Integrating stakeholder interests into eco-engineering projects

Guidance and case-studies

ECOSTRUCTURE
Climate Change Adaptation through
Ecologically-Sensitive Coastal Infrastructure

Cronfa Datblygu Rhanbarthol Ewrop
European Regional Development Fund

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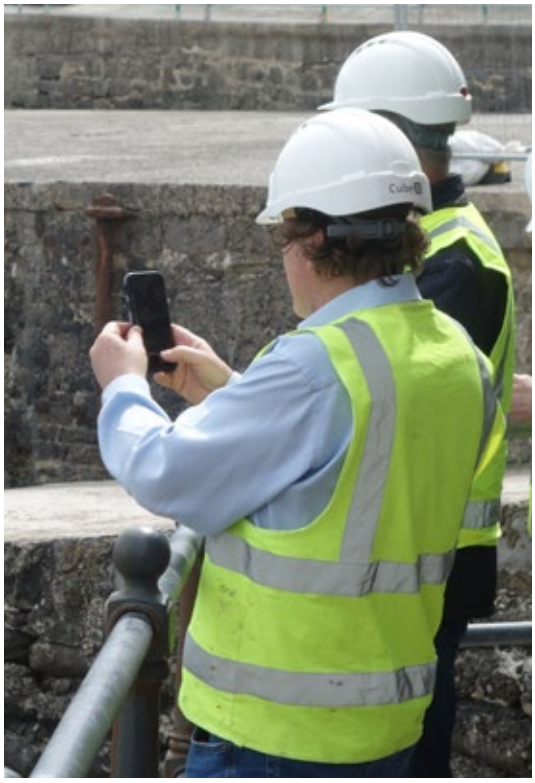


"...I think it's a fantastic idea and will really enhance the sea wall. Any project that encourages wildlife and creates a better relationship between our use of the environment and the local flora and fauna is a good thing."

(Online survey comment)

Contents

Summary

Marine and coastal eco-engineering includes ecological principles in the design of infrastructure, with the purpose of enhancing its ecological value for wildlife. Stakeholders of eco-engineering projects are people, groups or organisations who have an interest in coastal or marine infrastructure projects and can influence their development. They may come from industry, government, academia, or from wider society. Engagement with stakeholders is an ongoing process that builds relationships between parties and enables information exchange. The process allows stakeholders to contribute to the decision-making process.

The purpose of stakeholder engagement is to provide information, understand objectives of stakeholders, listen and respond to concerns, agree realistic outcomes, and generally develop goodwill. Barriers to effective stakeholder engagement can be deep-rooted beliefs affecting the trust levels in the project lead or other stakeholders, lack of time, or inactivity.

The first step is to identify relevant stakeholders. For eco-engineering projects the scale and nature of infrastructure projects and their location determines the stakeholder community. Generally, they are owners of marine or coastal infrastructure, design engineers, planners, construction engineers, environmental regulators, local and national government, schools, community groups, local residents, environmental researchers and formliner and concrete manufacturers.

Internally, a stakeholder engagement officer has to be appointed, who serves as a broker and mediator, bringing across expectations and reflections of stakeholders back to the project, and vice versa. The task is to regularly communicate and provide feedback, and to connect stakeholder engagement processes with the project development. Trust-building is a fundamental part of any stakeholder engagement process, which is assisted by addressing inequalities in power of different stakeholders and aspiring to equal importance of their contributions.

Stakeholders can be consulted through personal interviews, workshops, focus groups, public or “town hall” meetings, surveys, stakeholder panels or online tools. After the stakeholder engagement, results need to be analysed and evaluated. Appropriate feedback to stakeholders is necessary in order to keep them interested in the project, and it also ensures fair relationships with stakeholders.

Ecostructure project examples of stakeholder engagement

During the Ecostructure project several engagement formats were trialled. A high-level online multi-stakeholder workshop was organised titled 'The Future of Coastal Communities in Swansea and South Wales'. It explored the relevance of coastal and marine subjects to stakeholders and the relative importance of eco-engineering compared to other topics.

A project workshop was held linked to the Mumbles Sea Hive project in Wales, where hexagonal wall panels with thirteen patterns were trialled. The purpose of the workshop was to update interested parties about research results and discuss next steps for the project among people with different interests. The diversity of participants with backgrounds from local government, industry, academia, and the wider community allowed discussing the research results from different perspectives, and the importance of next steps was evaluated from a variety of viewpoints.

A design workshop was organised to develop new eco-engineering ideas with industry partners. Design workshops are meetings of two or more individuals who collaborate to either start or finalise a design or to make progress on overcoming an obstacle on an existing design. It is an iterative and non-linear process that involves empathising with people and challenges, defining problems, and creating ideas. The outcome of the Ecostructure event was a new design for the Porthcawl breakwater project.

One-to-one meetings with stakeholders were the most common engagement format. They allowed communicating in a more unstructured way enabling knowledge exchange and detailed understanding of each other's sectors and viewpoints. During Ecostructure over 100 meetings were held with infrastructure owners, design and construction engineers, academics, formliner designers and manufacturers, concrete industry representatives, conservation organisations, community officers and residents.

Stakeholder engagement at conferences enables exchange of information and ideas across sectors and can lead to productive networking. The Ecostructure project arranged a set of stakeholder presentations at the final conference, which enticed interested business representatives and governmental officers to attend the event. Ecostructure staff, who are mostly academics, benefitted from the first-hand reports by non-academic stakeholders, and business and government representatives gained insight into the scientific research generated by the project.

Community engagement describes the interaction with the wider community for the mutually beneficial exchange of knowledge and resources in a context of partnership and reciprocity. The purpose is to enrich research and creative activity, and to enhance teaching and learning. Ecostructure staff engaged with primary and secondary schools, using eco-engineering interventions to discuss climate change, sea-level rise and biodiversity. Participating at a community farmers market stand allowed engagement with residents, and an online survey gathered views about specific eco-engineering projects. Researchers also used interviews and a questionnaire to learn more about the cultural significance of the coast and coastal infrastructure.

The media and press can be seen as stakeholders in their own right. They play a crucial role in the dissemination of information and provide a forum for debate. They shape the visibility, acceptance, and reputation of projects. Ecostructure produced press releases, gave TV and radio interviews, posted on social media channels, created videos for a YouTube channel and created information boards for specific projects.

Background

Natural coasts are characterised by topographically complex substrates. In contrast, marine infrastructure has typically vertical, smooth concrete surfaces that reduce attachment opportunities for fauna and seaweeds. Artificial structures provide less shelter from harsh environmental conditions and fewer refuges from predators.

Eco-engineering includes ecological principles in the design of infrastructure with the purpose to enhance its ecological value as a habitat for coastal and marine wildlife. It provides an approach that can be used to mitigate some of the harmful environmental effects of necessary coastal and marine construction. This can be done by designing new structures with nature in mind or by modifying existing structures. In some cases the aim is to increase biodiversity and enhance ecosystem functions and services by creating structures with high surface complexity and incorporating water-retaining features. In other cases, the aim is to produce an environment suitable for colonisation by specific species, such as reef-building shellfish or commercially valuable fish.

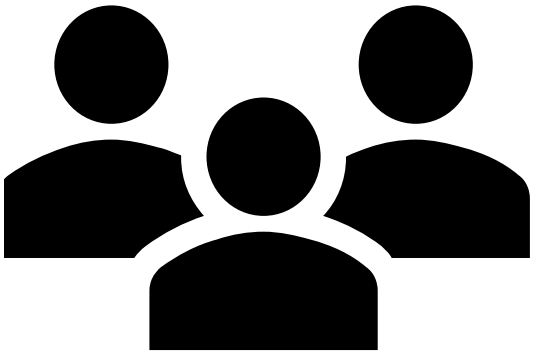
Ecostructure was an interdisciplinary European research project that ran from 2017 to 2022, which explored eco-engineering and biosecurity solutions for coastal adaptation to climate change. The project brought together research institutions from both sides of the Irish Sea. A key aspect of the project was to involve interested people and organisations from government, industries and wider society into eco-engineering projects.

This guidance document outlines general considerations about stakeholder engagement and reports examples from the Ecostructure project. The Mumbles Sea Hive project features heavily, because stakeholders were involved right from the start. The project is located in Swansea, Wales, UK, where an ageing seawall is going to be restored. The local council allowed the Ecostructure project to trial upscaled textured concrete panels at the existing wall. Thirteen patterns were tested at three sites. Several stakeholder engagement formats were initiated throughout the project.

What is stakeholder engagement?

Eco-engineering stakeholders are people, groups or organisations who have an interest in coastal or marine infrastructure projects and can influence their success. The nature of their interest may be linked to industry, government, academia, or to wider societal concerns.

Stakeholder engagement is an ongoing process that builds relationships between parties enabling information exchange (GRRIP 2022). This process allows stakeholders affected by decisions to contribute to the decision-making process.



The process of stakeholder engagement is voluntary and identifies current positions of all parties included. It outlines objectives and outcomes and ascertains how to achieve them. Parties that are included in the engagement can change, but the process of engagement continues. The process of stakeholder engagement includes:

- Providing information
- Capacity building to equip communities and stakeholders to engage effectively
- Listening and responding to community and stakeholder concerns
- Including communities and stakeholders in relevant decision-making processes
- Developing goodwill and an understanding of objectives and priorities that will lead to confidence in decisions
- Establishing a realistic understanding of potential outcomes
- Building an understanding of the decision-making process

(APGA 2015)

Generally, engagement is referred to as interaction between stakeholders and organisations, where interaction influences stakeholder thoughts, actions and emotions toward an organisation. The main value of engagement with stakeholders lies in the understanding of dialogue dynamics and enabled participation.

There may be barriers in the process of engagement. For example, participation may be more passive rather than active, or stakeholders have deeply rooted value and belief systems affecting the trust level in the organisation or other stakeholders.

While considering views of all interested parties is an intuitive approach in any project, this may be difficult to achieve. Despite great efforts not all stakeholders may be identified or reached. In eco-engineering projects, budgets may focus on specific aspects dealt with by specialists who work in silos and exclude other interests.

For engagement to be effective there needs to be willingness and motivation of stakeholders to participate, and inclusivity of all possible interests and equal access to information and knowledge.

Stakeholder engagement and Responsible Research and Innovation (RRI)

The concept of wider stakeholder involvement gained traction during the past decades in academic research. Applied research in particular needs to include stakeholders from all sectors if results are meant to be implemented in the non-academic realm. It is referred to as Responsible Research and Innovation (RRI) or Responsible Innovation (RI), and it implies that societal actors (researchers, citizens, policymakers, businesses, third sector organisations) work together during the whole research and innovation process in order to better align both the process and research outcomes with the values, needs and expectations of society (RRING 2022).

In practice, RRI is implemented as a package that includes multiple actors and public engagement in research and innovation. It enables easier access to scientific results, the take-up of gender equality and ethics in the research and innovation process, and formal and informal science education.

A widely used definition of responsible innovation is “a commitment to care for the future through collective stewardship of science and innovation in the present”. While the definition is broad, in eco-engineering it can encourage actions around ethics, ensuring gender equality in research processes and enable the wider public to understand the scientific process both by increasing STEM (science, technology, engineering and mathematics) education and making research outputs freely available.

Carrying out participatory reflective processes in product or service development helps to build a competitive advantage through the inclusion of diverse perspectives that increase the fit of the innovation outcome in the market (RRING 2022). Opening research and innovation might provide new ideas for product and market development, and engaging in networks can help to identify stakeholder needs.

In order to really benefit from open communication and addressing societal needs, it is also important to include stakeholders with opposing views during the research process, in order to fully capture those concerns in the outcomes.

In RRI, stakeholders are referred to as a 'Quadruple Helix', referring to the four strands of 'policy makers, industry, academia, and wider society'. Interests and views of these groups ought to filter into the entire research and innovation process.

In eco-engineering projects all strands of the Quadruple Helix contain key decision makers, and therefore all sectors should be involved from the start of a project throughout its development, delivery and legacy.

How to engage with stakeholders?

General steps of successful stakeholder engagement can be transferred to eco-engineering projects, based on the H2020 GRRIP project document 'Stakeholder Engagement Guidelines' (GRRIP 2022).

Identify, plan and understand

The first step to effectively engage with stakeholders is to identify who they are. A list of stakeholders needs to be created that can be categorised according to sectors (e.g. government, industry, academia, wider society) and how important they are to the project.

The involvement of each stakeholder in decision making processes may be identified.
In order to ensure equality and diversity of the stakeholder group the list should be analysed in terms of sector representation and gender.

For eco-engineering projects there is a wide range of stakeholders. The scale and nature of infrastructure projects and their location determines the stakeholder community. Generally, stakeholders include people and organisations representing the infrastructure owners, government and regulators, and anyone affected by changes at the coast.

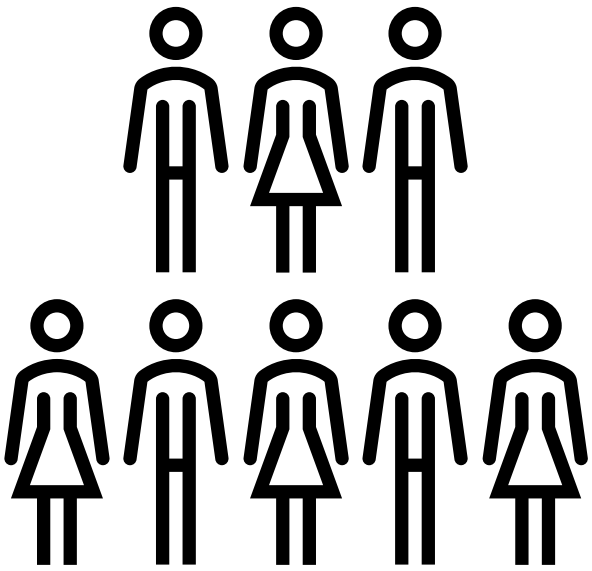
Stakeholders of eco-engineering projects

Stakeholder	Category
Owner(s) of marine or coastal infrastructure	Government/Industry
Design engineers	Government/Industry
Planners	Government/Industry
Construction engineers	Government/Industry
Environmental regulators licencing	Policy makers/ Government
Environmental regulators planning and conservation	Policy makers/ Government
Local, regional and national government	Government
Schools	Government/ Society
Community council	Government/ Society
Community groups (e.g. sports, nature conservation, U3A)	Society
Local residents	Society
Cultural heritage (museums, galleries, local history societies)	Society
Environmental researchers (university, regulator)	Academia/ Government
Engineering research (university, industry)	Academia/ Industry
Concrete manufacturing	Industry
Industry designers	Industry
Formliner manufacturing	Industry

Internal stakeholder coordination

The depth of engagement with stakeholders depends on aligning their interests and objectives with the project. Ideally, an internal stakeholder management team is created to support the coordination of the stakeholder group. Tasks would be to regularly communicate and provide feedback, and to connect stakeholder engagement processes with the project development. At least one person from the project needs to be included in the coordination and support of stakeholder engagement in order to maintain regular communication and provide stakeholders with opportunities to comment. The stakeholder management team or stakeholder coordinator serves as a broker and mediator between stakeholders and project leads.

One of the barriers to stakeholder engagement is lack of time and resources. It is therefore important to motivate stakeholders by being mindful of their benefits from engagement and emphasising them.



Trust-building

Building trust is a fundamental part of any stakeholder engagement process. This can be assisted by addressing inequalities in power of different stakeholders and aspiring to equal importance of their contributions. Cultural barriers must be respected, and all communication must aim for commonly understood language. To build trust, there must be willingness of all parties to understand others' viewpoints.

For the trust building process, project managers need to consider obstacles and anticipate them when engaging with stakeholders. Gaining trust of stakeholders relies on addressing the identified issues upfront.

Engagement techniques

Several techniques can be used to consult with stakeholders:

- Personal interviews
- Workshops
- Focus groups
- Public or "town hall" meetings
- Surveys
- Stakeholder panels
- Online tools

Prior to consultation, project leads must decide which stakeholders to consult and the appropriate mechanism that will be utilised, keeping in mind local conditions and characteristics of the stakeholders. This could mean that different techniques will be used for different stakeholders.

Respond and implement

After the stakeholder engagement, results need to be analysed and evaluated. Suggestions, raised concerns and priorities need to be addressed:

- Assess measures to manage raised concerns and issues: time, cost, capacity, effectiveness
- Develop management plan: objectives, measures, responsibilities, targets
- Monitor and evaluate progress

Monitoring and evaluation of stakeholder activities and interventions is an ongoing process. All actions should be documented and reported. Record-keeping will enable strengthening of stakeholder relationships with the project. Appropriate feedback to stakeholders is necessary in order to keep them interested in the project, and it also ensures fair relationships with stakeholders. The quality of relationships with stakeholders can vary over time, and it is important to regularly review their state and the level of satisfaction.

Workshops

High-level workshops

Workshops addressing broad subject areas attract people from a wide variety of backgrounds and allow scoping the societal relevance of different topics. They allow eco-engineering designers to better understand the importance of biodiversity enhancing measures for stakeholders compared with other coastal and marine topics.

An example of a high-level workshop was a LINC event at Swansea University, which convened participants around the 'Blue economy' and attracted in excess of 100 participants. The range of topics discussed included Blue Carbon, using the oceans to fight climate change, and exploring marine energy resources.

Swansea University Biosciences organised an online multi-stakeholder workshop titled 'The Future of Coastal Communities in Swansea and South Wales'. It was organised with the aim to explore the relevance of coastal and marine subjects among stakeholders; the workshop was part-funded by the Horizon 2020 project GRRIP. It brought together coastal stakeholders from governmental organisations, environmental charities, academia, residents and community organisations, and industry representatives (Callaway et al. 2021). A similar event was held at University College Cork (UCC) titled "Shaping the Future of Marine and Maritime Communities".

The multi-stakeholder workshops consisted of an introduction to marine research at the organisations, followed by two breakout sessions where groups of 7-10 delegates discussed challenges to coastal communities, and ways of rising to those challenges. Environmental risks and societal concerns linked to living in coastal communities were

raised by breakout groups. Community cohesion and conflicts between industry and communities were highlighted, as well as demographic imbalances disadvantaging younger generations. The romanticising of coastal life by visitors, as well as resistance to change were seen as societal challenges. Pollution, loss of biodiversity, climate change, flooding, health of local rivers, coastal erosion and rising sea levels were all pointed out as serious environmental concerns.

Instilling an interest in the natural environment, raising awareness of coastal problems and enhancing natural sciences skills were seen as starting points for rising to challenges. Communities were highlighted as pivotal to engagement. These need to have ownership and be empowered to address issues affecting their local marine environment. Citizen science projects were seen as a productive way of generating information by members of communities. Working with schools and children in general was recommended. Public sector bodies can fill evidence gaps via routine monitoring and the collection of long-term data. Industry can translate academic research into real-world applications.

All groups emphasised the importance of engaging as many societal groups as possible in discussions and solutions of coastal challenges. It was acknowledged that conflicts between communities, industry, conservation, and academia are inevitable and need careful conflict management. Involving local people at the early stages of project development is crucial.

Eco-engineering was only mentioned by one industry partner and ranked low in comparison to subjects such as water quality or community cohesion. However, topics triggering the need for eco-engineering such as climate change and declining biodiversity featured highly. Also, the emphasis on community involvement in decision-making highlighted the importance of early community engagement for eco-engineering projects.

Project workshops

Project workshops bring together stakeholders with interests in a specific eco-engineering development. Motivation for participation may be commercial, environmental, academic, historical, esthetical, educational, or linked to legislation and regulation.

In the Ecostructure project we organised a project workshop one year after installing the Mumbles Sea Hive panels. The purpose of the workshop was to update interested parties about research results and discuss next steps for the project among people with different interests.

Twelve stakeholders participated, ranging from Swansea Council owning the infrastructure, NRW officers, design and construction engineers, formliner and concrete manufacturers, engineering and biosciences academics, and community engagement officers. Gender balance was ensured.

The workshop consisted of two presentations and three group discussions. The presentations covered results of the Mumbles Sea Hive project and new guidelines for eco-engineering projects produced by NRW. Both presentations were discussed among stakeholders. A separate discussion covered views on next steps and possible upscaled solutions for eco-engineering interventions.

The diversity of participants' backgrounds and gender equality allowed discussing the research results from different perspectives, and the importance of next steps was evaluated from a variety of viewpoints. For example, the potential future texture of the Mumbles defences was discussed in terms of manufacturing limitations as well as opportunities for citizen science projects.

Generally, project workshops have the advantage that stakeholders have a direct professional or personal interest in the subject. There seems to be a greater openness to listen and comprehend views and contributions of stakeholders from different sectors, possibly because attendees are often experts in their field. Delegates appear more engaged than during high-level events that discuss broader topics. Limiting delegate numbers to 10-20 allows discussions within the entire group. For larger workshops breakout groups would need to be arranged to ensure that all delegates have a chance to get their voice heard.

Design workshop

A design workshop is a meeting of two or more individuals who collaborate to either start or finalise a design or to make progress on overcoming an obstacle on an existing design. The outcome should be 'progress made' and 'decisions taken'. Key elements of design workshops are:

- Design thinking
- Creative
- Unstructured time
- Discussion space
- Longer duration
- Output portfolio
- Small numbers of participants
- Creative space or location
- Variation of locations

Design workshops revolve around a deep interest in understanding the people for whom we design products and services. Problems, assumptions and implications are analysed. Design workshops are particularly useful when tackling problems that are ill-defined or unknown. They involve ongoing experimentation through sketches, prototypes, testing and trials of new concepts and ideas.

Design workshops are linked to 'design thinking'. This is an iterative and non-linear process that involves empathising with people and challenges, defining problems and creating ideas. These stages can happen in parallel, may be repeated or circled back to at any point in the process.

Design thinking can help people generate out-of-the-box ideas. It assists developing new ways of thinking, asking significant questions and challenging assumptions. One element of out-of-the-box thinking is to falsify previous assumptions.

Design workshops are both an art and a science. They combine investigation into ambiguous elements of a problem with rational and analytical research. The research process pools experience from previous projects, considers future conditions of products and services and tests practical applications of alternative solutions. This combination has the potential to reveal previously unknown parameters and helps to uncover alternative strategies which lead to innovative solutions.

In Ecostructure a design workshop was held in August 2021 with staff of the formliner and concrete manufacturer CubeX. The purpose was to understand challenges of a new coastal breakwater project in Porthcawl, South Wales, and to develop eco-engineering ideas and produce prototypes for testing. The flexible agenda for the 2-day design workshop entailed:

- Site visit of the Porthcawl breakwater
- Inspection of the Porthcawl infrastructure

- Assessment of the natural environment surrounding the breakwater
- Conversation with Porthcawl construction and design engineering companies (Arup, Knights-Brown)
- Workshop at Swansea University with formliner and concrete manufacturer CubeX and marine ecologist
- Sketching and discussing eco-engineering ideas for Porthcawl project
- Deciding on a prototype solution
- Preparing presentation for Porthcawl infrastructure owners

A site visit was arranged with design and construction engineers of the Porthcawl project. This allowed gaining deeper understanding of the environmental conditions at the site, challenges to construction, and the needs of stakeholders such as the local council and marina users.

Subsequently a design session was held, where eco-engineering ideas and solutions were proposed, sketched and discussed. Participants decided on the best possible compromise between manufacturing constraints, cost and ecological potential. Drawings and models were produced and a presentation for the infrastructure owners and construction company was created.

Conference workshops

Conferences are meetings of experts or interest groups to exchange and discuss information about a particular topic. Since conference topics and their organisational format are often specialised, these events attract delegates with a similar background, as opposed to diverse stakeholders. For example, scientific conferences attract academics to exchange latest scientific results, and industry conferences attract businesses from specific sectors.

More conference organisers are now interested in cross-sector communication and include presentations for non-specialists. The aim is to attract delegates without the prerequisit of in-depth specialist knowledge. Experts want to disseminate information and hear about stakeholders' perspectives.

Enabling cross-sector attendance allows participants to gain deeper insight into unfamiliar areas. For example, academics attending industry congresses will assist them to understand concrete manufacturing, project planning and economic realities. Businesses attending conferences on governmental policy enhances awareness of upcoming regulation affecting their sector, and conservation organisations getting involved with scientific conferences will grow their knowledge of scientific thinking.

The Ecostructure project arranged a set of stakeholder presentations at the final project conference, which enticed interested business representatives and governmental officers to attend the event. Feedback suggested that the Ecostructure project staff, who are mostly academics, benefitted from the first-hand reports by non-academic stakeholders. On the flip side, business and government representatives enjoyed the detailed scientific research, and they gained insight into the depth of knowledge generated by the project. The stakeholder presentations can be viewed here.

Stakeholder engagement at conferences enables exchange of information and ideas across sectors and can lead to productive networking. It grows confidence and trust among stakeholders through experiencing the language and culture of different sectors.

One-to-One meetings

During the Ecostructure project, one-to-one meetings with stakeholders were the most common engagement format. Over 100 meetings were held with infrastructure owners, design and construction engineers, academics, formliner designers and manufacturers, concrete industry representatives, conservation organisations and community officers.

The advantage of one-to-one meetings is the opportunity to communicate in a more unstructured way that allows knowledge exchange and detailed understanding of each other's sectors and viewpoints. Meetings can be one-off or part of a series.

The most common purposes of one-to-one stakeholder meetings in Ecostructure was

- Introduction and discussion of the concept and background of eco-engineering
- First steps towards a new eco-engineering opportunity
- Discussion of upscaling Ecostructure patterns
- Knowledge exchange about formliner design and manufacturing
- Knowledge exchange about coastal ecology and the role of eco-engineering
- Knowledge exchange about concrete manufacturing

Here are some examples of one-to-one stakeholder meetings:

1. Meetings with Swansea Council staff to discuss the Mumbles Coastal Protection Project. Swansea Council owns the Mumbles seawall, which is located in a highly populated area. Officers were open to the idea of trialling eco-engineering interventions. One-to-one meetings were held with Ecostructure officers to discuss cost, feasibility, safety, public information boards and press releases.

2. The upscaling of research-scale formliners to an industrial scale is a highly technical process. A series of online meetings were held with the formliner manufacturer Reckli. The aim of the meetings was to improve the Ecostructure researchers' understanding of formliner manufacturing, and on the flip-side Reckli's knowledge of coastal ecological processes. The knowledge exchange allowed the development of new eco-engineering products based on existing commercial patterns.

3. Meetings were held between design and construction engineers and Ecostructure staff to explore future eco-engineering opportunities in England and Wales. Staff responsible for the restoration of parts of Pembroke Port, Penrhyn Bay sea defences and the Barmouth Viaduct met with Ecostructure staff to discuss the tools developed during the Ecostructure project and possible eco-engineering interventions.

4. One-to-one meetings with precast concrete manufacturers were held to discuss opportunities and hurdles of upscaling eco-engineering interventions.

Site visits

Stakeholder visits of potential or actual eco-engineering sites have the advantage that discussions do not solely rely on language and visualisations such as models or images. They provide impressions of the relevant locations beyond descriptions and data. During the Ecostructure project multi-stakeholder site visits were crucial for decision making stages of eco-engineering projects. Site visits may also comprise visiting the workplace of stakeholders for knowledge exchange.

Examples of site visits during the Ecostructure project:

1. A multi-stakeholder meeting was held at the Mumbles seawall to decide on the exact location of interventions, inspect trial hexagonal panels, discuss fixings as well as information boards for the wider public. The meeting was attended by Swansea Council who owns the infrastructure, design and construction engineering companies, the formliner and precast concrete manufacturers as well as Ecostructure staff. The site visit resulted in final decisions and enabled the construction of the interventions four weeks later.

2. Three site visits were arranged for the Porthcawl breakwater restoration.

a. Scoping site visit: a meeting with a local council officer, a design engineering

company and Ecostructure staff was arranged to understand if the site was suitable for eco-engineering interventions;

b. Design visit. A site meeting with the design and construction companies, local council representative and the site manager was arranged to exchange views on design opportunities and limitations;

c. Logistics visit: Ecostructure staff met on-site with the construction company to finalise the delivery schedule for eco-engineering interventions.

3. Ecostructure staff visited the site of a formliner and concrete manufacturer. This allowed knowledge exchange. It particularly informed Ecostructure staff about industrial processes in the manufacturing of precast concrete units.

Community engagement

Community engagement describes the interaction with or collaboration between an organisation with the wider community for the mutually beneficial exchange of knowledge and resources in a context of partnership and reciprocity. The purpose is to enrich research and creative activity, and to enhance teaching and learning. This will result in educated and engaged citizens and strengthen democratic values and civic responsibility. It will address critical societal issues, contribute to the public good, and create cultural, recreational and other assets, and contribute to the regeneration of neighbourhoods and community wellbeing (Carnegie Community Engagement Classification 2006). Eco-engineering is of interest to a wide range of members of the community and activities should be tailored to the interests of the residents. Here are some examples of interactions with the community linked to the Mumbles Sea Hive project and the coastal landscape in Co. Wicklow (Ireland).

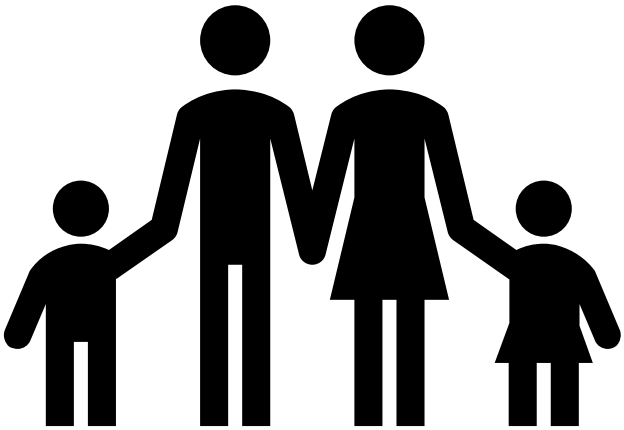
Schools

Ecostructure project staff linked up with local primary and secondary schools and engaged with over 200 children. They visited the Sea Hives in Mumbles to learn about the project. The purpose of the visit

was to inform teachers and pupils about sea-level rise and climate change, the necessity of coastal and marine infrastructure, negative impacts of infrastructure on biodiversity, eco-engineering concepts to enhance biodiversity and the local coastal wildlife. The visits were also used to inform about EU funded projects such as Ecostructure.

Pupils and teachers examined the sea hive panels and then ventured into the intertidal area and explored seaweeds, molluscs and crustacea that inhabit local shores. The outcome of visits was that teachers and pupils are more aware of the local impact of climate change and sea-level rise. They understand the concept of eco-engineering and were inspired to create their own eco-engineering solutions and designs.

Further, science teachers from a secondary school visited the sea hives to explore opportunities of integrating the project into their ecology teaching. They investigated the panels and video-recorded Ecostructure staff who explained the thinking behind the project, its concept and how results will be analysed and interpreted. The recordings will become part of science teaching.



Community market

Ecostructure staff joined the Mumbles Community Council to share a market stand at the popular monthly Mumbles Market. The purpose of the market stand was to encourage conversations with the residents about eco-engineering and the Ecostructure project. One of the textured eco-engineering panels was displayed. Interested members of the public were informed about the project and they could voice their views. They were encouraged to fill in a survey asking for opinions. Conversation about eco-engineering, the Ecostructure project and the Mumbles Sea Hive were carried out with 43 people, and approximately 600 people saw the stand. Ecostructure staff recorded the gender and age range of people interested in the project to better understand demographic and societal bias in engagement.

A template was created for children to draw their own eco-engineering panel. Due to Covid-19 restrictions it was not possible for children to draw at the stand, and the templates were handed out to take home.

Coastal resident engagement

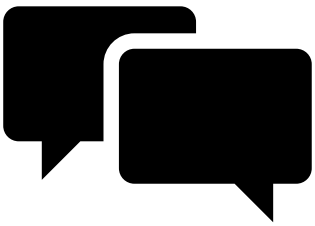
Ecostructure staff engaged with residents of Co. Wicklow (Ireland) to better understand connections between people and the coast and coastal infrastructure.

They carried out several interviews and distributed questionnaires to almost 200 participants using both social and traditional media. This gave coastal residents the opportunity to explain important cultural functions of the landscape and provided Ecostructure staff with a better idea of how coastal change impacts on the community.

The results were shared with the community during two presentations.

Online questionnaire

An online questionnaire (Google Forms) was created to better understand people's view on coastal eco-engineering in general, and on specific aspects of the Mumbles Sea Hive project. The results allowed Ecostructure staff to quantify the importance of eco-engineering to participants. It also highlighted aesthetic preferences for individual textures.



The following questions were asked

1. Coastal wildlife is important to me. Please indicate if you agree with that statement (scale 1-5).
2. I support efforts to create more wildlife friendly seawalls. (scale 1-5)
3. I like the wall panels. (scale 1-5)
4. Do you prefer the natural (rock-type) or the artificial patterns? (3 categories)
5. If the entire Mumbles seawall was covered in panels, would you prefer a single pattern or a mix of patterns? (3 categories)
6. Choose your favourite pattern. Check as many as you like. (13 options)
7. Please leave any comments or views about the project. (free text option)
8. General information about yourself. Which of the following describes you best. (5 options)
9. How often do you visit the Mumbles seafront? (4 options)
10. Have you ever set foot onto the foreshore area of Swansea Bay (the wet sand area)? (4 options)

"I think it's a fantastic idea and will really enhance the sea wall. Any project that encourages wildlife and creates a better relationship between our use of the environment and the local flora and fauna is a good thing"

"Love the idea of getting involved if there are opportunities "

"I think it should look nice not scruffy"

"It's is an amazing idea"

"I like the lighter colour and shapes"

"Interesting whilst walking "

"I think the panels are both beautiful and interesting. I fully support the aims of the sea hive project and intend to visit and photograph them again"

Media and Press

The media can be seen as a stakeholder in its own right. It plays a crucial role in the uncovering, promotion, education, and dissemination of information. Media and press can provide a forum for debate and shapes the visibility, acceptance and reputation of projects. It influences public opinion. Considering this influential stakeholder and managing the media can be crucial for an eco-engineering project.

Information Panels

Eco-engineering interventions may not be recognised by the general public. They are often perceived as decorative modifications or pieces of art. Few people recognise their function. It is therefore useful to provide information panels in close vicinity to the eco-engineering intervention.

Two encased information boards were installed at the Mumbles seafront promenade in close vicinity to the Sea Hive project. They informed about the purpose of the project and the collaborating partners, and provided a QR code, which linked members of the public to an online questionnaire where they could voice their views. They also acknowledged the Ecostructure project.

Press release

A press release is an official statement delivered to members of the news media for the purpose of providing information, creating an official statement, or making an announcement directed for public release. Generally, a press release consists of four to five paragraphs with a length range from 300 to 800 words. Press releases are typically delivered to news media electronically, ready to use, and often subject to “do not use before” time, known as a news embargo.
Swansea Council initiated a press release for the Mumbles Sea-Hive project, which was picked up by local media. It ensured that residents were kept informed about the project and understood the purpose of the construction work at the sea defences.

TV and Radio

Presenting eco-engineering interventions on TV and radio will reach a broad audience and will inform the wider public about the purpose and nature of specific projects. TV is powerful in terms of reaching audiences not normally engaging with environmental or coastal topics.

During the project, Ecostructure staff took up opportunities to present projects on the BBC. For example, Prof. Pippa Moore presented artificial rock pools in a news program, and the Mumbles Sea Hive project featured in Michael Portillo's Great Coastal Railways program. BBC Radio Wales Country Focus presented the project in the program 'Seashore Tales and Rural Life'.

Social media

Social media are interactive technologies that facilitate the creation and sharing of information, ideas, interests, and other forms of expression through virtual communities and networks. Platforms are user-centric and enable communal activity and exchange. Some of the most popular social media websites, with more than 100 million registered users, include Facebook, TikTok, Instagram, Twitter and LinkedIn.

All of the platforms can enable communication to reach different audiences. Depending on the nature of an eco-engineering project and its stakeholders, different platforms may be preferred. For example, Facebook allows setting up community groups and is suitable for engaging with local residents, while LinkedIn may be more suitable for engagement with industry stakeholders.

Ecostructure set up a YouTube channel, which allowed publishing overview videos providing information about ecoengineering, introductions to individual work packages and explanations about outputs.

Conclusions

based on Ecostructure project experience

The Ecostructure project experience highlighted that stakeholder engagement is most successful if it is part of a project from beginning to end. It can be seen as an information dissemination activity to inform stakeholders, but this precludes dialogue and the opportunity for stakeholders to influence the decision-making process and the nature of the project. Engaging with stakeholders from the initial conceptual discussions allows the project to be more aligned with societal needs and builds greater trust and confidence in the project.

Eco-engineering is a particularly useful sector for start-to-finish stakeholder engagement since the benefits go beyond ecological enhancement. They allow people to form closer bonds with their local coastal environment, understand climate change and sea-level rise impacts, as well as coastal squeeze. They may also be enticed to commit to longer-term initiatives linked to coastal infrastructure such as citizen science projects.

The management of the stakeholder engagement process is time-consuming and needs to be adequately staffed. This requires commitment from the project lead and appropriate funding.

During the Ecostructure project, workshops focussing on individual interventions were successful in terms of active participation of stakeholders, as well as their willingness to consider views and information provided by other participants. Meetings were more productive when there was gender balance and a wide range of age groups. This may be difficult to achieve in all stakeholder events, but equality, diversity and inclusivity ought to be considered.

Workshops attended by stakeholders from different sectors were particularly welcomed by attendees, because it can be difficult, for example, for industry representatives to hear from community officers, or for academics to discuss regulation with local councils. For the engagement manager these workshops are also most difficult and time-consuming to organise.

Multistakeholder site visits were the most successful events. It appears that seeing the infrastructure and the surrounding coastal environment facilitates visualising eco-engineering interventions. Within a short period of time opportunities and potential problems could be explained and decisions were made. Joint site visits appear to be a suitable format to reach solutions.

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