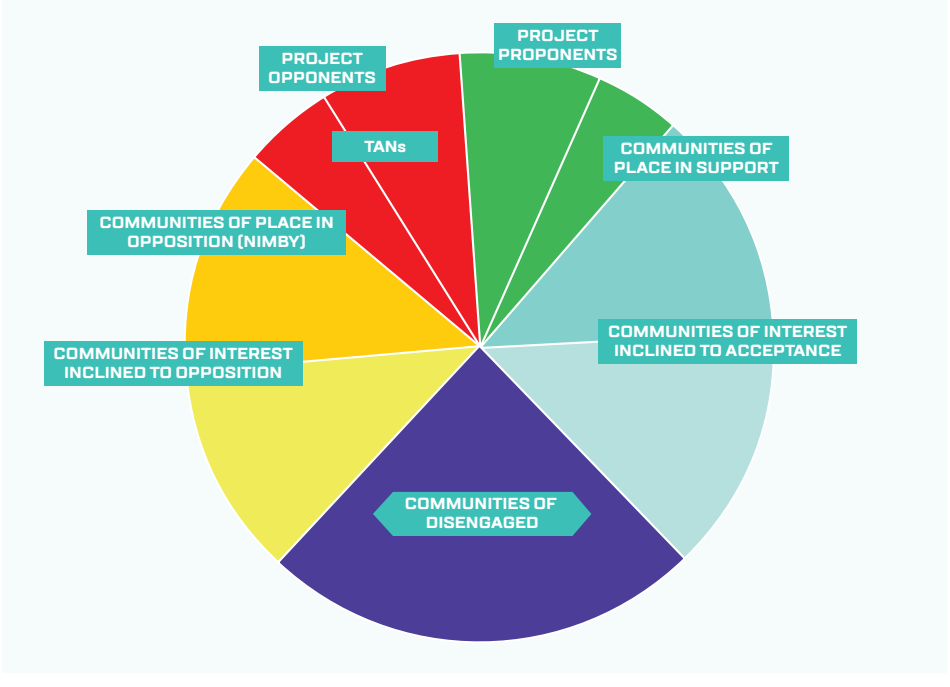

FIGURE 1

Stakeholder community types.

TABLE 1

An interpretation of the four factor 'pyramidal' model and the SLO.

THE FOUR FACTOR MODEL – Social Licence				Legal Licence
Level and label		**Description**	**Role in determining SLO levels**	**Approvals**
TRUST	4 Institutional Trust	Relations between stakeholders and proponents are based on regard for each other's interests.	Without this, psychological identification with the project is unlikely.	Stakeholders and the wider community can clearly see that the approval conditions are being met and maintained during the construction and operation phases. This applies in particular to environmental approvals.
	3 Interactional Trust	Proponents listen and respond to stakeholders, keep promises and engage in dialogue and reciprocity.	Without this, stakeholder approval is less likely. If both 2 and 3 are lacking, stakeholder approval would be rare. If both are present, approval is likely.	Environmental and other approvals including permit conditions have been clearly communicated to stakeholders.
LEGITIMACY	2 Socio-political legitimacy	Proponents contribute to the well-being of the region and respect the local way of life. Project meets stakeholder expectations of their role in the community and acts according to stakeholders' view of fairness.	Without this, stakeholder approval is unlikely.	Environmental and other approvals have been obtained.
	1 Economic legitimacy	The project offers a clear economic benefit to the community.	Without this, most stakeholders will withhold or withdraw the SLO.	The approval process (environmental and other approvals) start.

(Transnational Advocacy Networks). A number of TANs are involved in environmental and global warming movements that have ensnared marine project developments, especially when linked with fossil fuel expansion (Hudson, 2002). The Wilderness Society's organisation of opposition to oil exploration in the Great Australian Bight is an example.

Moffat and Zhang, in their 2013 research of Australian attitudes to coal seam gas, agree that gaining stakeholder trust is the key. They have suggested that overcoming suspicion and gaining trust can be achieved through:

- perceived procedural fairness;
- contact quality and to a lesser extent, contact quantity; and
- impacts on social infrastructure.

The four factor model

In the last 20 years, a number of researchers have worked on ways to measure the SLO. This has resulted in a consensus that the community understanding of 'legitimacy' and 'trust' is key to measuring stakeholder attitudes. Legitimacy, as a societal norm has been understood for some time, however recent researchers have tended to view trust as the key to acceptance. Where, according to Gehman, stakeholders develop a sense of co-ownership with the project (Gehman et al., 2017).

Boutilier and Thomson (2011) developed what has become the four factor 'pyramidal' model of the SLO. This model emphasised the fact that while obtaining legitimacy is critical, it is not sufficient and stakeholders needed a higher level of trust in the project before they would provide the social licence.

They hold that positive perceptions of a project will begin with economic legitimacy, i.e. showing an economic benefit to stakeholders, however higher perceptions of legitimacy are socio-political. Legitimacy is necessary but not enough. Proponents should work to reach a level of interactional trust with stakeholders and then go on to achieve institutionalised trust. At that point, the project could be regarded as having a Social Licence to Operate.

In the day-to-day dredging world, the simple equation that project legitimacy equals the attainment of the legal licences, has justification. If these statutory requirements are inserted into the model at the legitimacy level, it helps explain why proponents have so many times been surprised that the gaining of approvals has not quelled stakeholder opposition.

The four factor 'pyramidal' model is comprehensive and roadmaps the required levels of trust that need to be obtained. Table 1 sets out its framework and has been expanded to show an interpretation of how it can interact with the legal licence process and how the LLO can assist in achieving and maintaining stakeholder trust.

Environmental approvals

Obtaining environmental approval for the project to proceed is critical. Without this approval, the project will not proceed and all other efforts will have been in vain. The approval is also critical to attaining project legitimacy. It is often the most difficult and time-consuming part of the whole pre-project stage.

FIGURE 2

Flow chart of the EES process in Victoria, Australia. Source: Victoria State Government, Department of Environment, Land, Water and Planning.

Proposed infrastructure works trigger an approval process. The process is mostly composed of a number of environmental and works licence applications to be granted from different governmental bodies. An approval process is intrinsically related to the local legislation that is different for each country and often between the regions or states within a country. However, at a high level, there is certain degree of consistency in the approval application process and in the way infrastructure projects in the marine sector are assessed.

The Initial Environmental Risk Level (IERL)

In general, the industry acknowledges that it has the potential to create significant environmental impacts and must utilise the range of mitigation and management strategies that are available. Finding a balance between economic and environmental values is crucial to the acceptance and therefore, the success of a project.

From the very earliest project concept, proponents are assessing and juggling environmental risk to find an outcome with the best possibility of satisfying regulators and communities. Eventually, a design concept with a certain environmental risk profile is settled on to form the basis of the submission.

A suitable term for this could be called the 'Initial Environmental Risk Level' (IERL). Its importance is critical. Not only for the success of the environmental approval, but for stakeholders' initial responses.

It will be shown in the case studies that if the IERL is seen as too high, the proposal's environmental riskier aspects will become a rallying cry for stakeholder opposition.

The EES process in Victoria, Australia

Given that the presented case studies in this article are located in the State of Victoria, Australia, the State's Environmental Effects Statement (EES) process is briefly outlined and illustrated in Figure 2. An EES evaluates the environmental and socio-economic effects of a proposal in a legal framework.

At an initial assessment of a project proposal, it is decided whether a more in-depth and formal EES or environmental impact assessment is required. This depends on the size of the project, sensitivity of the surroundings and the potential impacts.

Generally, development proposals that have the potential to significantly impact the environment include the necessary public consultation mechanisms, where the general public has the opportunity to react, give feedback and express their concerns on the proposal. This process is incorporated into the approval process.

A public consultation in which stakeholders provide feedback, runs for a certain period in time. Meaningful responses and valuable concerns from the community may be integrated in a permit's conditions. Generally, a permit comes with conditions for the project owner to comply with. These conditions can reflect on the execution method of the project. A common example is that the dredge material or part of it is originally proposed for ocean disposal, but after objections on grounds of contamination concerns, generation of turbidity and impacts on sensitive marine species, the dredge material needs to be disposed of elsewhere, mostly, on land.

In the effort to explore reuse and beneficially use of the dredged sediments, innovative technologies and methods can result from these permit conditions. Additionally, permit conditions can include environmental offsets. This involves that the environmental loss or damage is compensated for. Offsets can range from the physical replacement or creation of habitat elsewhere, or can be imposed in other forms such as funds.

Stakeholder engagement

There are opportunities to take community involvement a step further with the active recruitment of stakeholders of place as well as interest and the unengaged during all phases of a project. A practical and non-limitative overview of participation and stakeholder engagement is illustrated in Table 2. The next section elaborates on a number of strategies mentioned in Table 2, presenting them as tools to attain 'the responsible project'.

Tools to gain stakeholder trust

There exist tools and strategies that can assist project proponents active in the blue economy and in marine infrastructure and developments to act proactively. Many are already adopted by companies. The aim is that those tools are known and used as to contribute to the attainment of these legitimacy and trust levels, and therefore to the development of a responsible project. The following sections detail existing approaches and concepts that can be considered and utilised at an early stage of a project or later on, however it doesn't guarantee a social licence and a successful responsible project.

TABLE 2

Stakeholder engagement though all project phases.

	Stakeholder engagement
EARLY PROJECT CONCEPTION	· Develop a communication strategy plan for the project, potentially identifying environmental stewardship opportunities. · Identify stakeholders and actively commence communication via town halls, social media, publications and establish regular lines of communication.
PRE-CONSTRUCTION **Design** **Approvals** **Procurement**	· Continue with lines of communications with stakeholders. · Develop activist counter strategies, correct disinformation and robustly defend the project where required. – Demonstrate corporate social responsibility commitments. – Roll out early-stage environmental stewardship programmes. – Update on the approvals progress.
CONSTRUCTION	· Continued communication. · Continue with activist counter strategies where disinformation is employed against the project. · Continue to engage stakeholders. · Clearly outline the environmental approvals conditions. · Organise stakeholder participation.
OPERATIONS	· Continued communication. · Implement post-construction/operational ongoing environmental stewardship programmes. · Make use of smart technology for licence compliance. · Demonstrate environmental approvals conditions are met.

Corporate Social Responsibility

The concept of 'Corporate Social Responsibility' (CSR) focusses on the corporate level of the proponent's organisation. It aims to map and assess the performance of a company by taking into account societal, environmental and economic issues (Kelly et al., 2017). It should underpin the proponents' philosophy in achieving a responsible project and include early and detailed demonstrations of environmental responsibility.

Sustainable Development Goals

Also on the corporate level is the development and implementation of the United Nations' Sustainable Development Goals (SDGs). There are 17 sustainable development goals in terms of economy, society and ecology. Adopting and embedding SDG targets into a company's business represents an opportunity for companies to align their own sustainability goals with broader societal goals and reflects a company's engagement in society and the environment in the long term.

Building with Nature

The starting point is simply building 'with' nature, not 'against' it. The concept considers the natural systems in the design of a project, rather than only considering the technical aspects (Van Raalte et al., 2007). Integrating Building with Nature in the design, often requires an innovative and novel approach that asks questions, such as:

- Can the project bring other benefits to its immediate vicinity in addition to socio-economic benefits such as employment?;
- How can nature help us in building or making what we need?;
- Can the structures be used in another way?;
- What can be added or combined to achieve more value in your infrastructure?; and
- Is there room for ecology?

An example of this type of thinking can be seen when Dr Todd Bridges (National Lead for USACE Engineering With Nature Initiative) challenged his audience to consider trees and mangroves as infrastructure (Engineering With Nature, PIANC 2020, Fremantle, Western Australia).

It is recommended that each new major project goes through this 'thinking' process, focussing on the ecosystem context. The addition of Building with Nature aspects to a project is very likely to support the SLO and to contribute to a responsible project.

Nature-based Solutions

Similarly, as with the Building with Nature concepts, Nature-based Solutions (NbS) aim to integrate natural elements or use natural solutions in infrastructure. NbS is the collective name for more sustainable solutions, as defined by IUCN, actions to protect, sustainably manage and restore ecosystems (PIANC, IUCN).

Nowadays, NbS is an emerging practice in coastal protection and climate adaption, where its place is claimed alongside the traditional engineering solutions.

When a project adopts NbS, the starting point is a thorough understanding of the natural environment and physical processes. Additionally, an added value is a proactive stakeholder engagement seeking win–wins on a social as well as ecological level. Furthermore, it also tends to prioritise the local economy by using local resources and products.

Ecosystem Services

Ecosystem Services (ES) are benefits to humans provided by the natural environment

Obtaining environmental approval is critical for the project to attain legitimacy and to proceed.

and ecosystems. The ES concept is a recent effort to evaluate the cost/benefits of a project, by assessing the economic alongside the environmental values of a project or of the area in which a project is planned. Adopting the ecosystem services approach integrates the economic aspects with the ecological values that, in turn, are also expressed in monetary terms (Boerema et al., 2016). To quantify the ecological values, the question 'What does nature allow for and what are its functions?' needs to be addressed. Incorporating the ES concept in the development of a project at an early stage provides the maximum benefit. However, even if applied in later phases of a project, it can provide significant context and insights. Integrating this approach is yet another element that increases the likelihood of a project obtaining a SLO.

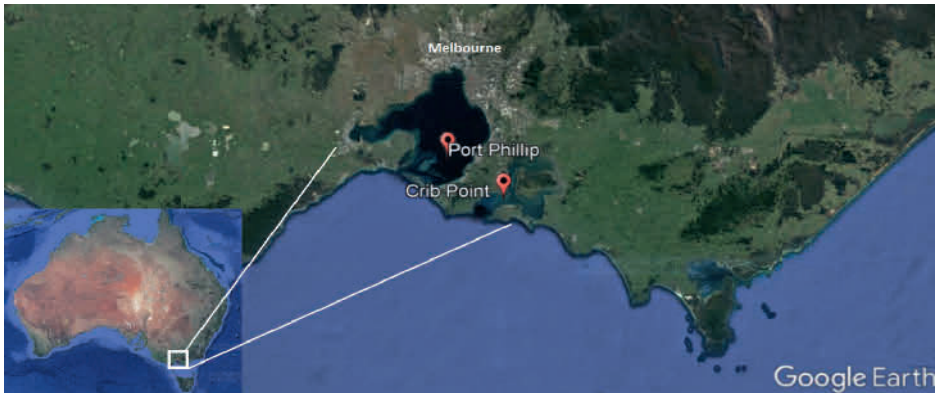

FIGURE 3

Location of the two case studies in Victoria, Australia.

Contract and procurement type

Realise clear and transparent collaboration by embedment in the right contract type and identify best practices upfront, agreeing on shared responsibilities and shared risks. Examples are early contractor involvement and an 'alliance contract'. In the case a proposal is abandoned late in the process, the often already significant investment cost is lost.

Furthermore, contractors, subcontractors and other service providers can quickly undo the work of the owners to gain stakeholder trust if they take actions that are contrary to SLO objectives and the owners' policies. All individuals and parties employed or contracted to work on the project need to understand and commit to the owners' SLO objectives.

Communication strategy (Plan)

This plan should be developed at the beginning of a project, even before the concept has been finalised. If it is developed early, it has the best potential to guide the communication culture of the proponents' organisation by elements such as:

- setting out the intended openness, transparency and degree of proactiveness for engagement with stakeholders;
- determining how much information will be placed in the public domain; and
- adopting communication streams through:
  - social media;
  - dedicated interactive websites;
  - community information sessions/ meetings/briefings and workshops;
  - establishment of a community liaison group or stakeholder advisory committee;
  - letterbox and e-newsletters; and
  - TV/radio media releases and printed advertising.

Environmental stewardship

Examples of environmental stewardship include activities, such as (re)planting trees and mangroves, restoring degraded areas, or cleaning up rubbish from beaches. This tool is most important in achieving the upper level of trust as it focuses on the active involvement of the local community and local perspectives by prompting questions such as:

- How can we involve the local and distant communities?;
- What are their concerns and needs?; and
- In what fields can we improve things and where would they feel valorised/want to be involved in?

Environmental stewardship is an opportunity to utilise local environmental knowledge. Many individuals, local communities, environmental groups, municipalities and governments around the world are leading, supporting and promoting actions to steward the environment (Bennet et al., 2018). This can also be initiated by project proponents or contractors to obtain and maintain a SLO and support a company's CSR.

Environmental stewardship should be initiated as early as possible. As with most of the other tools, an early start establishes the desired on-going culture of stakeholder engagement throughout all phases of the project. During early project conception already, opportunities for potential environmental stewardship activities could be identified.

All individuals and parties employed or contracted to work on the project need to understand and commit to the owners' SLO objectives.

Case studies

The two case studies from the marine sector in Victoria (Australia) focus on the rather traditional marine activities; dredging

(deepening) and oil and gas developments. However, the SLO is no less applicable to the emerging industries, such as offshore renewable energy and seabed mining.

The examples illustrate the important role of community involvement and social licence in the approval process, and aim to show how the concerns and issues have been responded to. Both projects experienced a similar level of public opposition in the beginning but managed the process in contrasting ways obtaining contrasting results.

Case study 1: Port Phillip channel deepening project, Melbourne (2004–2009)

The Port Phillip channel deepening project (Port Phillip CDP) involved the deepening of the channels in Port Phillip Bay leading to Melbourne for the Port of Melbourne Corporation. The dredging works were conducted by Boskalis in 2009 and involved the removal of approximately 23 million m^3 by trailing suction hopper dredger, of which around 3 million m^3 was contaminated sediment. The material was disposed of in two designated dump areas in the bay. The contaminated sediments were stored in an existing spoil ground, an underwater containment area bunded with clay walls and capped by clean silt and subsequently sands. The remainder of the uncontaminated sediments were placed in a new spoil ground, also located within the bay (Bradford and Siebinga, 2009).

The dredging works were preceded by a 4-year-period of extensive environmental studies, risk assessments and intensive public consultations. An Environmental Effects Statement (EES) was submitted in early 2004, followed by a supplementary EES. After numerous delays and a trial dredging programme, the dredging works commenced in early 2008. Protests from the public however continued after the LLO was obtained.

Community consultation could not reassure a local group of bayside residents who were clearly opposed to the project that eventually led to court action. This temporarily stopped the dredging operations but eventually the works were completed in late 2009.

The problem

The project caused significant controversy among the Victorian population and was strongly opposed by scientists and many groups representing the community. It was believed that the dredging would disturb the marine environment throughout large areas of the bay. Public rallies were held between 2004 and 2008, involving surfers, as well as people in canoes, kayaks, boats and yachts who put themselves in the path of the trailing suction hopper dredger, delaying the project.

Solutions

The client and contractor had formed an alliance contract to share responsibilities and risks, and also the communication effort, leading to successful completion of the project. Stakeholder acceptance of the project was a result of the accurate and transparent public communications. Extensive communications efforts were undertaken to demonstrate to the public that the dredging works were not detrimental to the environment and to inform and educate as to how the environmental impacts were to be managed.

Stakeholder engagement included public consultations, public hearings, a dedicated website, a 24-hour toll-free telephone number, weekly press conferences, media releases, mailing lists, signage around the Bay and notices to mariners (Bradford and Siebinga, 2009).

In this project, the alliance invested in research and innovation to address the permit conditions and to manage the impacts of concern. It resulted in the development of a ripper draghead and work method to dredge the reef at the bay entrance to minimise the likelihood of residual rock tipping over the edge and falling into the 80-metre-deep canyon and damaging sensitive corals, as shown in Figure 4A and 4B..

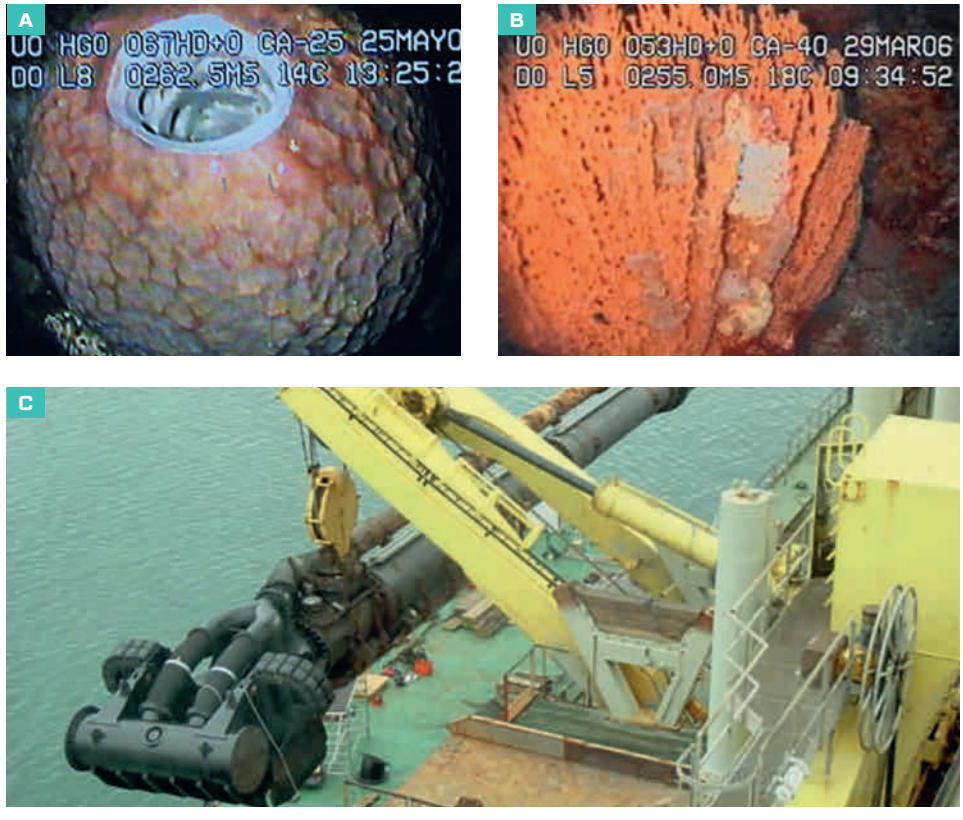

FIGURE 4

Video footage of coral reefs in the bay entrance (A and B) and ripper draghead on trailing suction hopper dredger (C).

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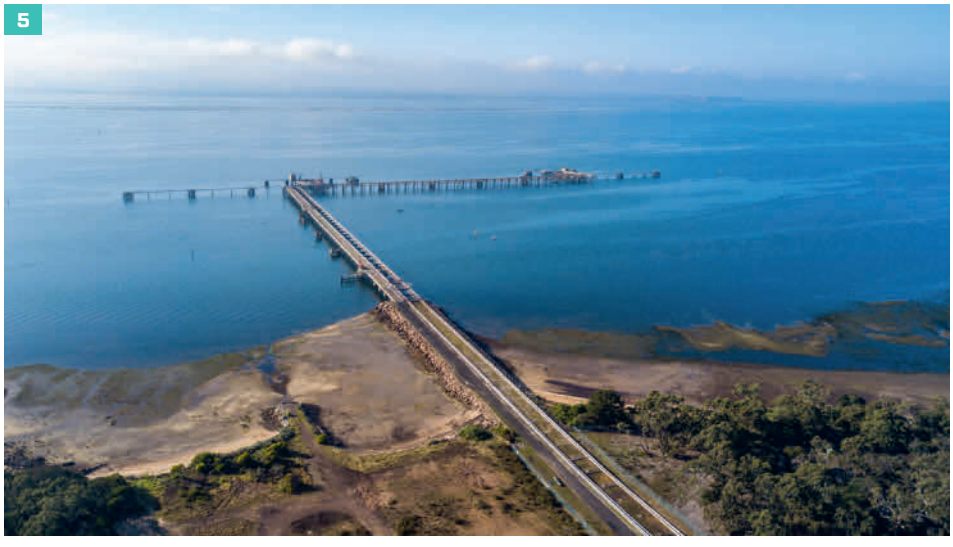

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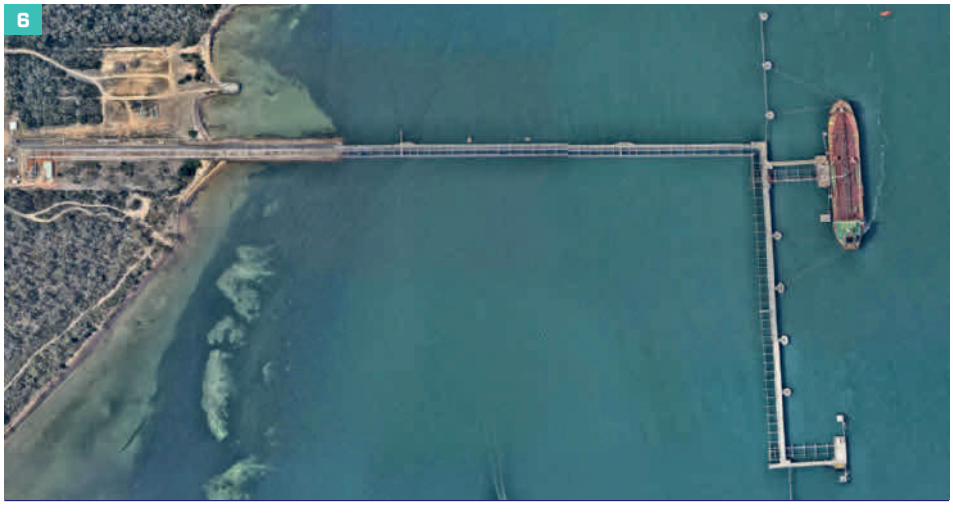

FIGURE 5 AND 6

Crib Point in Westernport Bay, the location where the FSRU was proposed. Photo © AGL, Gas Import Jetty and Pipeline Project EES.

This particular case study was selected as it points out that despite a strong and continued opposition, and significant delays, the project was executed with a responsible consideration for the environment, which prompted the development of new designs and methods. The open and transparent communications efforts by both client and contractor appeared to be instrumental in overcoming the obstacle of the negative reactions and in reassuring the many stakeholders that the channel deepening project could be conducted in a safe and environmentally sustainable manner (Bradford and Siebinga, 2009).

The successful features were:

- the initial strong opposition quickly dissipated once the works were completed and when it became apparent that there were no immediate noticeable impacts observed; and
- the creation of an alliance type of contract that shared the risks, the responsibilities and the problem solving;

This was achieved however, at the cost of:

- the consultation period, which was lengthy; and
- the negative perceptions of Melbourne residents and industry members around the Bay, which began to dissipate during the work but did not disappear entirely until years after the project was completed.

Case study 2: AGL Gas import project, Westernport Bay (2018–2021)

The second case study on the other hand outlines how a determined community succeeded in stopping energy giant AGL from installing a Floating Storage and Regasification Unit (FSRU) at Crib Point in Westernport Bay and the 60-kilometre-long pipeline proposed by Australian Energy Infrastructure APA.

Additionally, a data analysis tool applied to the vessel tracking system was used to prove that the operations proceeded in accordance with the environmental management plan. Online video data was available for the public to view in real time and follow the dredging of the hard rock near the reef (Figure 4A and 4B). Later surveys showed re-growth of the original kelp vegetation (Bradford and Siebinga, 2009).

This is a recent example of a project proposal being scrutinised based on its environmental effects and impacts. The proposal went through an extensive environmental study and assessment, complemented with public hearings with a variety of committed and concerned stakeholders. In October 2020, the newspaper quoted, 'This is the largest and most complex environmental assessment

carried out in Victoria, with 6058 submissions and a record number of public objections.'

The project

In 2017, AGL, an Australian energy, electricity and gas provider, proposed to develop a liquefied natural gas (LNG) import facility. The facility was to be located at Crib Point in Westernport Bay, on Victoria's Mornington Peninsula, 60 km southeast of Melbourne. The facility required the building a 290-metre-long permanently moored vessel called a Floating Storage and Regasification Unit (FSRU). It was intended to receive LNG via shipments from LNG carriers of approximately 300 metres in length, which was to moor adjacent to the FSRU. The LNG would be converted back into gas for distribution, so the project also included the building of a new gas pipeline connecting to the existing gas network.

The setting

The wider Westernport Bay area is characterised by low-lying coastal plains dissected by intertidal channels, mudflats, saltmarshes, seagrass beds and cold-water mangroves. It has to be noted that the proposed works were located in a RAMSAR site, a recognised wetland of international importance.

The bay is connected to Bass Strait and is a home to vulnerable, endangered and critically endangered whales, turtles, fish and water birds. The intertidal mudflats attract a large number of water birds, including migratory birds. The mudflats are important feeding and breeding areas as well as refuge, providing habitat all year round. An abundance of seabirds uses the wider area near the project area. The mudflats support seagrass, macro-algae and fauna, which along with the mangroves, provides an important breeding habitat for fish and other food sources for seabirds (DELWP, 2017).

The proposal went through an extensive environmental study and assessment, complemented with public hearings with a variety of committed and concerned stakeholders.

Although the area is already developed, it has been semi-rural for many years. Industrialisation and heavy industry are recent and confined to the Hastings area. There is no large-scale urbanisation but tourism now plays a key economic role for the regional communities along the coast. Nearby Phillip Island is a big tourist site of prime interest amongst tourists (DELWP, 2017).

Issues and concerns

With the site being a conservation area with high natural values, regulators and stake-holders had two major concerns: 1) the marine component of the project is located within a Ramsar wetland of international importance; and 2) AGL applied to discharge wastewater and chlorine from the proposed floating gas terminal into the sea.

This discharge of potentially contaminated wastewater into the bay was regarded as a significant issue as it was not what known what affect it would have on the marine biodiversity. As part of the regasification process, 450,000 m^3 of seawater per day would be taken in from the surrounding waters to heat cold LNG (stored at a temperature of -162°C). In return the same amount of cold seawater from the FSRU would be pumped back into the Westernport waters. The return water would have been 0.3°C to 7°C cooler than the ambient seawater temperature and contain chlorine from the process. Furthermore, there were also climate change issues amongst

FIGURE 7

Proposed layout of the FSRU and LNG Carrier alongside at Crib Point Jetty. Photo © AGL, Gas Import Jetty and Pipeline Project EES.

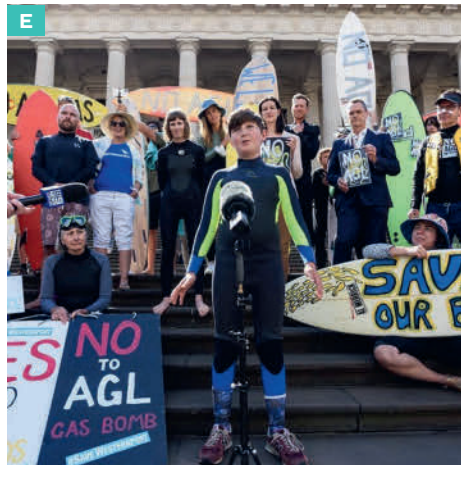

FIGURE 8A–G

Community opposition and public protests against the AGL Crib Point proposal in Melbourne and Westernport Bay. Photo © Save Westernport Facebook page and Environment Victoria.

environmental groups over the facility handling fossil fuel.

Stakeholders began to ask the questions:

- How would the cold chlorine discharges and other toxicants affect and impact marine life and ecosystems and over what distances?;
- What would be the effect of the release of the cold and chlorinated seawater into the ambient environment?;
- Will the smaller marine organisms be entrained in the water intake?; and
- What will be the risks and potential impacts due to the increased shipping and loading and unloading operations on the marine environment, such as bilge water, contaminant releases, spills and leaks?

Timeline approval process

October 2017: AGL announced that Crib Point was the preferred project location.

September 2018: the proposal was referred to the federal as well as state (Victoria) government for assessment.

October 2018: the state minister for planning decided the project was subject to a formal environmental impact assessment, called the Environment Effects Statement (EES), and established its scope.

February 2019: the EES's scope requirements were established and over the course of 1.5 years, the statement and its supporting studies were prepared by AGL and APA.

July 2020: the final multi-volume EES was open to public comment for 2 months. In response, an unprecedented number of public submissions, more than 6,000, were lodged. This triggered the appointment of an independent Inquiry and Advisory Committee (IAC) to consider the public submissions and advise the Minister for planning.

October 2020: All submissions were heard during a 10-week public hearing. The aim of this process was to allow the IAC to hear from the project proponent, AGL, from the experts and from the submitters. At the end of the public hearings, the IAC was required to submit a report to the Minister that contained its conclusions and recommendations.

March 2021: The IAC concluded that the project would have unacceptable environmental effects and the Victorian Planning Minister decided to block the project.

May 2021: AGL confirmed to cease further development of the liquefied natural gas import jetty at Crib Point.

A determined community succeeded in stopping energy giant AGL from installing a Floating Storage and Regasification Unit in Westernport Bay.

F

G

Community consultations

AGL commenced information sessions and community meetings from mid–2017 to inform and engage with local residents and special interest groups. Consultations began soon after the announcement of Crib Point as the preferred location in order to ascertain the local community's sentiment toward the project and to identify any emerging issues they might have with the proposed development. As part of the EES preparation, stakeholder engagement continued throughout 2019 as opposition grew to the project. The feedback assisted in informing project planning, decisions and design, and the creation of a Consultation Plan and Community Engagement report. A further round of public consultation took place during the EES mandatory public comment period.

Action groups

Widespread concern about the risk to the Ramsar wetlands, local tourism, the marine environment and water and air quality, led quickly to the emergence of a range of stakeholder groups opposed to the project. Action groups organised campaigns (see Figure 8A–G) and established Facebook pages and employed social media postings. Road signs were also employed relentlessly over the 3 years, while websites provided an update on the project's approval process.

During the hearing process, the opposing community went to great lengths to challenge the many uncertainties concerning marine ecology impacts and hired experts and lawyers to represent them in their fight against AGL.

Conclusions

Both Port Phillip and Westernport Bays had iconic environmental status in the eyes of Melbourne residents. It had been anticipated that gaining SLO's for development would prove difficult. Both projects underwent the EES process resulting in a multi-volume, thousands of pages EES document. Although both project proponents began their stakeholder engagement in a similar manner, their approaches quickly diverged and the outcomes were polar opposites.

By failing to take sufficient caution in its planned waste and chlorine discharge, AGL's proposed design contained a high Initial Environmental Risk Level (IERL). This failure, and its apparent reluctance to make any substantial changes to the proposal, appeared to doom the project. It was a risky approach. Environmental approval was uncertain and broad stakeholder opposition quickly materialised.

More than a decade earlier, the Port Phillip Alliance (PPA) had also faced immense opposition. However, the proposal offered a lower IERL and the PPA responded to stakeholder feedback with efforts and solutions to reduce it further.

Although both proponents showed an understanding of the SLO process and commenced early consultation, the PPA appeared to have a better understanding of the importance of stakeholder approval, who they were and what their concerns were. AGL's response appeared less flexible and less accommodating to increasing concerns of the community.

Both projects were opposed by vocal

communities of place and communities of interest. The Port Phillip Bay dredging was adjacent to Melbourne's recreational and property-focussed shoreline that engendered a strong NIMBY movement. The proposal to place and cap toxic dredge material in the bay triggered the involvement of a large community of interest.

Westernport Bay had a much smaller local population, but managed to obtain expert evidence and legal representation to invigorate their voice. However, the project's location in a semi-rural Ramsar site of high natural value, the discharge of high volumes of wastewater and chlorinated water, its association with fossil fuels and especially the high IERL, considered dangerous and irresponsible by many, created a very determined community of interest.

Trust is key to obtain a Social Licence to Operate.

Finally, it is the comparison of both case studies with the four factor 'pyramidal' model that is the most telling. AGL's actions appeared to reflect a belief that the economic argument alone would be sufficient to obtain environmental approval and allow the project to proceed. In the model, economic justification is only the first level and as it transpired, the only level that the project would accomplish. In contrast, the PPA, in spite of all the initial stakeholder hostility, achieved all four levels and therefore sufficient stakeholder trust to justify that the project had a Social Licence to Operate.

To conclude, the Social Licence to Operate is a complex, dynamic and layered process that complements the legal environmental approval process. Project proponents should be aware of this twofold pathway. In this article, we make the connection to current trends, mechanisms and approaches that project proponents could consider and include in their strategy to propose new developments. Trust is key to obtain a social licence.

Summary

The article describes two case studies, both located near Melbourne, Australia. The Port Phillip channel deepening project (CDP) and the AGL gas import project. Both projects faced strong public opposition. The Port Phillip CDP managed to counter the concerns and to offer solutions, whilst the AGL proposal did not succeed to present its proposal in an environmentally acceptable way. So far, it is been the largest and most complex environmental assessment carried out in Victoria, Australia. The AGL case also demonstrates that small local communities can stand up against corporate interests, no matter how much money the company has invested in the approval process, as long as their efforts are backed by the deciding government. Furthermore, a project proponent and intrinsically the government need the trust of the community to successfully develop and maintain a project.

Valérie Biernaux
Valérie is Account Manager Sediments and Dredging at Antea Group Belgium. She obtained her MSc in Physical Geography at the Vrije Universiteit Brussel in 2002 and has a postgraduate diploma in Dredging Engineering. After working for DEME and as a marine scientist for consultancies in Australia, her work focusses on the development of activities in line with resilient coasts and rivers. She has a special interest in innovative coastal protection and in the reuse and beneficial use of dredged materials.

Greg Miller
Greg has had a long career in dredging, offshore and marine construction that has seen him involved in harbour works, oilfield installation and coastal construction throughout the Australasian Pacific region. He is a Principle Dredging Consultant with in2Dredging Consultancy Services in Perth and is currently studying international policy and politics at Macquarie University, New South Wales. Previously, Greg worked on major gas field and coal and iron ore export port developments. His involvement in stakeholder engagement and the environmental regulatory processes led to an interest in social licence.

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THE VALUATION OF EXTERNALITIES IN MARITIME INFRASTRUCTURE PROJECTS

Climate change and increasing environmental damage are demonstrating the urgency of transformation to a sustainable global economic model. The implementation of the sustainable development concept tends to narrow to integrating environmental, social, and economic concerns in the decision making. In economics, the definition of such concerns is an externality that represents the divergence between social and private costs. This study investigates the available sustainable asset valuation methods that can include the externalities materialised in maritime infrastructure projects and compares them based on economic, social and environmental criteria.

Inclusion of externalities refers to the assurance that all related project benefits and costs are accounted for.

The need for sustainable development was initially promoted during the first United Nations (UN) conference on the Human Environment in 1972 (Smardon, 2008). The definition of sustainable development is, 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (United Nations General Assembly, 1987). The consideration of intergenerational equity is one of the essential features that separates sustainable policy from a traditional approach (Emas, 2015).

The international maritime industry is a significant stakeholder in sustainability compliance (Wang et al., 2020). Besides being a catalyst industry for economic activity and globalisation, maritime industry activities create environmental, social, and economic externalities that should be accounted for to understand the actual value these projects provide to society. Furthermore, the maritime infrastructure industry is one of those industries where appropriate planning can significantly improve project sustainability since the timeline required to complete a project is often long. Thus, improvements in the initial project planning related to sustainability can increase the likelihood of project acceptance by the regulative authorities continuously working towards being more sustainable.

The improvement required to increase the quality of project assessment in ex-ante project evaluation is the inclusion of externalities that the maritime infrastructure projects create. Inclusion of externalities refers to the assurance that all related project benefits and costs are accounted for (Ding et al., 2014). Such evaluations are also known as 'green accounting' because they include all sources of future growth (Weitzman, 2016). The project-specific externalities can be best internalised and accounted for in the project valuation by considering the three sustainability pillars: economic, social and environmental (Kastenhofer and Rammel, 2005; United Nations General Assembly, 2005).

Businesses still find it difficult and costly to include all the externalities based on the sustainability pillars due to a lack of available methodology to do so efficiently. De Boer et al. (2019) note that the externalities are accounted for only if an impact assessment is required. Moreover, during the project stage at which these assessments are necessary, the project design is already fixed (Laboyrie et al., 2018). If externalities are not accounted for during the initial design stage, the approval of the regulator is less likely (Laboyrie et al., 2018). Additionally, businesses may not be aware of all the externalities encountered in a particular project since incorporation of externalities requires multidisciplinary expertise. Thus, there is a benefit to the industry from awareness about the holistic effects of infrastructure projects. There exist methodologies that include externalities that the infrastructure projects create and, in such a manner, estimate the actual value of the project. Use of the ex-ante evaluation of maritime infrastructure projects could lead to better management of environmental, social and economic externalities, and thus improve the sustainability of the maritime industry.

This study provides a comparison of available valuation methods by answering two

FIGURE 1

The UN's 17 Sustainable Development Goals (SDGs) arranged into the three sustainability pillars.

questions: 1) What are the sustainable project valuation methods currently available; and 2) Which methods are the most suitable for evaluating externalities in maritime infrastructure projects?

The first question is answered by employing secondary research and contacting owners of methodologies for additional information that is not publicly available. The second question is answered through a comparison study conducted using the Analytic Hierarchy Process (AHP) framework, which was introduced by Thomas Saaty (1977) as a tool for Multi-Criteria Decision Making (MCDM). Furthermore, these results will be tested using a case study of the Hondsbossche and Pettemer (H&P) sea dyke, a maritime infrastructure project reinforced in 2015 at the Dutch seaside.

The three sustainability pillars

The **economic** pillar covers the effects on economic growth and the economic viability of the project. This study describes the financial perspective by indicators of taxes and wages paid, corruption effects, procurement spending and subsidies received.

The **social** pillar focuses on the well-being and conditions of all involved stakeholders of the specific project and their basic human needs (Brown et al., 1987). This pillar will be accounted for by effects on recreation facilities and ecotourism, heritage, aesthetics, existing infrastructure, health and safety, knowledge and education.

The most well-known pillar is the **environmental** pillar, which stresses the importance of well-functioning ecosystems and the diminishment of environmental pollutants. It stimulates the inclusion of externalities that appear from waste and pollution of the economic activities (Brown et al., 1987). In this study, this pillar will be based on effects on natural habitat, biodiversity, the level of flood protection, freshwater production, climate regulation, water quality, coastal stability and coastal processes, energy use, noise pollution and fisheries.

Understanding the fundamentals of valuation methodologies

Maritime infrastructure project valuation is a complex and time-consuming task. The complexity of valuing different projects' environmental and social impacts is the main reason why valuation is one of the most challenging tasks in the project's initial stages. Nevertheless, Lara-Pulido (2018) argues that such valuations would help compensate the benefit providers, internalise environmental losses, invest in ecological infrastructure and help to conserve natural capital. The difficulties at this level of valuation come from the estimation of environmental, economic, and social benefits that can be expressed in non-monetary values only (Carson et al., 2003; de Groot, 2006). The economics domain focuses on maximising social welfare and therefore has methods to internalise the externalities (Bithas, 2011). These methodologies will be discussed in this section.

Monetary valuation methods

There are various monetary valuation methods that are used to estimate monetary value of goods that do not have a monetary value attached. These methods form the foundation of valuation methodologies that are suited for inclusion of externalities. The methods can be separated into four categories:

- Direct market valuation, based on direct monetary exchange value;
- Indirect market valuation, used when there are no markets for the resources that are being evaluated in financial terms;
- Contingent valuation, uses survey methods that allow for creation of a missing market by determining the people's willingness to pay or accept in financial terms; and
- Group valuation, based on political theory and values resources from open public debates and referenda.

Carson (2003) argues that excluding externalities, such as environmental,

economic and social effects from decision-making processes would mean that public resources such as clean air could be harmed or used for personal benefit without incurring responsibility. This exclusion could be interpreted as attachment of zero value to the public resources. It is essential to recognise what monetary value the public attaches to resources to avoid the overuse of public goods (Flores, 2002). The paper by de Groot (2006) explains that undervaluation of benefits provided by natural and semi-natural landscapes appears from an inability to use conventional, market-based economic analysis. Such inability can lead to market failures that may result in irreversible damage to environmental resources.

Therefore, there are many valuation efforts in accounting for maritime infrastructure projects' environmental, economic and social impacts. The economic effect valuation is much more straightforward since most of the components in economic valuation are market goods and thus have a monetary value attached to them. Nonetheless, it is just as essential to have a profitable project to comply with the valuation social, environmental and economic pillars since non-profitable projects should not be pursued due to available superior alternatives.

Cost-benefit analysis

The next step of the holistic valuation is the cost-benefit analysis, a comprehensive valuation method that includes the estimated and existing monetary values in order to compare total benefits to total costs of economic activity. Therefore, at the cost-benefit analysis stage all externalities should be internalised and assigned monetary values. In the case of sustainable project valuation, cost benefit analysis usually focuses on summing up the costs and benefits of all sustainability pillars: social, environmental and economic. The provision of such valuation methods is advantageous in the initial stages of a maritime infrastructure project. The reasoning behind that is that maritime infrastructure projects are very capital-intensive projects and include a vast amount of regulation around them. Therefore, proper consideration of the best possible capital use and compliance with regulation would provide the most efficient resource allocation. Therefore, if projects do not align with society's preferences, there is a risk of the project not being accepted by local governments. Therefore, additional re-planning of the project is required to match the requirements presented by the governmental institutions.

Ecosystem Services (ES) is a commonly used approach incorporated in a cost-benefit analysis for project valuation. The ES approach provides a framework for estimating the project's total value. It divides the environmental and socio-economic externalities into four sub-groups or services that society receives from ecosystems: provisioning, regulating, cultural and supporting services. Provisioning services are defined as basic materials retrieved from natural resources and are used by people. Regulating services provide natural resource quality regulation, such as air and water, while cultural services create opportunities for recreation, education or other cultural benefits (Boerema et al., 2016). Finally, the supporting services focus on the primary creation of resources, such as soil formation or other ecosystem functions necessary to provide the first three ecosystem services (Boerema et al., 2016). The pricing and inclusion of services in the cost-benefit analysis are done using this structure. The valuation of ES is based on the Ecosystem Services Valuation Database (ESVD), which is the successor to the Economics of Ecosystems and Biodiversity (TEEB) that the Foundation for Sustainable Development (FSD) developed. Currently, ESVD holds 4,042 value records, with the majority of them being obtained in Europe and Asia (de Groot et al., 2020).

Current sustainable asset valuation methods

A review using a secondary research approach was undertaken to answer the first research question concerning finding currently available methodologies for sustainable project valuation. The criteria for the methods to be included in this study is that each method applies to the maritime infrastructure sector and can provide a comprehensive overview of direct impacts and all three categories of externalities: environmental, social and economic. Thus, a methodology is only sustainable valuation if it involves all three pillars of sustainability. The criteria was inspected using the public information available about the methods. If that was insufficient, the owner of the methodology was contacted to receive the accessible information. Once these requirements were met, contact was made with the methodology owner to verify the method's applicability to the maritime infrastructure industry. The methodologies that satisfied both of the requirements are described below.

Sustainable Asset Valuation (SAVi)

Sustainable Asset Valuation (SAVi) is a project assessment methodology that combines system dynamics and project finance modeling (IISD, 2021a). It is owned by The International Institute for Sustainable Development (IISD), which is a non-profit organisation that acts as an independent think tank that focuses on the creation of solutions to enhance stable climate, sustainable resources and fair economies (IISD, 2020). The impacts included in the SAVi database are environmental, social, economic consequences and direct costs, and climate risks. The three main features of the SAVi methodology are valuation, simulation and customisation (Schlageter, 2020). During the valuation process, all externalities and risks are converted into monetary terms.

Once that is achieved, the SAVi incorporates system dynamics and project finance modeling (Schlageter, 2020). It receives the data about previously mentioned impact estimates from peer-reviewed literature, case studies, international databases and project-specific values that may be available

Holistic infrastructure project valuations would help compensate the benefit providers, internalise environmental losses, invest in ecological infrastructure and help to conserve natural capital.

from social and environmental impact assessments. The methods used to obtain impact estimates when data is not available are contingent valuation and replacement cost. Additionally, IISD has cooperated with Copernicus Climate Change Service (C3S) to acquire additional data currently implemented in the SAVi valuation methodology (IISD, 2021b). C3S provides a database that focuses on climate and climate change impact. Currently, the database that is implemented in SAVi methodology consists of 1,354 externality valuations, 196 valuations of direct costs and 511 measures of climate risk (Schlageter, 2019).

Royal HaskoningDHV's Performance Standards

The description of this methodology is based on one of the Environmental and Social Impact Assessments conducted by the Royal HaskoningDHV. In addition, the impact evaluation method is based on the World Bank's 2012 Environmental and Social Performance Standards. The methodology of Royal HaskoningDHV implements the performance standards through the following steps in the process of the impact assessment:

1. Identification of project actions that may have an impact.
2. Identification of sensitive areas based on the findings in step 1.
3. Identification of potential impacts generated by each project activity.
4. Recognition of standard measures that are in place to mitigate negative impacts.
5. Application of scoring system to rank the impacts.
6. Determination of the type of each impact: direct or indirect to the affected parties.
7. Completion of impacts scoring matrix while acknowledging available standard measures for mitigation of adverse effects. Significant impacts should be subject to additional prevention actions.

KPMG's True Value

KPMG's project valuation method focuses on societal value creation and externality internalisation in the corporate value. It connects the net values of earnings, economic, social and environmental impacts to define 'true' earnings (KPMG, 2018). KPMG identifies four aspects that should be considered while applying this methodology: scope, materiality, baseline and data.

Scope refers to the range of assessment since the true value methodology can be applied both on a project and company basis. Materiality defines the feature that states that only relevant externalities should be included in the assessment. The baseline specifies the timeline for which the evaluation will be made. Lastly, data chosen to be implemented in the model should be of high quality and fit the given assessment. Data sources include Natural Capital Coalition for environmental externality pricing, Organisation for Economic Co-operation and Development (OECD), and Social Return on Investment (SROI) Network for social externality pricing (KPMG, 2014). Furthermore, KPMG bases the volume data on its internal sources such as greenhouse gas emissions, occupational health and safety data, and community investment.

KPMG's valuation method works in a three-step manner:

1. Assessment of earnings that also includes externality valuations.
2. Implementation of risk and possible future earnings.
3. Develop projects that create both corporate and societal value.

PwC's Total Impact Measurement and Management

PwC's Total Impact Measurement and Management (TIMM) methodology is another holistic project valuation methodology that differs from others. It includes fiscal impact separately from environmental, economic and social pillars – using the four pillars, each composed of five indicators.

The TIMM methodology follows five steps to create a holistic impact assessment (PwC, 2013a):

1. Definition of the scope.
2. Definition of the dimensions of value.
3. Collection of existing data.
4. Sourcing of new data.
5. Analysis of the data and valuation of impacts.

Thus, TIMM estimates the impacts that can arise directly from project activity, indirectly through the choice of vendors, or induced impacts from employment and procurement spending on the economy as a whole (PwC, 2021). Furthermore, it compares possible alterations to a suggested project to find the most sustainable and efficient option (PwC, 2013b). The comparison is made through the presentation of potential trade-offs between impacts under each pillar in monetary terms.

The valuation method should be the best in valuing the indicators that are perceived as containing the highest risk for a specific project.

True Price

The True Price is a methodology owned by a True Price Foundation and is developed to assess the externalities. It does so on a per-unit basis and attaches a monetary value to them (True Price Foundation, 2020). It is implemented using three steps:

1. Provision of transparency concerning the sustainability of a product or a service.
2. Creation of voluntary remediation markets.
3. Creation of incentives to market players to become more sustainable.

This methodology identifies five main stakeholder groups: businesses directly responsible for production, businesses and other suppliers, consumers, governments and investors. The directly involved businesses are responsible for identifying externalities and reducing and reporting them (True Price Foundation, 2019). Additionally, they should be involved in voluntary remediation practices to restore the damage of created externalities.

EcoMetrics LLC

EcoMetrics LLC, a methodology developed by Restore The Earth, employs social return on investment (SROI) methodology to predict social, economic and environmental returns from infrastructure projects. The SROI used in EcoMetrics LLC methodology is based on principles established by Social Value International and the International Integrated

Reporting Council's Framework, IFC Performance Standards on Environment and Social Sustainability, and Winrock International (Social Value International, 2021). These principles combine the involvement of stakeholders, understanding of intended and unintended externalities, and their valuation, transparency and independence. In addition, this methodology places a significant emphasis on stakeholder inclusion to identify the actual values.
The SROI analysis follows the process of six steps (Hemmerling et al., 2017):

1. Establishing the scope and identifying the major stakeholder groups.
2. Developing an impact map that describes the relationship between objectives, inputs, outputs, and environmental, social and economic outcomes.
3. Documenting relevant indicators and assignment of monetary values.
4. Establishing impact.
5. Calculating the SROI.
6. Reporting and recommendations.

Value Balancing Alliance

Value Balancing Alliance (VBA) distinguishes two main viewpoints on value – the stakeholders and the financial view. While stakeholders are likely to identify externalities arising from businesses' activities that affect them, the economic perspective exclusively focuses on its financial performance. The VBA methodology intends to connect both of these perspectives of value to obtain the entire value a business activity creates. The scope of the method can be described by the following dimensions (Value Balancing Alliance, 2021b:

- Economic: GDP contribution, economic contribution in terms of taxes and wages;
- Human and social: health, safety, education; and
- Environmental: GHG and other emissions, water consumption and pollution, land use and effects on biodiversity, waste.

Thus, each business activity evaluated using this methodology should include at least these indicators in the assessment.
To estimate these, the 'impact pathway' is used. Firstly, the identification of impact sources is performed based on input-, output- or outcome-based scales. While the input-, output-based model elicits impacts based on the effects created through the supply chain, the outcome-based model does so by finding the project's perceived value. Thus, the choice of the model is case specific. Secondly, comprehension of the effects of these impacts is assessed (Value Balancing Alliance, 2021b). The impacts are described at the country level to account for the common unequal distribution of externalities through regions (Value Balancing Alliance, 2021a). Lastly, the valuation of identified impacts in monetary terms is completed, focusing on society and people's well-being. Well-being is defined based on the Organisation for Economic Co-operation and Development (OECD) framework that aims to pay attention to objective and subjective well-being outcomes on households by considering the distribution of impacts instead of the average effect only (Shinwell and Shamir, 2018).

System of Environmental-Economic Accounting

The System of Environmental-Economic Accounting (SEEA) assesses the project's impact by incorporating the relationships between environmental and economic assets and the changes in the size of the stock of such types of assets (United Nations, 2017). The assessment is carried out by integrating social, economic and environmental data into the SEEA Central framework developed to include financial asset information in monetary values and environmental asset information in terms of physical values (United Nations, 2014). SEEA Central Framework is based on the principles and accounting concepts of The System of National Accounts (SNA) that has been historically used to measure economic activity and wealth. However, SNA did not involve the environmental impacts, so the SEEA framework was adapted to do so.
The information concerning the impacts includes both stocks and flows of the relevant indicators to fully account for the effects that may alter the future performance of given resources.

The framework divides assets into three areas (United Nations, 2014):

- Physical flows of resources between the economy and the environment;
- Stocks of environmental assets and their changes over time; and
- Economic activity that is interconnected with the environment.

The aforementioned methodologies were found to be suitable for maritime infrastructure valuation. However, each has its strengths and weaknesses, which is the reason for conducting a comparison study between them. However, not all have agreed to participate in the survey on which the comparison is based. Due to this reason, the study includes fewer methodologies than were found.

Comparison study

Since each maritime infrastructure project faces different location-specific externalities, the choice of an ex-ante project evaluation method should be based on the relative importance of each sustainability pillar (Laboyrie et al., 2018). In other words, the valuation method should be the best in valuing the indicators that are perceived as containing the highest risk for a specific project. The perceived high-risk externality categories are usually established using the historical knowledge for the particular project or location or by the inclusion of experts. The Multi-Criteria Decision Making (MCDM) approach was employed to compare the available assessment frameworks while considering social, economic and environmental criteria. The MCDM is an operations research sub-discipline widely used in decision-making analysis and is applied in various fields (Saaty, 1987).
It enables the decision-makers to choose the best alternative between different trade-offs when a decision should be based on multiple criteria of equal or disproportionate importance.

The methodology applied to compare different sustainable project valuation methods in maritime infrastructure projects is the Analytic Hierarchy Process (AHP), created by Thomas Saaty (1987). The AHP is one of the most widely used methods in Multi-Criteria Analysis (MCA) (Macharis et al., 2004). It is used in qualitative risk analysis and is positively evaluated as a tool for analysing expert opinions (Ramanathan, 2001). This method evaluates alternatives based on specific attributes that are usually decided on by the decision-maker. The attributes should represent all substantial concerns on which the decision should be based. Furthermore, there exist predetermined alternatives, which in this case are sustainable project valuation methodologies.

The main advantages of using this method are straightforwardness, apparent decomposition of the problem into criteria, the ability to evaluate both objective and subjective criteria, and uncertainty and risk. Ramanathan (2001) has identified that AHP is an intuitive measure for decision-makers and is applied to solve various problems, from practical issues to significant policy solutions. Macharis et al. (2004) explained that the hierarchical structure of the AHP allows one to define the criteria of the given problem clearly. Furthermore, AHP allows for converting all the criteria in the study to the same units (Garfi et al., 2011). All the qualities mentioned above show how the AHP framework can help take multidimensional decisions even if the dimensions could not be evaluated on the same scale. Due to this characteristic, typically unmeasurable risks and uncertainties can be compared using a ratio scale (Millet and Wedley, 2002). Therefore, this method contributes to finding solutions to problems that have uncertainty and risk involved (Millet and Wedley, 2002).

The AHP application begins with the creation of a hierarchical structure that is separated into levels: Level 1 represents the goal or target to be achieved, level 2 collects the main attributes on which the decision will be based as well as essential sub-criteria that are paired with corresponding attributes. Level 3 represents available alternatives by which the goal can be achieved. This structure can be seen in Figure 2. Most inclusive valuation of externalities here is defined as project valuation that can value the externalities most accurately. The externalities are project specific. Thus, the methodology that values those externalities most accurately can be called the most inclusive valuation methodology.

In this study, the goal of the decision-maker is defined as finding the most suitable sustainable project valuation methodology. Furthermore, the decision-maker in this thesis study is a dredging company or contractor searching for the most suitable sustainable valuation methodology to apply for an upcoming infrastructure project. The decision-maker requires that the choice of an alternative is based on all sustainability pillars: social, economic and environmental. By doing so, the decision-maker can be sure to observe the total net impact of the maritime infrastructure project. However, the sustainability pillars have broad definitions that combine all possible effects of different industries on society and nature. To narrow down the spectrum of the pillars to particular indicators of common effects in maritime infrastructure projects, the sub-criteria was constructed specifically to the corresponding pillar.

Results of the comparison study

This section presents the results of the comparison study using the AHP methodology. Each valuation methodology is evaluated separately to find the relative strengths and weaknesses of the method. To preserve the anonymity of the relevant methodology experts, their names have not been disclosed.

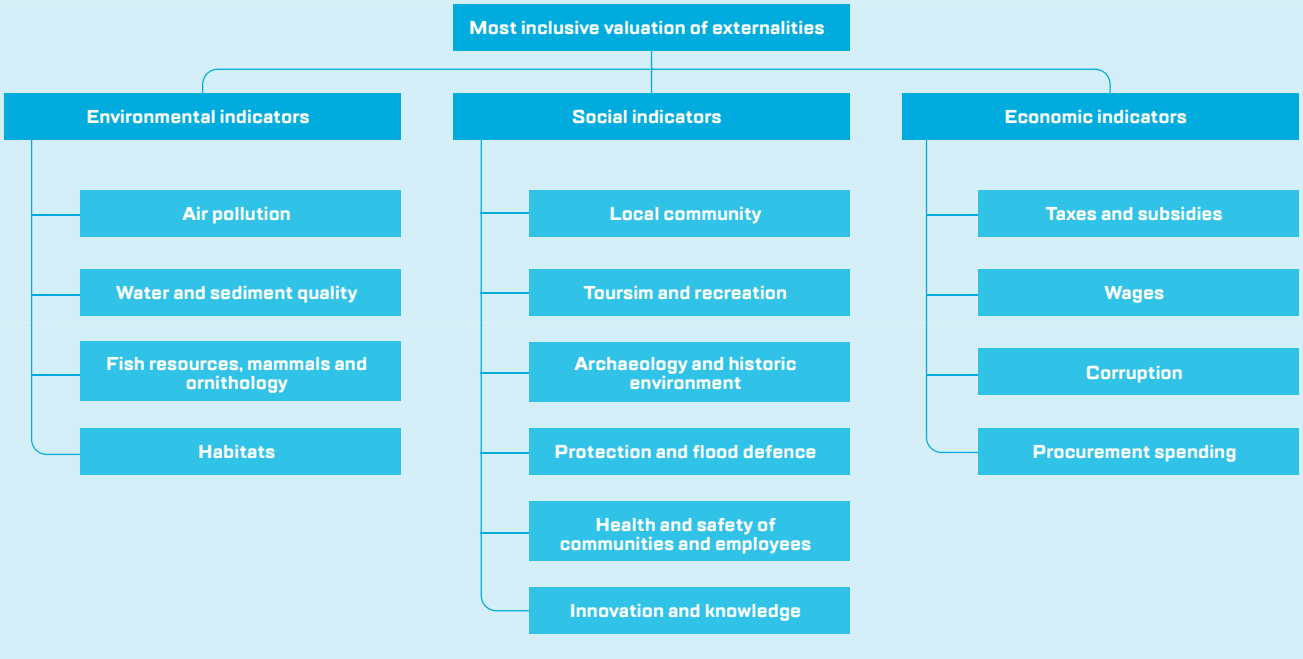

FIGURE 2

The AHP structure.

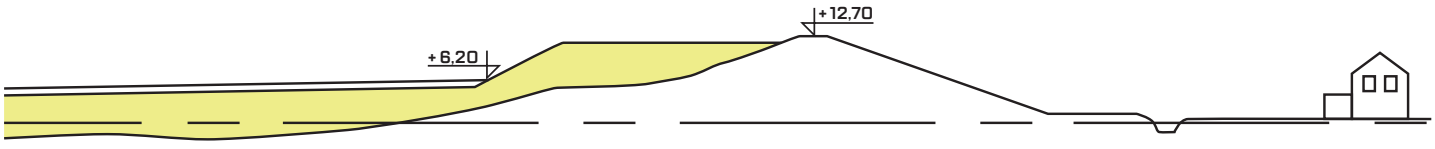

FIGURE 3

The Hondsbossche and Pettemer (H&P) sea dyke design.

The findings show that, as expected, methodologies have strengths in measuring some externalities over others. For environmental externalities, the majority of methodologies are relatively good at measuring the externalities related to air quality. This may be the case since governments widely apply regulations concerning air pollution. Water and sediment quality-related externalities are estimated more accurately by EcoMetrics LLC and SAVi methodologies. Fish resources, mammals and ornithology category is measured significantly better by SEEA impact assessment methodology than other methodologies. Lastly, effects on habitats are best valued by the methodology of EcoMetrics LLC.

Research indicates that social externalities in the local community is best measured by the SAVi methodology. As for tourism and recreation, the SEEA methodology is the most accurate. Concerning the archeology and historic environment, the Royal HaskoningDHV methodology is the most exact. The EcoMetrics LLC methodology is by far the most accurate method for the category of protection and flood defence. Two methods stand out in the category of effects on health and safety, being the SAVI method and the SEEA method. However, the SEEA method has a slightly higher eigenvalue. Lastly, for the effects on knowledge and innovation, the eigenvalues are relatively low for each of the methods, with the Royal HaskoningDHV method being the most accurate.

The EcoMetrics LLC method is the most suitable method for the categories of taxes and subsidies, and wages. As stated before, none of the included methodologies are particularly useful for the category of corruption, but the Royal HaskoningDHV methodology is slightly more effective than the other methodologies. For the category of procurement spending, the SAVI method is superior. Since the SEEA method is based on the Ecosystem Services framework, it does not include the assessment of economic externalities. Therefore, the expert has indicated that the SEEA method is equally accurate for all economic externalities.

Based on the results of this thesis, it is clear to see none of the methodologies are uniformly better than the others. This is made clear by the fact that each methodology has its specialties and shortcomings. Maritime project promoters can use the results of this thesis to examine which valuation methodology is best suited to be used for their projects since each project has specific externalities that are more likely to occur or that will have a larger impact than others. The application process of these results is explained more elaborately in the case study of the Hondsbossche and Pettemer sea dyke.

Case study: Hondsbossche and Pettemer sea dyke

The project of the Hondsbossche and Pettemer (H&P) sea dyke was used as a case study in this thesis to provide an example of the application of the AHP method in decision making concerning the choice of valuation methodology. In 2004, the Directorate-General of Public Works and Water Management in the Netherlands (Rijkwaterstaat) declared that the dunes and sea dykes of H&P are not in line with the flood protection standards of the Netherlands. Therefore, a EUR 250 million project was undertaken to improve flood safety and spatial quality. This project followed the Building with Nature (BwN) design to comply with the sustainability aspects. The specifics of the design allow for a seabed erosion-free solution that also provides a shallow foreshore for leisure and an artificial dune landscape that can develop into a natural habitat (Ecoshape, 2018).

Figure 3 represents the final design choice of the project. Besides the aforementioned advantages of this design, it also received broad support from stakeholders and did not involve high delay risks.

This project is a perfect fit for the case study since BwN projects tend to contain more objectives than traditional projects. For example, traditionally, it is common to focus on flood protection and cost efficiency only, while H&P sea dyke focuses on flood protection, nature development and improvement of spatial quality. Therefore, the project involved longer temporal and larger spatial scales than those of traditional maritime infrastructure projects (Ecoshape, 2021). To evaluate the created value through all three objectives, a holistic methodology is essential.

Using the same externality criteria as for the evaluation of methodologies, the case study can be matched to the methodology that estimates the largest externalities most accurately. The most important category for this case study is the protection and flood defence-related externalities. Based on the results of this study, the methodology of EcoMetrics LLC is the most accurate when evaluating such externalities. Besides the EcoMetrics LLC, SAVi and SEEA methodologies also indicated some ability to measure flood defence-related externalities accurately. Furthermore, for the H&P sea dyke project, it is important to value effects on knowledge and innovation since the

project is designed under the framework of nature-based solutions, which requires innovative infrastructure design to preserve nature in the project area. The Royal HaskoningDHV methodology is the most accurate in measuring externalities on knowledge and innovation. However, it is important to mention that all the methodologies lack accuracy in measuring such externalities. Lastly, the H&P sea dyke project involves elements that would increase the number of leisure facilities and thus may increase the local tourism in the surrounding area. To account for this effect, the methodology of SEEA is suggested since it is the most accurate in measuring the externalities related to tourism and recreation. It was also found that H&P sea dyke project does not have significant economic externalities.

To summarise, the choice between the available methodologies to evaluate the H&P sea dyke project, trade-offs will have to be made. The EcoMetrics LLC methodology would be the best fit in regards to environmental externalities. From the perspective of social externalities, multiple methodologies could be used, specifically the Royal HaskoningDHV, the EcoMetrics LLC and SEEA methodologies. However, flood protection and defence is one of the most important externality categories concerning the H&P sea dyke project and thus, the EcoMetrics LLC methodology is advised.

Conclusions

This study has undertaken two research questions: 1) What are the sustainable asset valuation methods currently available; and 2) Which methods are the most suitable for evaluating externalities in maritime infrastructure projects?

Concerning the research question about available project valuation methodologies, it can be concluded that there are a variety available. Furthermore, while the research found there are other methodologies, these were not applicable to the maritime infrastructure sector. Based on the methodologies that were found, it is noted that some approach project valuation from different perspectives. For example, while the SAVI methodology bases its valuations on its well-developed databases and system dynamics, and project finance models, methodologies like the Royal HaskoningDHV method use local experts familiar with the applicable project area, alongside their in-house knowledge and data. This makes their methodology very accurate in certain projects. The downside is that this methodology can be more costly and slower than other available methods. Furthermore, what most of the methodologies have in common is that they employ some public databases that have been created by international organisations, which may be skewed towards the more developed regions. Therefore, one could expect the currently available methodologies are less likely to estimate the projects accurately in the developing world.

The researched methodologies tend to use the guiding principles created by international organisations, such as the UN, World Bank and OECD. It is also commonly observed that the environmental pillar tends to receive the most amount of attention. Meanwhile, the social pillar is gaining an increasing amount of recognition. This could be partially due to the publicly available framework of ecosystem services, which focuses on the interconnection between the social and environmental pillars.

Concerning the research question about the comparison study, the findings of the AHP-based questionnaire show that the different methodologies excel in different types of projects. The methodologies are different in their advantages and disadvantages, and should therefore be applied depending on the type of project and the most impactful externalities connected to them. The categories of maritime infrastructure projects that were discussed in this study are basic recreational infrastructure, coastal and foreshore defence infrastructure, offshore energy installations and fisheries infrastructure. In the case of the basic recreational infrastructure projects, the most impactful externality concerns tourism and recreation. These externalities tend to be accounted for most accurately by the SEEA methodology. Based on the study results, coastal and foreshore defence infrastructure projects, like the case study of the H&P sea dyke, are most accurately valued by the EcoMetrics LLC methodology since this methodology is best suited to include externalities in the flood defence category. Offshore energy installations, such as gas, oil extraction and wind farms tend to have more major impacts on the environmental pillar. To be more specific, effects on fish resources, mammals and ornithology and their habitats are some of the most impactful externality categories to be measured in offshore energy installations, which, based on the experts' opinions, are valued more precisely by the SEEA methodology. These examples show that the comparison between SAVi, Royal HaskoningDHV, EcoMetrics LLC and SEEA methodologies demonstrates that there exist various sustainable asset valuation methodologies that can be applied in maritime infrastructure project valuation. They possess various trade-offs that will require the project owner to assess the largest expected externalities to choose the most appropriate methodology.

Besides the most impactful externalities, other factors should be taken into account before settling on a methodology. The quality of data is of high importance since it will determine the quality and accuracy of the valuation. The price and time of evaluation completion are also important to consider. Therefore, further research on this topic should focus on including these variables in comparison between the methodologies to improve the accuracy of results and present a more comprehensive comparison of these methods.

Lastly, the comparison study revealed the advantages and disadvantages of the usage of the AHP framework. The main advantage is the ability to extract information about non-public valuation methodologies using subjective expert opinions. The comparative questions were an asset in eliciting truthful expert's responses since they created challenges for dishonest answers by following the transitivity assumption. On the other hand, it has been shown that in some cases the Saaty scale is not suitable for comparison of the ability to value the indicators, as was the case for environmental externality indicators for EcoMetrics LLC.

Summary

This article investigates the available sustainable asset valuation methods and compares them based on economic, social and environmental criteria. A review using a secondary research approach is taken to find currently available methodologies for sustainable project valuation. Eight methodologies were found to be suitable for maritime infrastructure project valuation. Using the Analytic Hierarchy Process (AHP) method, four valuation methodologies have been compared. The results of the study show that if a project has more than one significant externality, trade-offs exist between the accuracy of their valuation. The Hondsbossche and Pettemer (H&P) sea dyke project was used as a case study to represent a possible application of the comparison study. The findings show that for the valuation of terminal reclamation projects like Hondsbossche and Pettemer sea dyke, the EcoMetrics LLC is the most appropriate methodology. Different maritime infrastructure projects are recommended to use various methods depending on the most impactful externalities they possess.

Viktorija Karaliūtė holds a Master's degree in Economics with specialisation in sustainable development from Tilburg University in the Netherlands. In 2021, as a sustainability intern with IADC, she wrote a report on the inclusion of externalities in dredging project assessments, on which this article is based. She has also worked as a policy research officer at the European Student Think Tank investigating the effects of the COVID-19 pandemic on youth unemployment. Viktorija is currently a consultant for Mount Consulting, with a focus on sustainability reporting in the financial services industry.

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JAN DE NUL CREW INVENTS INNOVATIVE BOLLARD STEP

During marine transfers, it is essential to achieve a maximum level of control. With the bollard step, Jan De Nul has designed a simple solution to enhance safety during transfers of crew and visitors. This innovative idea came from the crew of the multicat DN46 and was picked up during an Operational Control meeting, where an advisory board discusses suggestions that improve the safety and efficiency of the company's operations. 'We stimulate all possible innovative ideas within our company', says Quinten Schaumont, Area QHSSE advisor. 'At all levels, at all times.'

Designed by crew members, the bollard step transforms mooring equipment into a safe and secure step on which to make marine transfers.

Jan De Nul's bollard step has created a solution that is both easy and quick to use, as well as being low on maintenance. Designed by crew members, the bollard step transforms mooring equipment into a safe and secure step on which to make marine transfers. The main materials used are steel and anti-skid grating. The latter creates a safe surface from which one can make a safe transfer either between two vessels or from a vessel to the shore. The fact that the bollard step is quick and easy to use is reflected in the way it is mounted: two persons can effortlessly carry the two parts of the step and put it in place without the need for extra securing measures.

Operational advantage

A major plus of the bollard step not being a fixed structure is the operational advantage it provides. When in use, the deck space is not restricted as the step can be dismounted at any time (e.g. when cargo needs to be lifted on deck), nor does it interfere with mooring operations. If mooring operations would be hindered, the bollard step can simply be removed or placed on an alternative bollard.

The design is adjustable to different sizes of bollards and could be extended with a longer surface to step on or made adjustable in length, in the case the width between two vessels is larger than usual. A simple and clever solution, the bollard step creates a safe and steady platform where there could never be a safe step-over zone. Thanks to a straightforward design, local workshops can easily manufacture the bollard step to match the specifications of locally hired vessels. The costs of the prototype were considerably low at around EUR 850 making it a cost effective solution.

There are several step designs that can be used on a variety of vessels. The innovation will also increase safety of crew transfers on small Crew Transfer Vessels (CTVs) where designated means of transfer such as built-in steps are temporarily out of use. Future enhancements of the design could include an adjustable platform at the end to cope with different project locations. One benefit is that CTVs that otherwise might not be suitable during a project could therefore be used thanks to the bollard step. Depending on the cost of the CTV, this could result in considerable savings.

Design and engineering

Normally, the Marine Design and Engineering Department of Jan De Nul first designs the equipment, after which it is manufactured. 'For the bollard step it was somewhat different', explains Wouter Tollet, coordinator of the Marine Design and Engineering Department. 'The crew members first created it for the use on their vessel. We then took over that design and improved it for fabrication so it can be used on all workboats and possibly other crafts as well.'

The Marine Design and Engineering department provides engineering assistance resulting in successful, efficient and safe execution of projects. 'Our designers are responsible for the design of equipment and components for vessels and offshore structures in 2D and 3D', says Wouter. 'From the initial concept design to detailed drawings and related part lists, we provide a complete package for logistics, maintenance and production. In a second phase, our

IADC Safety Awards 2021

The International Association of Dredging Companies' Safety Committee and Board of Directors received 15 submissions for the 2021 Safety Awards. Since this year, two awards have been granted: one to a dredging contractor (also non-IADC members) and one to a supply chain organisation active in the dredging industry.

The committee selected Jan De Nul's innovative bollard step as recipient of the Safety Award for dredging contractors. During IADC's Annual General Meeting held digitally on 16 September 2021, Secretary General Rene Kolman announced the winners and later presented the award to Heleen Schellinck, PR and Communications, who accepted it on behalf of Jan De Nul Group.

structural and marine engineers check the design against their calculations, ensuring safety and efficiency.'

Besides that, the designers and engineers also support the new building department: getting the preliminary design for new build vessels on paper, implementing design modifications and improvements, and keeping the design data up to date. 'We always consult our internal departments to determine the design constraints', Wouter concludes. 'Helping out with the bollard step fitted perfectly within our scope.'

Operational control meetings

'Operational control and the drive for improvement are embedded at all levels within Jan De Nul', explains Quinten Schaumont, Area QHSSE advisor. 'It is founded on our Imagine, Think, Act (ITA) philosophy. To achieve maximum operational control, the QHSSE department has defined seven critical risks, one of which is marine transfer. The bollard step is the result of this way of working.'

The ingenious idea of the bollard step is now ready to be rolled out to various departments within Jan De Nul. 'It's the result of years of hard work to implement a platform where such ideas reach us more easily', explains Christophe Leroy, Head of QHSSE Department. 'As such, the bollard step found its way to our Operational Control meeting, an advisory board to discuss suggestions that improve the safety and efficiency our operations. These monthly meetings are set up as a synergy between the technical, operational and QHSSE departments, with the cooperation of other departments if necessary. Together, we discuss inspections, incidents and propositions of employees and other stakeholders. The goal is to define and identify lessons learned, but also to work out promising initiatives for the benefit of the entire company. Since the start of these meetings in 2015, we have been able to transform a number of ideas of our employees into initiatives that are supported throughout the entire company.'

Code Zero programme

The Operational Control meetings are firmly anchored within the organisational structure of Jan De Nul Group. More so, they have supported the birth of the company-wide Code Zero programme. 'In 2015, we launched our Imagine, Think, Act (ITA) campaign in which we focus on operational control', says Christophe. 'Now that ITA is well integrated, we have taken the next step with Code Zero. This sustainability programme defines clear ambitions that go way beyond safety: Zero breaches, Zero waste, Zero accidents and Zero emissions.'

The focus of Code Zero is not so much on the individual goal but rather on the common road towards them. An important role is laid out for the employees of Jan De Nul. 'Colleagues who do their jobs well and continuously want to improve themselves, automatically contribute to these ambitions', explains Christophe. 'The bollard step is a beautiful example of this approach. And this is just one of the ideas that came forward. In total, we submitted six initiatives for the IADC Safety Award. We are glad that the bollard step gets the credit it deserves.'

FIGURE 1

The Marine Design and Engineering Department took the crew's initial design of the bollard step and improved it for fabrication.

KEPPEL OFFSHORE & MARINE'S

SAFETY PLUS PROGRAMME

IADC's Safety Committee and Board of Directors awarded the very first Safety Award to a supply chain organisation active in the dredging industry to Keppel FELS. The company was praised by the committee for the results of its safety programme and commitment to safety onsite. Anchored in Keppel Offshore & Marine's Safety Plus Programme and Singapore's National WSH Vision 2028, Keppel FELS continues to consistently improve and enhance its existing Health, Safety and Environment (HSE) management systems.

People are our most important resource, and we invest in their training and empower them to stop any unsafe acts in the workplace.

Safety, People-Focus, Agility, Accountability and Can-Do are the core values at Keppel FELS. Safety is a condition of work to achieve an incident free work environment and the company is committed to ensuring everyone returns home safe at the end of each workday. With a robust HSE management system in place, the company invests in building HSE competency and capabilities through training, outreach activities and empowering every individual in its workforce to intervene and stop any unsafe acts.

Within the Safety Plus Programme and our National WSH Vision 2028, we put our stakeholders at the centre of all our initiatives. Our customers are invited to participate in our HSE Steering Committees and we continue to share with them the lessons learnt beyond delivery of projects in our shipyards. In embracing agility and accountability, we place emphasis on the quality of our work and production innovation as key success factors to deliver our solutions safely and responsibly. We embrace a strong 'Right mindset, right processes and right tools' approach to complete our work right the first time, therefore reducing rework, reducing risk exposure to our workforce and more importantly, enhancing our product offering to our customers. We believe in investing in our design, engineering, planning and construction processes by adopting digitalisation and smart asset technology to further value-add to our products and in serving our customers.

Continuous improvement

With a robust HSE management system certified to OHSAS 18001:2007 and ISO 14001:2015 certifications, Keppel FELS continue to improve and enhance HSE excellence consistently. The shipyard adopts a set of 10 lifesaving rules and observes zero tolerance in the violation of these lifesaving rules. In addition, lessons learnt from past projects have also led to a set of high impact risk activities (HIRA) being identified in the shipyard where additional risk assessments are performed prior execution of work.

FIGURE 1

Tan Leong Peng, Managing Director, receives the IADC Safety Award 2021 on behalf of Keppel FELS..

As part of continuous improvement, regular cold eye reviews by third party stakeholders and workforce pulse surveys are undertaken to ensure that feedback and site conditions are addressed holistically. To achieve a positive safety culture and a 'no blame' culture within a diverse workforce, we invest in building the HSE competency and capabilities through safety training, raising awareness via various outreach activities and empowering every individual in our workforce to intervene and stop any unsafe acts, practices or workplace conditions without hesitation. Feedback is reviewed and followed up by the respective managers responsible and shared with our customers. Our customers are also invited to review our programmes and contribute their experiences to further enhance our implementation.

Stakeholder engagement

At Keppel FELS, we have a collaborative team that fosters strong partnership with internal stakeholders. Frequent engagements are

organised with all parties and safety aspects from the planning stage to the execution process are objectively deliberated to achieve the main objective of an incident-free project.

Various site walkabouts are scheduled throughout the year, involving all levels of the workforce from senior management, management, site-specific lead and subcontractors' representatives. The main objective of the walkabouts is the engagement of the workforce on the ground, understanding their needs and motivating them while ensuring everyone is working safely in a safe working environment. Follow-up actions are planned and reviewed conscientiously in the management committee review meeting.

HSE observation programme

We strongly encourage and facilitate the workforce on the ground to report any unsafe practices anonymously, thus eliminating the perception of fear of having any repercussion. This augments our belief in empowering everyone to stop work and has provided the workforce on the ground with a sense of security to intervene in any unsafe situation.

To simplify the reporting of HSE observations, we introduced Performance Observation Walkthrough & Engagement Reporting (P.O.W.E.R) that allows anyone to report positive observations and hazards through a mobile device platform. The platform captures the types of observations for analysis and subsequent review of the safe conduct of the specific activities. High-risk observations are prioritised and reviewed closely to ensure follow-up action plans are formulated.

Technology and digitalisation

Technology and innovation are ingrained in the culture of Keppel FELS. It is essential in building a strong safety culture and enhancing safety standards of work processes. Leveraging modern technology, Keppel FELS' technology and digitalisation arm has driven the transformation of shipyard operations. These new implementations are further reviewed in the management of change of process and evaluated on a periodic basis. Hence, the lesson learnt captured in the change management or evaluation process are incorporated in our operating procedure systematically.

FIGURE 2

Our commitment to uphold a strong safety culture extends to our entire workforce, including employees and subcontractors.

For example, while working with Jan De Nul and Van Oord, Keppel FELS' iDiver was deployed to check the underwater conditions of the dredgers following undocking, replacing physical divers for underwater inspection. After undocking, it is imperative that the yard luffing cranes are able to operate to bring construction materials like spools, hull outfitting and equipment on board the dredger for installation. We then engaged Smart Robot to ensure the smooth operation of the cranes by remotely checking the condition of the quayside crane bus bar. This ensures work is carried out in a safe manner without exposing the yard facility personnel to confined space hazards.

Safety is always part of our shipyard culture and daily practice. In receiving this award, we are able to showcase how we strengthen our safety ownership, enhance focus on workplace health, safety and environment while embracing technology into our safety practices. Our continuous improvement and efforts drive a safe work environment for our workforce to deliver quality products.

Quality in products and processes

We work closely with world-class dredging contractors, such as Jan De Nul and Van Oord, exchanging lesson learnt and implementing safety solutions for our customers. We attained Zero Loss Time Incident man-hours throughout the Sanderus project delivery with Jan De Nul. Our use of machinery and automation allowed us to reduce our workforce man-hours by up to 30%, reducing our risk exposures and eliminating safety risk hazards.

Our quality records are testament to our emphasis on superior HSE products. Through our weekly safety progress reports, vessel safety plans, drawings to construction, maintenance and material handling, we engage our customers, vendors and contractors regularly to incorporate feedback. This not only ensures quality of the worksite for the benefit of the workforce but also product quality for the end user.

'Safety is a core value at Keppel Offshore & Marine and we have a strong safety culture in place to ensure strict HSE standards are met', explains Tan Leong Peng, Managing Director, Keppel FELS. Over the years, our clients, subcontractors and partners have graciously contributed generously to this programme to innovate and promote this HSE culture. While there is no silver bullet in enhancing HSE culture, neither should we put a value to the returns. Most importantly, our responsibility is to care for our workforce, making safety our core value and condition of work. In turn, we provide our HSE superior products to our customers, ensuring their confidence to use our products safely.

THE IMPACT AND COSTS OF BUILDING WITH NATURE PROJECTS

The use of nature and natural processes is an innovative way to increase water safety and create added value through nature development and recreation. This exploratory study provides an initial inventory of the impact and costs of existing Building with Nature projects in the Netherlands. It also includes an analysis of the decision-making process in choosing this type of project and identifies success factors. Building with Nature projects deliver added value but often also involve additional costs compared to traditional reinforcements. These costs give an indication of what we as a society are prepared to pay for the development of nature and recreation as part of hydraulic engineering projects.

A key tenet of Building with Nature projects is the combination of objectives for flood protection, nature development and spatial quality.

This study surveyed the characteristics of 11 Building with Nature projects (see Table 1). The projects are examples of natural solutions for the reinforcement of primary flood defences, coastal management and river management but also specifically for nature development. This inventory discusses the impact on flood protection, nature development and recreation. It also contains a reflection on the costs of Building with Nature projects and identifies critical aspects in the decision-making process for selecting this type of project. As part of this study, a literature review was conducted and interviews were held with those involved in several projects, such as the Houtribdijk, the Hondsbossche Dunes, the Marker Wadden, the Hertogin Hedwigepolder, the Prins Hendrikzanddijk, the Sand Motor and the Room for the River programme.

Impact of Building with Nature

The inventory shows that natural solutions create added value for the various stakeholders in different ways. A key tenet of Building with Nature projects is the combination of objectives for flood protection, nature development and spatial quality. Building with Nature measures are often a response to flood protection issues; flood defences that no longer meet safety standards are strengthened using natural materials and processes.

The Sand Motor is a prime example of how a Building with Nature project can be used for dynamic coastal management. Instead of replenishing smaller quantities of sand periodically, a huge volume of sand is deposited in one go. This protects the coast over a longer period. The benefits of dynamic coastal management are also evident in the Hondsbossche Dunes project. The sand deposits in this area are sufficient to keep pace with a rising sea level and subsidence.

Building with Nature projects stimulate nature development. Over the past 25 years, 12,000 hectares of additional nature have been created by widening rivers as part of flood protection projects. Building with Nature facilitates the preservation and strengthening of habitats. Thanks to the Marker Wadden project, the Natura 2000 targets for various bird species will be achieved by an ample margin (De Rijk et al., 2018). Active management is required to achieve all nature objectives; one example of this is limiting the amount of woodland in order to create pioneering biotopes.

Nature development and recreation often go hand-in-hand in Building with Nature projects but in some instances, this involves making choices about day-to-day management and determining which function takes priority. In the case of the Houtribdijk and the Hertogin Hedwigepolder, opening the nature area to the

TABLE 1

Characteristics of Building with Nature projects.

Project	Year	Implementation/ design type	Approx. construction costs [in EUR millions]	Approx. additional costs [in EUR millions]	Approx. surface area of above-water nature [ha]	Nature type (SB; Sandbanks, D; Dunes, SM; Salt march; RB; Reed banks, L; Lagoon, M; Marshland)	Approx. costs per ha [in EUR thousands]	Ca. costs per km dyke [in EUR millions]	Recreational pressure	Source
Zandmotor	2011	Peninsula, foreshore nourishment	50	20[1]	100	SB, D, L	200	–	High	Finselier (2010)
Houtribdijk	2012	Hard and soft reinforcement, foreshore nourishment	90	0	530	SB, RB, L	0	3.6	Low	NH nieuws (2020)
Prins Hendrikzanddijk	2018	Along existing dyke, dune, salt march	55	12[2]	100	SB, D, SM	120	18.3	Medium	Hoogheemraadschap Hollands Noorderkwartier and Witteveen Bos (2016)
Hondsbossche Duinen	2015	Along existing dyke, dune	210	30	100	D, L	300	26.3	Medium	Warringa (2010)
Veur-Lent	2015	Side channel, island	338	183	–	–	–	–	High	Egbregt et al. (2005)
Noordwaard	2014	Depoldering	365	71	4500	SB, M	1,6	–	Low	Egbregt et al. (2005)
Kierbesluit Haringvliet	2018	Restoration of saline ecosystems	75	–	1500[3]	–	503	–	Low	Hees and Peters (1998)
Kop van Schouwen	2010	Dune restoration	5	–	800[4]	D	64	–	Medium	Province of Zeeland (2017)
Marker Wadden	2021	Construction of islands, channel system	90	–	500	SB, RB, L	180	–	High	IJff et al. (2018)
Eiland Griend	2016	Nature restoration, foreshore nourishment	2	–	16	SB, SM	125	–	Low	Govers et al. (2020)
Hertogin Hedwigepolder	2023	Depoldering, channel system, panorama hill	50	–	300	D, SM, L	166	–	Low	Scheltjens et al. (2013)

[1] Additional costs are equal to the costs of research and monitoring. [2] Additional costs are equal to the grant provided by the Wadden Fund.
[3] Number is equal to the number of hectares of underwater nature. [4] Concerns dune restoration, is not included in the cost analysis.

public is not desirable. However, opportunities for recreational use have been created at the periphery of the Hertogin Hedwigepolder, including the dyke and the neighbouring Drowned Land of Saeftinghe.

Building with Nature projects are often implemented with a time horizon of 50–100 years. Ecosystems need time to develop, which for some habitat types can be several decades. It is precisely for this reason that Building with Nature measures are often combined with long-term research and monitoring programmes. For example, the 40-metre-high Argus mast on the Sand Motor is equipped with cameras to closely monitor developments and at the Houtribdijk, a research and monitoring programme will run until the end of 2022 to examine, among other things, whether replenishment will be required after 10 years. Besides contributing to the development of knowledge, these research programmes make it possible to intervene when things do not develop as expected.

Varying costs of Building with Nature

Unlike Building with Nature projects, traditional reinforcements for flood protection are often monofunctional, primarily aimed at improving flood protection. However, traditional dyke reinforcement projects are often less expensive than Building with Nature projects. In the cost analysis, a distinction is made between nature development projects primarily intended for nature development and flood protection projects primarily intended to increase flood protection.

For the preliminary investigation of the costs of Building with Nature projects, two broad indicators were derived: the costs per hectare of developed nature and the costs of dyke

reinforcement per kilometre (for reinforcement projects only). These broad indicators are not intended for drawing conclusions about individual projects but are used to present a range of costs for flood protection and nature development projects.

In Building with Nature projects, the contractor is usually responsible for the construction, as well as several years of maintenance. This is included in the inventory as construction costs (see Table 1). For flood protection projects, an estimate is given of the additional costs compared to traditional reinforcement projects. In many cases, the additional costs are derived from Environmental Impact Assessments (EIA) and are the difference between the preferred alternative (Building with Nature) and the reference alternative (traditional). The number of hectares of nature is the surface area of above-water nature; nature areas that are permanently under water are not included. Given the integrated nature of hydraulic engineering projects and Building with Nature projects in particular, it is difficult to derive additional costs.

For nature development projects, the costs amount to an average of EUR 130,000 per hectare realised and vary between EUR 50,000 for nature restoration and EUR 180,000 for the development of the Marker Wadden per hectare of newly established nature. For flood protection projects, the additional costs per hectare amount to an average of EUR 120,000 and vary between EUR 1,600 per hectare for the depoldering of the Noordwaard polder and EUR 300,000 for the reinforcement of the Hondsbossche and Pettemer sea defences using sand.

There is also a considerable difference when it comes to the costs per kilometre of dyke reinforcement; the costs for the Houtribdijk amounted to EUR 3.6 million per kilometre, whereas the costs for the Prins Hendrikzanddijk and Hondsbossche Dunes amounted to EUR 18.3 million and EUR 26.3 million respectively. The inventory revealed several reasons why the costs of Building for Nature projects differ greatly from one another and are often higher than those for monofunctional projects aimed at improving flood protection. A few of these reasons are discussed in more detail below.

Each project is unique and has its own specific list of reasons as to why costs vary. However, certain factors are common to several projects. Natural solutions often require large quantities of sand. The low price per cubic metre and low transportation costs make reinforcement using sand an attractive option.

In the case of the Sand Motor project, transportation costs were limited because the equipment used for the construction of Maasvlakte 2 (the expansion project of the port of Rotterdam located west of the Maasvlakte) could also be used for depositing 20 million m^3 of sand. In the case of the Houtribdijk, one half of the dyke was reinforced with sand, the other with rock revetment. The limited depth of the stretch between Trintelhaven and Enkhuizen meant that the costs of a sand-based reinforcement were lower than those of a hard reinforcement. During the planning phase for the Houtribdijk, it transpired that the realisation of part of the Trintelzand nature area would be cost-neutral since the sludge released during sand extraction could be used to create the nature area.

For the Marker Wadden project (a cluster of five new, uninhabited natural islands, artificially created), the costs for sand were kept low by combining the construction of the islands with digging a system of channels for nature. A similar approach is being used for the development of a panoramic hill at the Hertogin Hedwigepolder, which will contribute to the recreational use of the area and will be constructed using the soil released during the digging of the channel system. The demarcation of the project area is key here; if sand can be extracted within the

FIGURE 1

Reinforcement of the Hondsbossche dunes using sand.

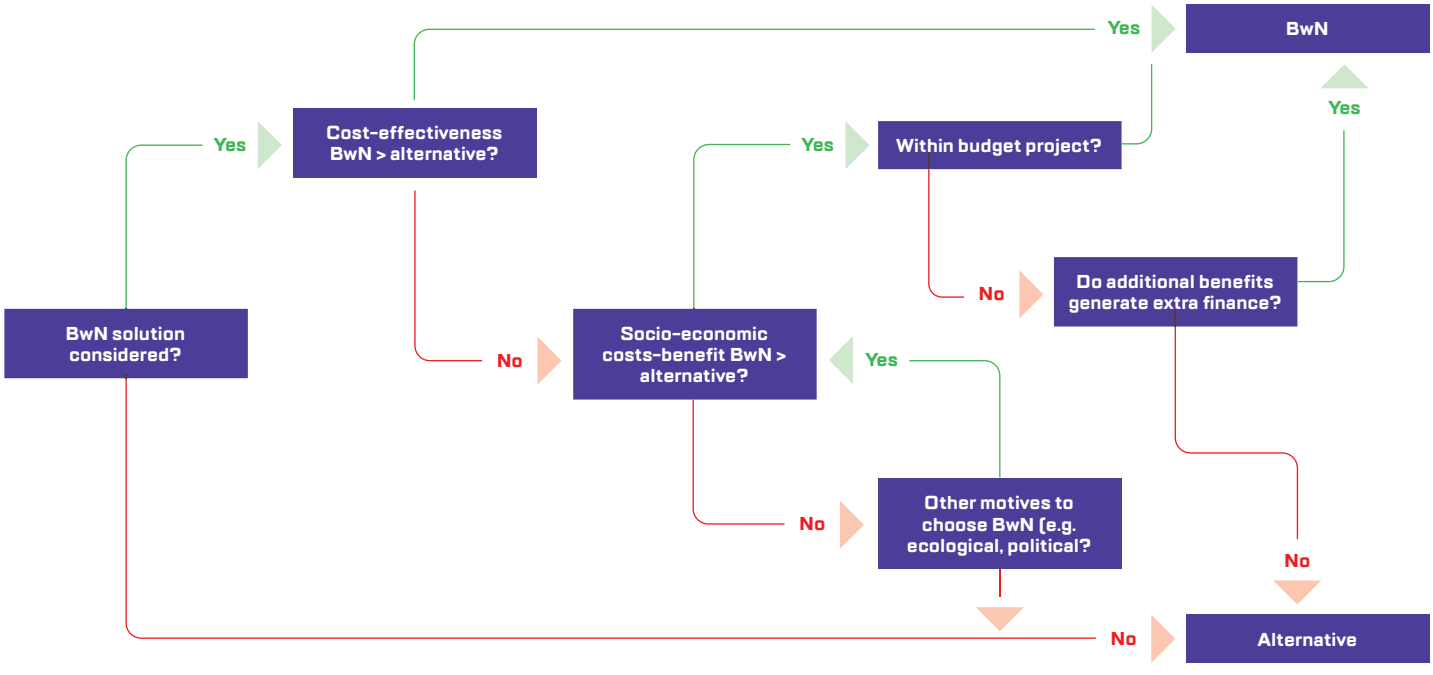

FIGURE 2

The decision-making process involved when choosing Building with Nature projects.

project area, this is not only cheaper but is also easier to use the resources released during one project to work on another.

In addition, depending on the location, costs are also incurred for changes in land use. For example, approximately half of the costs for the development of the Hertogin Hedwigepolder relate to real estate such as the purchase of agricultural land and considerable costs have been incurred to create a new primary defence around the area.

Building with Nature solutions are inherently more dynamic. They require a broader approach to planning and design that prioritises the functioning of the natural system. When natural processes are used, it is more difficult to accurately forecast how the implementation of the project will progress. For example, sand drifts occurred at the Houtribdijk, which meant the dyke had to be closed to road traffic on a number of occasions. Of the EUR 11.8 million risk reserve, which corresponds to about 15% of the value of the contract, EUR 3.4 million was spent on tackling the sand drifts.

The expectation is that costs will decrease as more experience is gained in implementing natural solutions. At the same time however, an adaptive approach to implementation, management and monitoring will continue to be necessary due to the dynamic nature of such projects. Additionally, the differences in costs are difficult to interpret, primarily because it is hard to determine how the costs for various parts of these Building with Nature projects are distributed. On the one hand, this is a result of the integrated nature of such projects, which makes it impossible to connect a specific part of the costs to a function, and on the other, it is due to the absence of an accurate inventory of the costs for different projects. For example, information on how much of the contract value was spent on construction and how much on maintenance is not always available, which makes it difficult to fine-tune the above-mentioned indicators and to gain new insights. Therefore, one recommendation is to create a database to record the breakdown of costs for existing and future Building with Nature projects.

Key factors in decision-making and planning

For the projects under review, interviews were also conducted with project owners to investigate the decision-making process. How did they actually end up choosing a Building with Nature solution? There are several similarities between the motives for selecting natural solutions and the planning and implementation phases.

The decision to implement a natural solution for dyke reinforcement is often taken early on in the planning phase. It is often made by a small group of people from different organisational units who endorse a Building with Nature solution and its advantages. A crucial factor here is the early conclusion of an ambition agreement that combines objectives for flood protection, nature and recreation. This is exemplified by the Houtribdijk project, where an early decision was taken to reinforce half of the defence with rock revetment and the other half with sand. The ambition agreement for the Sand Motor, in which shared goals are laid down, also

formed the basis for selecting a Building with Nature project. The interviewees mentioned the following key reasons for favouring Building with Nature projects.

Building with Nature measures utilise space in a different way than traditional reinforcements, which often require space inside the dykes. This can make natural solutions a more attractive option for increasing flood protection. Reinforcing the Prins Hendrikdijk using traditional methods would be at the expense of agricultural land, buildings and nature areas located within the dyke. Consequently, the local community had a strong preference for a reinforcement outside the dyke that combines flood protection with nature development. Similar arguments were also put forward in the Hondsbossche Dunes project; here, a Building with Nature solution makes it possible to increase flood protection whilst using as little space as possible in the area protected by the dyke.

Co-financing by nature organisations can be a decisive factor in selecting natural solutions. With additional funding, it is possible to broaden the scope of the project rather than opt for a monofunctional solution. The sand-based solution for the Prins Hendrikzanddijk was awarded a EUR 12 million grant from the Wadden Fund. Without this contribution, and the additional funding from other parties, it would have been impossible to implement a natural solution. The depositing of 5 million m^3 of sand has created a varied sandy area with dynamic character in front of the sea dyke. This project also includes the creation of a new 200-hectare estuarine nature area and a breeding island. The initiative for the realisation of the Marker Wadden came from the Dutch Society for Nature Conservation (Natuurmonumenten). Thanks in part to a contribution of EUR 15 million from the Dutch Postcode Lottery, they were able to undertake the planning and part of the construction of the project.

Additionally, knowledge development is a powerful incentive for implementing Building with Nature projects. Long-term knowledge programmes such as NatureCoast at the Sand Motor and the Marker Wadden Knowledge and Innovation Programme (KIMA) also attract additional funding from organisations such as the Dutch Research Council (NWO). EcoShape, a foundation under Dutch law that facilitates the Building with Nature network, develops and shares knowledge on pilot projects in which Building with Nature is applied. More parties are involved in the planning and implementation of natural solutions than in traditional dyke reinforcement projects, such as government bodies, research institutes, the business community, social organisations, nature organisations and knowledge partners.

Since these projects have multiple objectives, it can often be beneficial to put them out to tender in a different way. Collaborating with the market at an early stage opens up opportunities for creating added value from the outset. This way, the contractor also has more freedom when it comes to shaping the project. For the reinforcement of the Hondsbossche and Pettemer sea defences, this led to the construction of a lagoon that had not been included in the original plan. For the Marker Wadden project, a conscious decision was made not to use a detailed design in the tender but to focus on building using natural processes as much as possible.

However, innovative tendering is not always possible. In the case of the Hertogin Hedwigepolder, an agreement was reached with the Flemish Region setting a lower limit of 600 hectares of estuarine nature. In the Netherlands, tender specifications are usually based on functional requirements; however, Belgian clients often prefer to work with a strict framework of what has to be delivered. This once again underlines the fact that not all positive findings from this exploratory study are directly applicable to other projects. They do however, provide useful pointers for future initiatives.

Conclusions

Building with Nature projects are generally effective in combining flood protection, nature development and recreation. The projects reviewed in this study are regarded as success stories that will inspire future initiatives. Besides the impact on flood protection, nature development and recreation, there are several other factors that also increase the appeal of Building with Nature projects, such as not taking up space in the area protected by the dykes.

The costs of natural solutions are typically higher than for projects solely aimed at reinforcing flood defences. The additional costs of Building with Nature projects as part of flood protection projects are similar to the costs of nature development projects. The additional costs per hectare of developed nature are on average EUR 120,000 per hectare, with considerable differences between the projects. The differences in costs are partly due to the varying flood protection challenges, the characteristics of the working environment and the possibilities for cost-neutral nature development by using the resources released during one project in another. The findings of this study can be used to inform the planning and decision-making process for future projects, including cost figures and drivers for successful decision-making.

To obtain a more complete information base, further research into the benefits of Building with Nature solutions is required. The impact on flood protection, nature development and recreation is monitored through monitoring and research programmes and, where possible, quantified. This exploratory study also demonstrates the value of investigating the actual costs of Building with Nature projects, hence the recommendation to compile a database in which the costs, broken down by project component, are recorded. This database can also be used to compare the costs of hydraulic engineering Building with Nature projects with the costs of nature development at other locations throughout the Netherlands. Reliable insights into the costs could further reduce the barriers to implementing Building with Nature projects, which will ultimately ensure that such projects move beyond the pilot stage and are applied more widely in hydraulic engineering.

The expectation is that costs will decrease as more experience is gained in implementing natural solutions.

Summary

Several appealing Building with Nature projects have been realised in the past 10 years. The use of nature and natural processes is an innovative way to increase flood protection and to create added value through nature development and recreation. In this exploration, an initial inventory was made of the costs and effects of existing Building with Nature projects in the Netherlands. In addition, the decision-making process for a number of these projects has been mapped out and success factors have been identified. Building with Nature projects for flood risk management provide added value but often result in additional costs (approximately EUR 120,000 per hectare of realised nature – with a considerable spread over the projects) compared to traditional reinforcements. These costs provide a first indication of what we as a society are prepared to pay for the development of nature, recreation and other functions as part of hydraulic engineering projects. Insights into costs can be used to inform planning and decision-making in future Building with Nature projects, for example with regard to cost indicators and motives for successful decision-making. The findings of this study can be used to inform the planning and decision-making process for future projects, including cost figures and drivers for successful decision-making.

Cees Oerlemans
Cees works as a flood risk consultant at HKV. In 2020, he obtained a double MSc in Hydraulic Engineering and Science Communication at Delft University of Technology, in the Netherlands. His areas of focus include hydrodynamic modelling, adaptive delta management and Building with Nature. He has a keen interest in projects where the result relies on the integration of different disciplines.

Carolien Wegman
Carolien works at the department of Rivers, Coasts and Deltas at HKV. Her main field of work are the hydrodynamics and morphology of coastal areas. Natural processes fascinate her, which is why she focuses her work on nature-based solutions. When designing such solutions the focus is not only on preventing erosion or flooding but to take all other aspects of an area into account as well, such as livelihood and ecology.

Bas Jonkman
Bas is professor of Integral Hydraulic Engineering at Delft University of Technology, in the Netherlands. His work focuses on flood risk reduction and hydraulic infrastructure. He holds a PhD degree from Delft University of Technology and has worked for the Dutch government, Royal HaskoningDHV and UC Berkeley. His research interests include flood risk management, climate adaptation and the performance and design of hydraulic infrastructure systems, such as flood defences, storm surge barriers and nature-based solutions.

Stefan Aarninkhof
Stefan is professor of Coastal Engineering at Delft University of Technology, in the Netherlands and Chair of the Department of Hydraulic Engineering. He holds a PhD from Delft University of Technology and previously worked for Delft Hydraulics (now Deltares) and Boskalis. His research interests include monitoring/modelling of nearshore coastal processes, dredging for marine infrastructure and Building with Nature, ultimately to enable broad implementation of nature-based solutions in daily engineering and management practice.

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UPCOMING CONFERENCES

Hydraulic Engineering Structures and Dredging Congress

16–17 February 2022
Russian Chamber of Commerce and Industry
Moscow, Russia

The Hydraulic Engineering Structures and Dredging Congress is a unique and highly acclaimed industry focused platform annually gathering stakeholders of hydraulic engineering and dredging works. It is a place for professionals to meet and to sign contracts.

In February 2022, the congress will include the 9th International Dredging Forum and the 5th Technical Conference 'Modern Solutions for Hydraulic Engineering'. During the congress, global leaders of the shipbuilding industry will share their opinion on how the contemporary dredging fleet should look like and how to ensure high efficiency of dredgers' operation while complying with the today's environmental standards. Maintenance and capital dredging projects will also be on the agenda

23rd World Dredging Congress and Exposition (WODCON XXIII)

16–20 May 2022
Tivoli Congress Centre
Copenhagen, Denmark
https://wodcon2022.org

The World Organisation of Dredging Associations (WODA) the Central Dredging Association (CEDA) will hold the 23rd World Dredging Congress and Exposition in Copenhagen, Denmark from 16–20 May. Under the intriguing tagline 'Dredging is changing', the congress promises to deliver an unforgettable mix of networking, state-of-the-art knowledge transfer, technical sessions and visits. Through innovation, participation and a creative approach, WODCON XXIII will provide the latest knowledge regarding all aspects of dredging in the broadest sense, as well as focus on new technologies and concepts.

WODA recognises and values a constructive partnership between all stakeholders within the industry. As a result, the exhibition will be an essential part of the congress. The programme is structured to optimise the opportunity for participants to visit the exhibition and interact with the exhibitors and sponsors. With a selection of speakers from around the world, cutting-edge studies, research, experiences and procedures will be presented, alongside exciting innovative session workshops.

IAPH World Ports Conference

16–18 May 2022
Vancouver, BC
https://www.worldportsconference.com/index.html

The 2022 World Ports Conference will bring together leading ports, their customers and stakeholders as well as regulators in a world-class event offering interaction with the people who run and influence the world's ports.

The ongoing supply chain crunch has exposed structural weaknesses in various components of maritime supply chains, including ports. The conference will present a 'state-of-the-art' global port system, identifying challenges and opportunities to improve the competitiveness of the world's major port regions and to help bridge the divide between ports in developed, emerging and developing economies.

WEDA Dredging Summit and Expo '22

25–28 July 2022
Marriott Marquis
Houston, Texas
https://dredging-expo.com

Organised by the Western Dredging Association (WEDA), the Dredging Summit and Expo '22 is a technical conference to promote the exchange of knowledge in fields related to dredging, navigation, marine engineering and construction. The theme for this year's conference is 'Building the future of dredging'.

The conference aims to provide a forum for improvement of communications, technology transfer and cooperation among associations and societies, while emphasising the importance of understanding and development of solutions for problems related to the protection and enhancement of the marine environment. The venue for the conference is the brand new Marriott Marquis in downtown Houston.

Join IADC's 1-day conference on Financing Sustainable Marine and Freshwater Infrastructure in Dubai.

COVID-19

Due to the COVID-19 pandemic, events can be postponed or cancelled. IADC has been following the Dutch authorities' advisory measures with regard to limiting the spread of the virus and is keeping a close eye on the situation. We advise checking the IATA website regularly to see the COVID-19 travelling regulations for every country (https://www.iatatravelcentre.com).

FIGURE 1

The winners of the mock tender at the Dredging and Reclamation Seminar in Delft, November 2021, were presented with a copy of *Dredging for Sustainable Infrastructure*.

Dredging and Reclamation Seminar

20–24 March 2022
Venue to be confirmed
Dubai, UAE
www.iadc-dredging.com

For (future) decision makers and their advisors in governments, port and harbour authorities, off-shore companies and other organisations that execute dredging projects, IADC organises its International Seminar on Dredging and Reclamation for the 61st time. Since 1993, this week-long seminar has been continually updated to reflect the dynamic nature of the industry and is successfully presented in cities all over the world. The five-day course covers a wide range of subjects, from explanations about dredging equipment and methods, rainbowing sand and placing stone to cost estimates and contracts. There is no other dredging seminar that includes workshop exercises covering a complete tender process, from start to finish.

Programme

The in-depth lectures are given by dredging experts from IADC member companies, whose practical knowledge and experience add an extra value to the classroom lessons. Subjects covered include:

- the development of new ports and maintenance of existing ports;
- project development: from preparation to realisation;
- descriptions of types of dredging equipment;
- costing of projects;
- types of dredging projects; and
- environmental aspects of dredging.

Site visit

Activities outside the classroom are equally as important. An on-site visit to the dredging yard of an IADC member is therefore an integral element in the learning process. This gives the participants the opportunity to see dredging equipment in action and to gain a better feeling of the extent of a dredging activity.

Networking

Face-to-face social contact is invaluable. A mid-week dinner where participants, lecturers and other dredging employees can interact, network and discuss the real, hands-on world of dredging provide another dimension to this stimulating week.

Certificate

Each participant receives a set of comprehensive proceedings and a Certificate of Achievement in recognition of the completion of the coursework.

Register for the seminar at:

https://bit.ly/SeminarDUBAI2022

For further questions contact:

Ria van Leeuwen, Senior PR & Communications Officer of IADC
Email: vanleeuwen@iadc-dredging.com

Save the date!

Financing Sustainable Marine and Freshwater Infrastructure Conference

17 March 2022
Dubai, UAE
Venue to be confirmed
www.iadc-dredging.com

How can private capital accelerate the green transition in marine and freshwater infrastructure? This is the overarching question that will be explored during the IADC conference, **Financing Sustainable Marine and Freshwater Infrastructure**. The 1-day conference aims to create awareness for the need to clarify sustainable concepts and associated financial structures in order to familiarise the financial sector with the financing of green coastal, river and port projects, and to develop ideas to bring this to mainstream infrastructure investment asset classes.

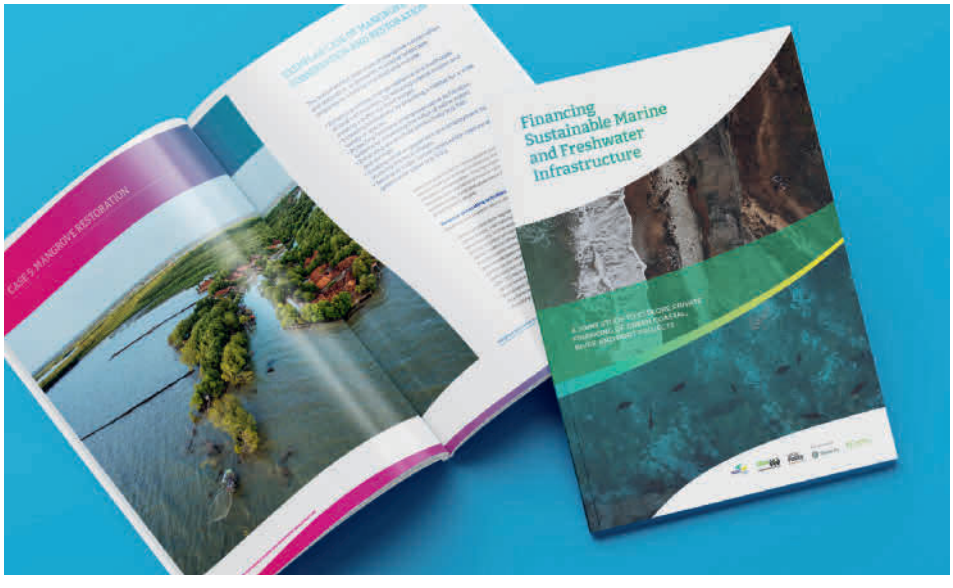
The conference will also provide an opportunity for further dialogue between the marine and freshwater infrastructure sector and the financial sector. The report, *Financing Sustainable Marine and Freshwater Infrastructure: A joint study to explore financing of green coastal, river and port projects*, will provide the basis of the conference programme.

A special pre-conference 'meet and greet' will be held on Wednesday evening (16 March) at the Dubai World Expo. Don't miss this unique opportunity to network with fellow professionals from the dredging industry, government agencies, port authorities, development finance institutions, private financers and NGO's. For more information on the programme and how to register, visit www.iadc-dredging.com.

BOOK REVIEW

FINANCING SUSTAINABLE MARINE AND FRESHWATER INFRASTRUCTURE

A joint study to explore what is needed in order to improve the connection between green-labelled funds and sustainable waterborne infrastructure projects.



Recent years have seen an increase in publications and forums discussing the financing of nature-based solutions and investments in nature. In this high-level study, representatives of the dredging sector, Swiss Re and B Capital Partners build on these publications in a joint exploration to identify and clarify the role of private finance in sustainable marine and freshwater infrastructure.
The purpose of this exploration is twofold: to raise awareness of sustainable dredging solutions within the financial community and to start building a bridge between the worlds of sustainable dredging and private finance.

'Both the sustainable marine and freshwater infrastructure sector and the financial sector seek to scale up their green portfolio, and it is quite obvious that synergy can be found in cooperation', explains Arjan Hijdra, Managing Director of Vital Ports. 'However, both sectors are mutually unfamiliar with each other's environment, which hinders to capture this synergy right away. We believe that this dedicated report could help further engagement between these two sectors.'

Against a background of substantial future infrastructure investment needs, particularly evident in coastal protection, there is a widespread ambition to scale up private finance. Meeting these investment needs cannot be done through public resources alone. There is a critical complementary and supporting role that private capital can play to bridge the investment gap. Marine and freshwater infrastructure presents a promising financing opportunity. The recent developments in sustainable concepts could be an attractive avenue for private investors seeking to invest in sustainable infrastructure.
This study aims to serve as a starting point for inspiration and to provide content for further dialogue on potential financing mechanisms for projects.

Within the early sections of the study, sustainable marine and freshwater infrastructure projects are characterised based on technical (physical) features and cashflow sources. In practice, projects tend to be highly tailor-made to both the physical context and the institutional setting. To illustrate how real-life projects can be viewed through these lenses, the report includes a series of case studies that provide tangible ideas on how things did or didn't work.

The study addresses how public-private partnership (PPP) and concession-type marine and freshwater projects can ensure a commensurate private capital remuneration. Furthermore, it proves that industry specific concession-type legal frameworks, albeit still in development and not widely available yet, are coherent with usual infrastructure fund managers' and lenders' investment requirements. The report demonstrates innovative financial structures that are already being implemented but are less well known by the financial investors. In short, showing that green marine, waterways and coastal projects, which return long-term cashflows, can be appealing for private capital.

Authors: Arjan Hijdra, Christine Kng, Kathleen de Wit, Lotte Vandekeybus, Mark van Geest, Polite Laboyrie and Sien Kok
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MAIN MEMBERS

DEME Group
Head office Belgium
+32 3 250 5211
info@deme-group.com
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Dutch Dredging
Head office The Netherlands
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Head office Belgium
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office@groupdecloedt.be
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Gulf Cobla (L.L.C.)
Head office United Arab Emirates
+971 4 803 7777
gc-info@gulfcobla.com
www.gulfcobla.com

Hyundai Engineering & Construction Co., Ltd.
Head office South Korea
+82 2 746 1114
webmaster@hdec.co.kr
www.hdec.co.kr

Jan De Nul Group
Head office Luxembourg
+352 39 89 11
info@jandenulgroup.com
www.jandenul.com

National Marine Dredging Company
Head office United Arab Emirates
+971 2 5130000
nmdc@nmdc.ae
www.nmdc.com

Penta-Ocean
Head office Japan
+81 3 3817 7181
poc_international_web@mail.penta-ocean.co.jp
www.penta-ocean.co.jp

Rohde Nielsen A/S
Head office Denmark
+45 33 91 25 07
mail@rohde-nielsen.dk
www.rohde-nielsen.dk

Royal Boskalis Westminster N.V.
Head office The Netherlands
+31 78 6969 000
royal@boskalis.com
www.boskalis.com

TOA Corporation
Head office Japan
+81 3 6757 3800
webmaster@toa-const.co.jp
www.toa-const.co.jp

Van Oord
Head office The Netherlands
+31 88 8260 000
info@vanoord.com
www.vanoord.com

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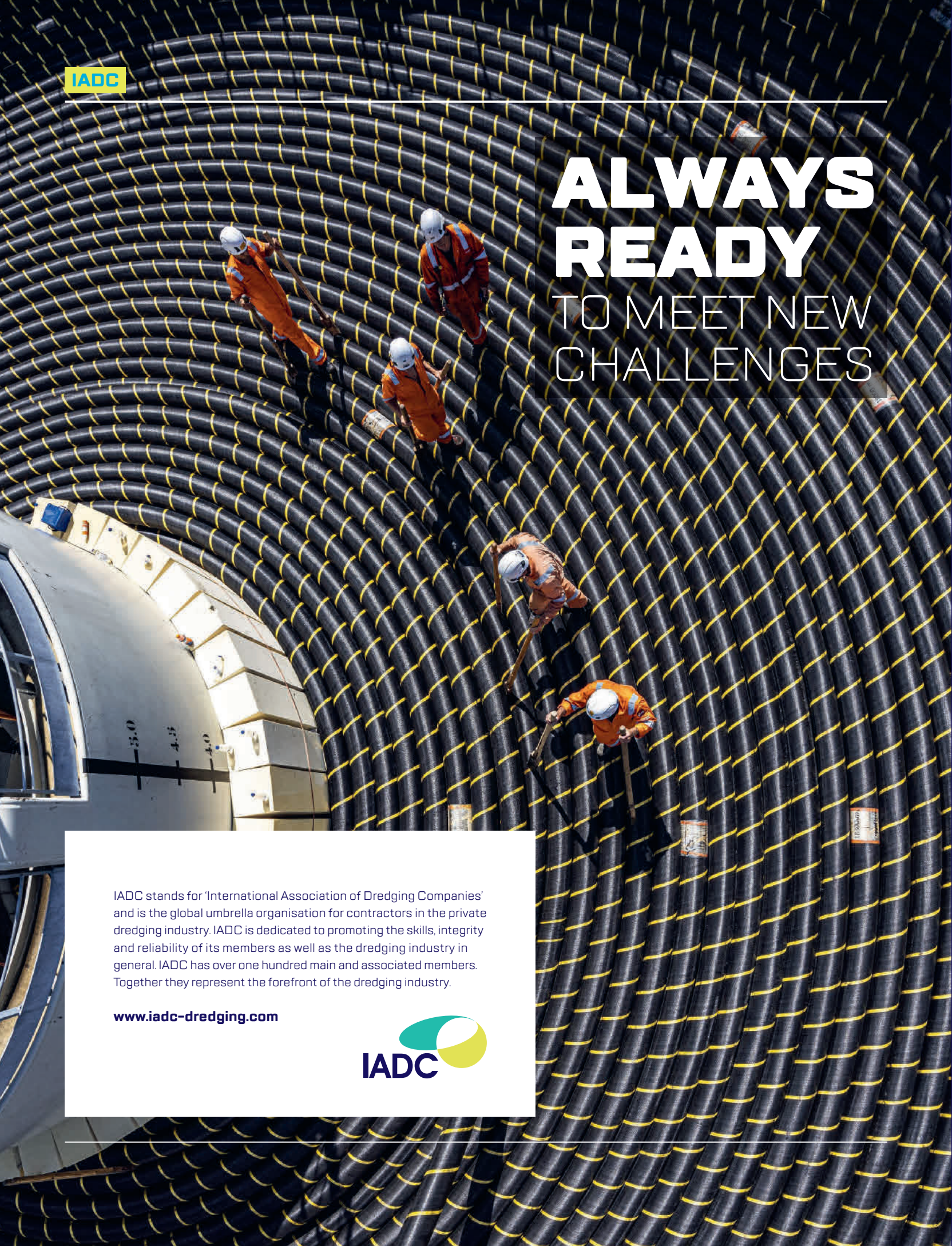

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