BONUS BALTSPACE Project Deliverable 3.2:

A CATALOGUE OF APPROACHES AND TOOLS FOR MSP

Authors:

Andreas Kannen, Kira Gee, Nerijus Blazauskas, Roland Cormier, Karsten Dahl, Cordula Göke, Andrea Morf, Antje Ross, Angela Schultz-Zehden

Geesthacht, March 2016

Important note: This document is a deliverable of the BONUS BALTSPACE project.

Recommended reference: Kannen, A, Gee, K, Blazauskas, N, Cormier, R, Dahl, K, Göke, C, Morf, A, Ross, A, Schultz-Zehden, A (2016): BONUS BALTSPACE Deliverable 3.2: A Catalogue of Approaches and Tools for MSP.

BALTSPACE has received funding from BONUS (Art 185) funded jointly from the European Union's Seventh Programme for research, technological development and demonstration, and from Baltic Sea national funding institutions.

Content

Summary

This catalogue describes a selected range of tools and approaches that may be used by MSP planners to facilitate integration in MSP. The catalogue grew out of the BONUS BALTSPACE project which aims to analyse key integration challenges in MSP, in particular policy and sector integration, multi-scale integration, and stakeholder and knowledge integration. In total, eleven tools and approaches were selected for presentation based on their capacity to help address one or several of the integration challenges identified by BONUS BALTSPACE. All of the tools selected are transferable and can be applied in national and transnational contexts.

The catalogue includes:

- Bowtie analysis
- Culturally Significant Areas
- Governance baselines
- Integrated indicator system for assessing cumulative impacts
- Marxan and MarZone
- Open Standards for Conservation
- Quality Assurance in MSP based on a risk management approach
- Rapid Policy Network Mapping
- Scenario analysis
- Spatial Cost-Benefit Analysis
- WebGIS/interactive maps

Each tool is described with respect to the following:

- Which integration challenges can sensibly be addressed by the tool/approach?
- What are the strengths and weaknesses of the tool/approach with respect to the integration challenges identified?
- What are important basic conditions for application?

The catalogue places the tools and approaches into the context of the MSP cycle, recognising that different tools and approaches may suit different stages or particular aspects of marine planning. Potential complementarities of tools are also highlighted. A description is provided for each tool listing the inputs required for its application, the outputs it can deliver, strengths and limitations, as well as any relevant training and competence needs. References and website links are provided to facilitate follow-up.

We note that this catalogue does not provide a comprehensive overview of all the tools and approaches that could conceivably be of interest to MSP. It does not include decision support tools and modelling approaches for which overviews are provided elsewhere. All of the tools could be described as informal decision support tools in the sense that they primarily generate information which can then facilitate the planning process.

We also note that any assessment and evaluation of the tools is based on the tacit knowledge of BONUS BALTSPACE partners, representing conceivable options and theoretical possibilities rather than field-tested evidence. A selection of the tools listed in the catalogue will be tested and evaluated as part of BONUS BALTSPACE case studies during the further course of the project.

1. About BONUS BALTSPACE

In the EU, Maritime Spatial Planning (MSP) has been defined as a "process by which the relevant Member State's authorities analyse and organise human activities in marine areas to achieve ecological, economic and social objectives" (EC, 2014)[1]. The main aims and aspirations of MSP are to deliver greater coherence in marine management (e.g. achieving greater policy coherence and transnational coherence in planning approaches), to achieve a "fair balance of interests", as well as balance socio-economic and ecological objectives for the sea.

Integration is commonly regarded as a key concept in delivering these aspirations. However, little is known about the specific role of integration in MSP. Firstly, this is a question of definition. What exactly is meant by integration, and what types of integration might be of relevance in different MSP contexts? Secondly, it is a question of assessment. How might different types of integration contribute to delivering the objectives of MSP? For example, does horizontal and vertical integration in MSP really contribute to more sustainable use of space? What are the benefits of stakeholder and knowledge integration in MSP processes? Apart from methodological aspects, such as how to improve integration in MSP, an important question is whether greater levels of integration are always linked to better outcomes in MSP, such as more sustainable marine management or a more efficient MSP process. The latter is also a question of calibration and establishing criteria against which to measure the success of integration.

BONUS BALTSPACE has been designed to provide science-based approaches and tools to clarify and improve the capacity of integration in MSP in the Baltic Sea Region. Integration is understood as a facilitator of MSP processes with implications for outcomes rather than an outcome in itself. Focusing on strategically selected case study areas, the project aims to:

- Identify the current status and functions of integration in BSR MSP, including shortcomings and inefficiencies,
- Assess the enablers that facilitate integration and specific obstacles hampering it in different contexts and at different scales,
- Develop science-based approaches and tools designed to address the integration challenges identified,
- Evaluate the application of selected tools in the context of the integration challenges identified and the implications of using these tools (e.g. favouring one type of knowledge over others).

BONUS BALTSPACE also aims to provide guidance to MSP practitioners on how to use selected tools and analytical approaches, enabling them to constructively respond to current and future challenges of Baltic marine governance.

This report gives an overview of a selected set of tools and approaches that can be used to address some of the integration challenges encountered in MSP.

[1] Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning

2. Integration as a multi-dimensional concept

2.1 Integration needs in MSP

MSP is a multi-dimensional concept with multi-dimensional challenges. The first and most obvious challenge of MSP is related to the unbounded nature of the marine environment and the high level objective to pursue an ecosystem approach to marine planning. Although MSP is primarily a national endeavour, the natural and economic environment in which marine plans are drawn up are clearly affected by an international context, implying that MSP always also has a transnational dimension. The same applies to land-sea interactions and the fact that the marine environment is crucially affected by developments on land and vice versa. These interdependencies were recognised by Baltic Sea states even before the publication of the EU MSP Directive (expressed for instance in the HELCOM/VASAB Principles for MSP[2] or the BaltSeaPlan Vision 2030[3]), and has led to the acknowledgement that with respect to transnational marine activities at least, MSP should be coherent across the Baltic. In order to achieve such coherence, some level of integration is required of the various national (and possibly regional) MSP systems, each of which may have different aims, objectives, timescales, and processes.

Another challenge is related to the integrative nature of spatial planning as such, transcending sectoral approaches and seeking to achieve the best possible balance between different activities and demands on marine space. Here, the challenge is again a multi-level challenge, as MSP needs to recognise national as well as international policy contexts as drivers of (potentially contradictory) developments. MSP needs to establish itself as an integrated policy platform and implement maritime spatial plans as integrated spatial policy.

A third challenge is related to knowledge about the marine environment (natural and socio-economic) and the integration of different voices in the MSP process. This is linked to issues such as legitimacy regarding decisions surrounding the sea. The specific challenge here is to establish MSP as a platform for deliberation and debate, ensuring broad participation of stakeholders and wider communities of interest.

2.2 Integration challenges identified by BONUS BALTSPACE

Following on from the above, BONUS BALTSPACE has identified four specific levels of MSP integration needs:

Policy and sector integration

- Integration of environmental policies and Blue Growth
- Integration of sectors in public policy (e.g. maritime transports, fisheries, tourism)
- Integration of public, private and voluntary sector activities
- Coordination of sectoral/policy interaction
- Reduce conflicts between sectors

Multi-scale and transboundary integration

---

[2] The HELCOM-VASAB Baltic Sea Broad–scale Maritime Spatial Planning Principles were adopted by HELCOM and VASAB in 2010. They are: Sustainable management, ecosystem approach, long term perspective and objectives, precautionary Principle, participation and transparency, high quality data and information basis, transnational coordination and consultation, coherent terrestrial and maritime spatial planning, planning adapted to characteristics and special conditions at different areas, continuous planning.

[3] Gee, K., Kannen, A., Heinrichs, B. 2011. BaltSeaPlan Vision 2030- Towards the sustainable planning of Baltic Sea Space. www.baltseaplan.eu

- Integrating different (geo)political scales in MSP
- Integration of MSP across national borders
- Integrating MSP and terrestrial planning
- Increasing policy coherence and "fit", as well as the commitment to integration

Stakeholder integration

- Integrating stakeholder values, interests, and procedural aspects (e.g. access, legitimacy, power, timing, roles)
- Integrating stakeholder views in MSP processes

Integration of knowledge

- Integration of different types of knowledge, e.g. scientific knowledge, local knowledge, cultural knowledge, procedural knowledge
- Risk and uncertainty analysis, sustainability assessments/criteria
- Sectoral knowledge
- Integration of decision support tools in practical MSP processes

There is significant overlap between these four categories: For example, policy and transboundary integration also imply stakeholder and knowledge integration; stakeholder integration also requires knowledge integration.

Table 1 shows how certain integration needs spring from the inherent challenges of MSP. Some challenges and associated integration needs, such as the degree of participation that should be provided for, are related to different interpretations of the purpose and style of MSP. Although all integration challenges are likely to be represented in MSP processes in some way, their severity and relevance may differ widely depending on the context in which MSP is taking place.

Table 1: The relationship of integration challenges to different constituting elements of MSP (examples)

Origin of challenge	**Integration challenge**
The nature of the marine environment	Ecosystem approach vs. administrative boundaries
	Transboundary impacts of national activities
Understanding of MSP as a forum for deliberation/form of participatory decision-making, resulting in a plan with a strong sense of ownership	Stakeholder integration
MSP as a provider of spatial management solutions	Knowledge integration

2.3 Implications of the four integration needs

Achieving these four types of integration may involve the following:

Policy and sector/ multi-scale and transboundary integration:

- Collaborating in situations with different regulatory and normative contexts within sectors, countries, regions, and levels of governance,
- The ability to deal with different views of the purpose of MSP,
- Bringing together nature conservation and economic interests:

- Improved interagency integration (across public, private and voluntary sectors) – reducing sectoral fragmentation
- Improved strategic integration (reframing: joining up the content of policies, plans and programmes)
- Improved operational integration (integration of MSP processes with other sectoral processes (strategic alignment), joined up delivery mechanisms)

Stakeholder integration:

- The ability to deal with questions of access, empowerment and legitimacy (are the “right” stakeholders involved in the “right” way at the “right” time in the process?),
- A culture of deliberation (does everyone have a fair say, are relevant conflicts addressed, is knowledge shared, does mutual learning occur?),
- Ensuring stakeholders have real influence on or at least a clear role in the MSP process (transparency of purpose of stakeholder involvement, rather than token involvement),
- Facilitating shared commitment to implementation of marine spatial plans,
- Integration of different values and interests held by various stakeholders,
- De-facto stakeholder involvement in MSP in relation to the regulatory ambitions,

Knowledge integration:

- Understanding the implications of integration for data collection and management (more or less standardisation, availability, access),
- Developing a broader evidence base for MSP (including scientific and other types of knowledge),
- Understanding the value of different types of knowledge for MSP,
- Using knowledge appropriately within MSP.

Successful MSP therefore depends on a good understanding of the respective planning context (i.e. the planning area itself and the factors affecting it, as well as the predominant planning culture), but importantly also the MSP process and the need to successfully address key integration challenges as part of this process. The targeted use of tools and analytical approaches can provide valuable assistance in this context.

3. The BONUS BALTSPACE catalogue of tools and approaches

3.1 Overall aim and structure

The main aim of the catalogue is to describe a selected range of tools and approaches to MSP planners in the context of MSP integration challenges, enabling them to assess the potential usefulness of each tool for addressing their own MSP integration challenges. Each tool is described with respect to the following:

- Which integration challenges can sensibly be addressed by the tool/approach?
- What are the strengths and weaknesses of the tool/approach with respect to the integration challenges identified?
- What are important basic conditions for application?

The catalogue also places the tools and approaches into the context of the MSP cycle, recognising that different tools and approaches may suit different stages or particular aspects of marine planning. Potential complementarities of tools are also highlighted.

It should be noted that the catalogue of tools sets the scene for future work within the BONUS BALTSPACE project, implying that the assessments provided here are not based on any practical application of the tools within BONUS BALTSPACE. A selection of the tools listed in the catalogue will be tested and evaluated as part of the BONUS BALTSPACE case studies during the further course of the project.

Chapter 4 gives a brief description of each tool and approach listed in the catalogue. Chapter 5 provides an overview table indicating the integration challenges each tool can address, followed by a more detailed description of the direct and indirect outputs each tool can deliver. Chapter 6 provides an overview of potential synergies between the various tools, followed by a brief section on challenges in assessing tools and the next steps of working with the tools within BONUS BALTSPACE (chapter 7). Chapter 8 then gives a longer description of each tool and its application, structured along the lines of the International Standard IEC/ISO 31010 for risk management techniques (IEC/ISO 2009)[4]. This sets out the inputs required for applying the tool (e.g. specific data or information, time or experience) and the outputs each tool can deliver, strengths and limitations, as well as any relevant training and competence needs. References and website links are provided to facilitate follow-up.

3.2 Definition of tools/approaches

"Tools" and "approaches" are terms that are widely used in different management contexts but not always clearly defined. In simple terms, we understand an *approach* as the broader of the two terms, namely a framework for thinking about a problem (in this case an integration challenge) and then working towards a solution. A *tool* is a "thing used to help perform a job" (Oxford English Dictionary, online), in other words a more specific technique. The distinction between approach and tool is arbitrary and may not always be clear-cut. Tools in MSP are typically programmes or applications that have helped to implement one or more approaches. At the same time, an approach may use one or several tools to come to a defined end result. Both tools and approaches may be general or problem-specific and more or less adaptable to different scales and MSP contexts.

3.3 Selection of tools and approaches

Eleven tools and approaches have been selected for inclusion in this catalogue. They were chosen because of prior experience by BONUS BALTSPACE partners, with the exception of those tools that are being specifically developed as part of BONUS BALTSPACE. They were also chosen to cover a range of applications, including spatial and non-spatial tools, tools that focus more on the MSP process (or elements) and tools that focus on data. Some tools and approaches are well established, including for example risk management or institutional and policy analysis; others such as the bow-tie approach or open standards of conservation are less well known. Some are generic to management and others specific to a particular step of the MSP cycle. Some have been adapted to the needs of MSP for the first time, others such as Culturally Significant Areas were developed specifically with MSP in mind. All of the tools selected are transferable and can be applied in national and transnational contexts.

It is important to note that this catalogue does not provide a comprehensive collection of all the tools and approaches that could conceivably be of interest to MSP. Overviews of decision support tools and modelling approaches for which overviews are provided e.g. by Center for Ocean Solutions (2011)[5], Stelzenmüller et al. (2012)[6] and Mohn et al.

---

[4] IEC/ISO International Standard 31010, Edition 1.0 2009-11. Risk management – Risk assessment techniques.

[5] Center for Ocean Solutions. 2011. Decision Guide: Selecting Decision Support Tools for Marine Spatial Planning. Primary authors: Heather Coleman, Melissa Foley, Erin Prahler, Matthew Armsby,

(2012)[7]. It should also be pointed out that none of the tools selected are decision-**making** tools in that they do not offer any ready-made solutions for MSP. All could be described as informal decision **support** tools in the sense that they primarily generate information which can then support decision-making or facilitate the planning process.

The specific selection criteria for inclusion in the catalogue included:

- Addresses one or several of the specific integration challenges identified in Table 3 (directly or indirectly),
- Fairly new or have not been widely discussed in an MSP context before,
- Tested in other management contexts,
- Fills knowledge or data gaps in MSP,
- Provides targeted information for MSP decision-making,
- Helps to weigh up different planning options,
- Links different types of knowledge,
- Facilitates a participative and transparent MSP process.

4. An overview of the tools and approaches

The following tools and approaches were selected for inclusion in the BONUS BALTSPACE tool catalogue:

- Bowtie analysis
- Culturally Significant Areas
- Governance baselines
- Integrated indicator system for assessing cumulative impacts
- Marxan and MarZone
- Open Standards for Conservation
- Quality Assurance in MSP based on a risk management approach
- Rapid Policy Network Mapping
- Scenario analysis
- Spatial Cost-Benefit Analysis
- WebGIS/interactive maps

4.1 Fit of tools within the MSP cycle

The selected tools are likely to find application at varying stages of MSP in support of different tasks of the planner. Here we use a generic MSP planning cycle for illustration, noting that the various steps may well overlap, involve smaller sub-cycles (e.g. repetitions of particular steps) and not necessarily occur in a neat and linear sequence. Tentative fits for the selected tools are indicated.

---

and George Shillinger. The Woods Institute for the Environment, Stanford University, California Download from www.centerforoceansolutions.org.

[6] Stelzenmüller V, Lee J, South A, Foden J, Rogers SI. 2012. Practical tools to support marine spatial planning: A review and some prototype tools. Marine Policy. www.elsevier.com/locate/marpol

[7] Mohn, C, Kotta, J, Dahl, K, Göke, C, Blazauskas, N, Ruskule, A, Aps, R, Fetissov, M, Janssen, F, Lindblad, C, Piotrowksi, M & Wan, Z. 2012. Modelling for Maritime Spatial Planning: Tools, concepts, applications. BaltSeaPlan Report No. 19, download from www.baltseaplan.eu

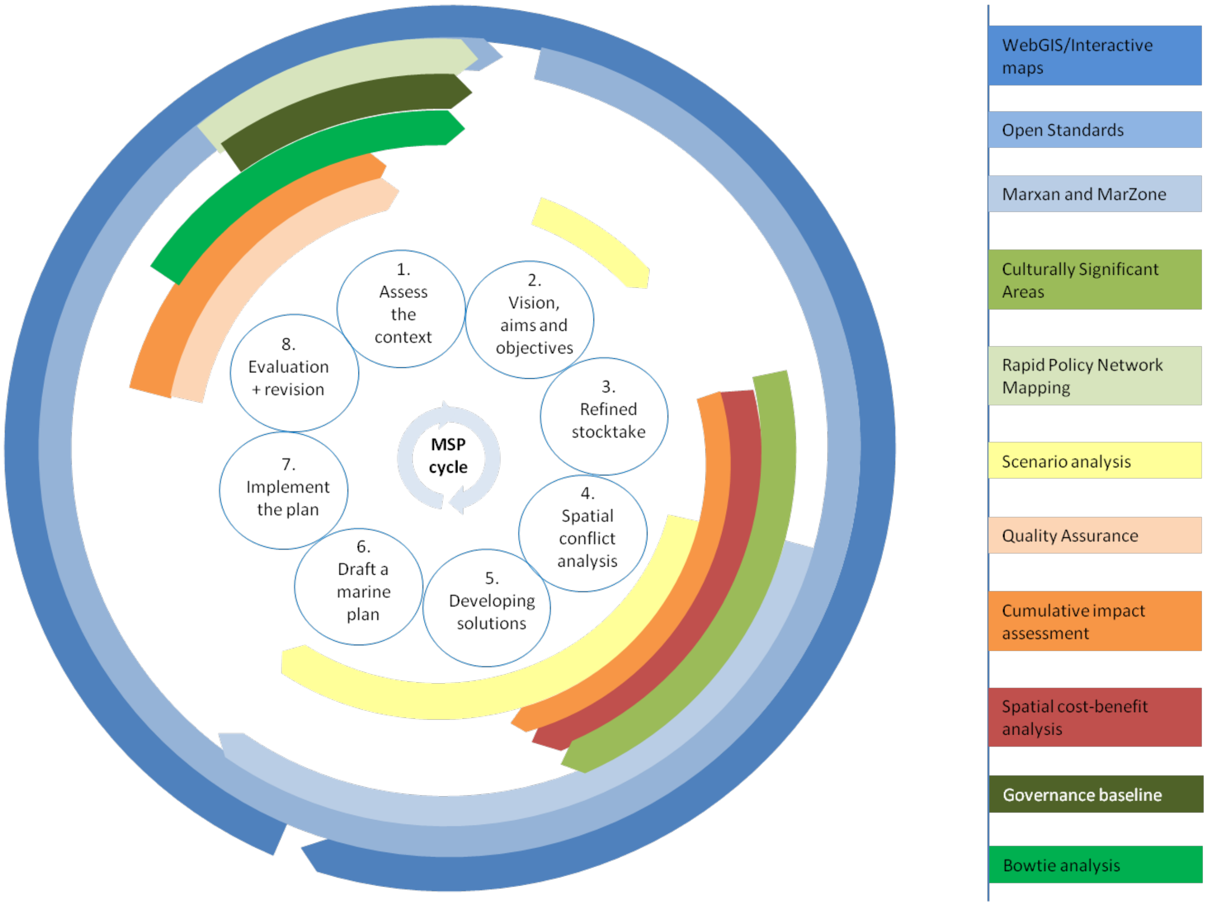

Figure 1. BONUS BALTSPACE approaches and tools in the MSP planning cycle

Open Standards for Conservation is a type of logical framework which accompanies the MSP process from the initial assessment of the context to developing solutions (which may then also feed into step 8). Interactive maps/WebGIS can also be useful during the entire MSP process as they support the viewing and exchange of spatial information.

Three tools (Bowtie analysis, Rapid Policy Network Mapping and Governance Baselines) can be used to analyse the context for MSP and the wider political, institutional and legal environment within which it takes place.

Spatial Cost-Benefit Analysis can provide important economic impact information which could be used during stocktaking and spatial conflict analysis. Analysis of culturally significant areas also applies during the stages of stocktaking, conflict analysis and development of solutions.

Marxan/MarZone are useful tools for systematically finding possible locations for specific uses or nature conservation and working towards drafting a spatial plan. Indicators for cumulative impacts (composed of environmental, economic and social indicators) are designed to evaluate the impact of MSP against an initial baseline and represent a tool that is also capable of evaluating MSP ex-post. This evaluation can then feed into an initial assessment for future plans, i.e. marking the step from a first to a second generation spatial plan. The same applies to Quality Assurance which is primarily an evaluation tool but which can also be applied to the initial stage of the planning cycle.

A brief description of the tools is presented below.

4.2 Bowtie analysis

Bowtie analysis is designed to help planners analyse risks and opportunities of different planning decisions in a structured way. A bow-tie analysis essentially shows the causes and effects of an event (or risk) as well as suitable control measures (Cormier et al. 2013)[8]. The DPSIR framework (drivers – pressures – state – impact – response, see Cormier et al. 2013) is a useful framework for conducting a bowtie analysis as it reflects a chain of causal links starting with 'driving forces' (economic sectors, human activities) as the sources of risk. 'Pressures' (emissions, waste) resulting from human activities can cause changes to the 'state' (physical, chemical and biological) of the environment, resulting in 'impacts' on ecosystems, human health and safety. 'Response' (prioritization, target setting, indicators) shows what should be implemented to prevent a change in the state of the environment and mitigate the consequences of the impacts.

4.3 Culturally Significant Areas

In many areas there is insufficient knowledge of the entire range of values the sea provides. In particular, it is still uncommon to regard the sea as a place defined by cultural meanings. For planners and managers, the question is how MSP can take account of immaterial cultural values in a way that is commensurate with ecological or economic values. The concept of "culturally significant areas" was developed to spatialize cultural values and to overcome problems with value classifications (ICES 2013)[9]. To identify an area as culturally significant is to conclude that it provides cultural services that are critical to the wellbeing and identity of a given community. High cultural significance implies high priority to the community concerned. The methodology proposes five criteria for determining cultural significance which can serve as a guideline for working with the communities concerned. Areas can therefore be defined as culturally significant for various reasons and based on different value sets. Once culturally significant areas have been identified, a risk assessment can be carried out based on existing and future pressures occurring in the planning area. It is also possible to map culturally significant areas.

4.4 Governance Baselines

A governance baseline is a time trajectory of how the governance system in a specific place has responded, or failed to respond, to the trajectory of ecosystem change (Olsen et al. 2009)[10]. Understanding conflicting histories, the evolution of policy frames, specific sectoral paradigms and governance mechanisms is essential for achieving better policy integration across sectors and countries. The approach was initially developed to document and analyse how the governance system in a specific place has responded – or failed to respond – to the trajectory of ecosystem change by examining long-term trends in both human well-being and environmental conditions. In BONUS BALTSPACE, this approach will be adapted to fit the specific requirements of MSP in a transnational setting. Governance Baselines will be applied in coordination with the Bow-tie approach:

[8] Cormier, R., A. Kannen, M. Elliott, P. Hall, and I.M. Davies. 2013. Marine and coastal ecosystem-based risk management handbook. ICES Cooperative Research Report No. 317. 60 pp.
[9] ICES 2013. Report of the joint HZG/LOICZ/ICES workshop: Mapping cultural dimensions of marine ecosystem services (WKCES). Helmholtz-Zentrum Geesthacht, Germany. ICES CM 2013/SSGHIE:12.70 pp.
[10] Olsen, S.B.; Page, G.G. & Ochoa, E. 2009. The Analysis of Governance Responses to Ecosystem Change: A Handbook for Assembling a Baseline. LOICZ Reports & Studies No. 34. GKSS Research Centre, Geesthacht, 87 pp.

detailed analysis of risks and policy gaps may feed into a governance baseline while the evolutionary component of the governance baseline may support the Bow-tie analysis.

4.5 Integrated indicator system for assessing cumulative impacts of marine utilisation

Indicator systems can be used to estimate the impacts of MSP *ex ante* and evaluate them *ex-post*, for example in terms of spatial efficiency, functionality of ecosystems, navigation, economic cost reduction and contribution to social welfare. This approach uses special combinations of ecological and socio-economic indicators and/or creates new combined indicators suitable for assessment of cumulative effects of various maritime uses. A new approach of using indicative measures is developed in order to measure and evaluate the cumulative effects of various spatial solutions provided. This work is based on combination of existing indicators facilitated with new assessment approaches, or, if relevant by creating new, integrated indicators for assessment of cumulative impacts. The proposed methodology will be the background for assessment and monitoring of a changing socio-economic situation before and after maritime spatial planning is applied. The main objective is to see whether MSP is beneficial for the coastal communities in terms of economic growth and social well-being, and if it will benefit the general ecological status of the marine environment.

4.6 Marxan / MarZone

The software Marxan and Marxan with Zones (MarZone) are site selection tools which help with assigning sites or zones to specific uses and nature conservation. Marxan/MarZone are designed to find the most suitable area for set targets while avoiding costs or conflicts caused by other uses or nature protection. Since the user defines the relevant input data and targets, the decision support tool can be applied to any management question as long as it can be broken down to the required input format (Göke and Lamp, 2012)[11]. This allows a range of scenarios to be developed based on different priorities and targets, which in turn can serve as a basis for finding solutions in the MSP process. MarZone is the more flexible tool, allowing zones with different and independent targets to be defined and costs and conflicts to be connected very specifically to the targets (Watts et al. 2009)[12]. This makes MarZone particularly suited for MSP. Targets for different sectors can be analysed at the same time, providing the opportunity to not only look at one sector at a time but resolve complex objectives in spatially diverse areas such as the BONUS BALTSPACE case study sites in the Baltic Sea. Marxan and MarZone have already been applied in the context of MSP in the Baltic Sea, e.g. in the area of Arkona Basin/Pomeranian Bight for offshore wind power and fisheries (Göke and Lamp, 2012, Schmiedel and Lamp, 2012[13]). The objective of applying a site selection tool in MSP is to demonstrate the usefulness and reliability of a systematic approach for all aspects of planning and to analyse the potential of such a tool to handle some of the integration challenges identified in BONUS BALTSPACE.

[11] Göke, C., Lamp, J. 2012. Case Study: Systematic site selection for offshore wind power with Marxan in the pilot area Pomeranian Bight. BaltSeaPlan. BaltSeaPlan Report no. 29, download from www.baltseaplan.eu

[12] Watts, M.E, I.R. Ball, R.R. Stewart, C.J. Klein, K. Wilson, C. Steinback, R. Lourival, L. Kircher, and H.P. Possingham. 2009. Marxan with Zones: software for optimal conservation based land - and sea - use zoning, Environmental Modelling & Software (2009), doi:10.1016/j.envsoft.2009.06.005

[13] Schmiedel, J., Lamp, J. 2012. Case Study: Site selection of fisheries areas for Maritime Spatial Planning with the help of tool “Marxan with Zone” in the pilot area Pomeranian Bight. BaltSeaPlan. BaltSeaPlan Report no. 30, download from www.baltseaplan.eu

4.7 Open Standards for Conservation

The Open Standards for the Practice of Conservation (OS) approach helps to structure the content of planning and management and combine it with the necessary process management. It facilitates a cyclical, adaptive perspective and uses a series of consecutive steps ranging from analysis to planning, implementation, and evaluation/adaptation, and broader learning. Each step implies a facilitated and systematic discussion process for the participating stakeholders. The approach ensures that final outcomes are broadly anchored, based on logically coherent situation analyses, objectives, strategies and measures, and steps of implementation including an evaluation plan. It promotes the setting of realistic priorities for actions and monitoring and the sharing of experiences with others. The OS approach was originally developed to improve conservation management, as protected areas were found to rarely reach their objectives. Lately, however, it has also been tested in marine and coastal planning and management, and has been broadened in their scope to include human use and social welfare aspects. A management software (MIRADI) as well as additional tools have been developed by the OS community of practice to facilitate logical analysis and practical management. This community also includes coaching resources.

4.8 Quality Assurance in MSP based on a risk management approach

The approach is designed as a Marine Spatial Planning Quality System (Cormier et al. 2015)[14] to provide a generic structure of how to set up spatial planning processes in marine areas. It offers guidance to practitioners developing the planning processes on what should be incorporated when designing and subsequently managing a process of spatial planning. Furthermore, it provides generic quality assurance objectives for the output of the planning process (the plan) and for the planning process. The approach is conceptually linked to ecosystem based risk management as outlined in Cormier et al. 2013[15] and clearly distinguishes between the process of planning on one hand and the process output. It points to sub-processes and types of information that need to be included at different stages of the process from the perspective of quality management in order to ensure that the process of planning as well as the output of the process, the plan itself, follow a clear and transparent structure. However, defining plan objectives is part of the planning process itself or predefined by policies and legislation, which the plan is expected to implement.

4.9 Rapid Policy Network Mapping

Rapid Policy Network Mapping (RPNM) is a simple, fast and pragmatic method for capturing and providing insight into institutional dynamics and policy information. It maps the current governance system around a particular policy context along different spatial levels. It may therefore become the information base for further discussions on policy processes and participation in them (Bainbridge et al. 2011)[16]. The approach particularly supports understanding the interlinkages among policy instruments and actors in this context.

---

[14] Cormier, R. Kannen, A., Elliott, M., Hall, P., Davies, I.A. 2013. Marine and coastal ecosystem-based risk management handbook. ICES Cooperative Research Report No. 317.

[15] Cormier, R., A. Kannen, M. Elliott, P. Hall, and I.M. Davies. 2013. Marine and coastal ecosystem-based risk management handbook. ICES Cooperative Research Report No. 317. 60 pp.

[16] Bainbridge JM, Potts T, O'Higgins TG. 2011. Rapid Policy Network Mapping: A New Method for Understanding Governance Structures for Implementation of Marine Environmental Policy. PLoS ONE 6(10): e26149. doi:10.1371/journal.pone.0026149

4.10 Scenario analysis

Scenario analysis is a name given to the development of descriptive models of how the future might turn out (IEC/ISO 2009)[17]. Most approaches focus on a qualitative storyline based on certain assumptions, which may be supported by data or model calculations. The purpose of creating scenarios is thus mostly exploratory. Scenarios can be to engage stakeholders in a discussion of different options; it is also possible to use them to discuss management processes or other necessary steps for achieving the desired future. Alternatively, sets of scenarios can be used to identify what might happen under particular circumstances. With short time frames and good data, likely scenarios can be extrapolated from the present. For longer time frames or with weak data, scenario analysis becomes more imaginative and is also referred to as futures analysis. The advantage of scenario analysis is that this is a highly flexible tool that can be applied to different settings and circumstances and combined with various visualisation techniques (e.g. GIS).

4.11 Spatial cost-benefit analysis

The Spatial Cost-Benefit Analysis tool will be newly developed and tested by BONUS BALTSPACE. It will enable analysis of the distribution of economic costs and benefits associated with a given set of maritime uses (including combined uses), highlighting who bears the costs and benefits and how the winners/losers of particular options are distributed geographically. This can help MSP to evaluate different development options against political objectives, such as maximizing social welfare or strengthening a particular sector. Analysis of the distribution of costs and benefits at geographical scales can help stakeholder communication and bring into play stakeholder groups or dimensions to blue growth that have so far not been considered in MSP. The tool focuses on monetary costs and benefits, but non-monetary costs and benefits could also be taken into consideration. Input data will be based on a combination of different statistical data sets and – where data cannot be extracted from these – a selected set of interviews with sector experts and members of local communities. The BONUS BALTSPACE Spatial Cost-Benefit Analysis tool will be developed to assess the costs and benefits of the most important sea use sectors, namely:

- Offshore wind energy production
- Shipping
- Sand and gravel exploitation
- Cables and pipelines
- Fishing
- Maritime tourism
- Aquaculture/mariculture

4.12 WebGIS/interactive maps

Interactive maps give users an overview of the situation in a particular geographical area. Compared to a full GIS their functionality is reduced, in a way that depends on the purpose of the maps. This could be to view relevant spatial data, to annotate, draw, or measure on the map, to create buffers around features but also more advanced analysis, modelling or editing. Interactive maps typically combine data (possibly in the form of data services) from many sources and thereby visualize which uses occur where in space or which ecological components are present at which location. Often, they also include information on administrative units and the option to add one’s own choice of data or

[17] IEC/ISO International Standard 31010, Edition 1.0 2009-11. Risk management – Risk assessment techniques.

services. Naturally, the data does not need to stop at the coast but can cover the land as well. Interactive maps are more flexible than prepared maps because users can decide which data layers to combine and zoom in and out according to their needs. Interactive maps can often be saved and shared (as online maps) or exported as pictures and included in other documents. Analysis data can be downloaded as spatial data, tables or reports.

4.13 Comparative characterisation of tools

Table 2 provides a comparative overview of the tools and approaches described in the catalogue. They are classed here according to the following criteria.

Spatial focus:	Describes whether the tool/approach primarily focuses on marine space itself, e.g. assists with the integration of different spatial claims or different spatial planning options.
Orientation:	Some tools can be used to support the MSP process (e.g. provide a structure for discussion), others are more data-oriented in that they provide information on particular aspects of MSP (e.g. costs and benefits of different marine activities, drawing together different types of data, making available information that was not available before etc.)
Generality:	Some tools apply to MSP generally, others address a specific aspect or problem.
Scalability:	Some tools are best applied at a particular geographical scale (e.g. for reasons of data availability), others can easily be adapted to different scales.
Availability:	Some tools have been available for some time (and have possibly found prior application in MSP), others are being developed as part of BONUS BALTSPACE and not yet available for immediate use.
Designed for MSP:	Some tools have been developed specifically for MSP, others have been adapted from other contexts.

Table 2: Brief comparative characterisation of tools and approaches

Tool / approach	**Spatial focus**	**Orientation**	**Generality**	**Scalability**	**Availability**	**Designed for MSP**	**Potential challenges in applying the tool**
Bowtie analysis	No	Data oriented	Problem-specific	Yes	Available	No	Given the complexity of the multidisciplinary aspects of MSP, the tool may have limited quantitative applications[18].
Culturally Significant Areas	Yes	Process and data oriented	Problem-specific	Limited	Available	Yes	Requires active participation of local communities/stakeholders. Time and resource intensive. Requires social science skills.
Governance baselines	No	Data oriented	General	Yes	Available	No	Lack of documentation from the organisations/institutions concerned, unwillingness of representatives to be interviewed
Integrated indicator system for assessing cumulative impacts of marine utilisation	Yes	Data oriented	Problem-specific	Yes	In development	Yes	Indicators usually do not provide absolute values, so this is a tool for comparative analysis, revealing the trends and main character of changes. Accuracy of the measured indicators also is very much dependant on the type and frequency of data collected by national statistical departments, level of scientific knowledge.

[18] ICES. 2015. Report of the Workshop on Probabilistic Assessments for Spatial Management (WKPASM), 9–13 March 2015, Hamburg, Germany. ICES CM 2015/SSGEPI:16. 32 pp.

Tool / approach	**Spatial focus**	**Orientation**	**Generality**	**Scalability**	**Availability**	**Designed for MSP**	**Potential challenges in applying the tool**
Marxan and MarZone	Yes	Data oriented	Problem specific	Yes	Available	No	The main challenges will be to deal with unresolved data gaps and the need to quantify and weight all information in relation to each other.
Open Standards for Conservation	No	Process oriented	General	Yes	Available	No	Time and resource limits of the conducting organisation. Need to work with many sectors and related objectives. Active participation required over time. The capacity to be coherent across sector objectives with regard to geographical scale needs to be tested.
Quality Assurance in MSP based on a risk management approach	No	Process oriented	General	Yes	Available	Yes	Lack of monitoring data, lack of evaluation criteria, the need to quantify information
Rapid Policy Network Mapping	No	Process oriented	General	Yes	Available	No	

Tool / approach	Spatial focus	Orientation	Generality	Scalability	Availability	Designed for MSP	Potential challenges in applying the tool
Scenario analysis	Yes	Data and process oriented	Problem specific	Yes	Available	No	Requires skilled facilitator. Short-term scenarios may be extrapolated from real data; availability not always given. Long-term scenarios may take time to build and require imagination and good communication.
Spatial Cost-Benefit Analysis	Yes	Data oriented	Problem specific	Limited	In development	Yes	Difficulty in separating out maritime sectors from more general sector categories. Lack of economic data at local/regional level
WebGIS/inter active maps	Yes	Data and process oriented	General or problem specific		Available		Not all data / information is spatially available

5. Linking approaches and tools to MSP integration challenges

Whilst the tools and approaches may offer interesting opportunities in their own right, the purpose of this catalogue is to link them to the MSP integration challenges identified by BONUS BALTSPACE. An overview of potential interactions is provided in Table 3, featuring a selection of different types of integration challenges. Tools and approaches are presented here in terms of their theoretical capacity of providing support. Rather than offer ready-made solutions, the tools and approaches can offer a means of addressing integration challenges, in some cases making a very targeted contribution.

The intention of Table 3 is to provide an indication of the type of integration challenge the tool or approach could assist with, bearing in mind that links with integration challenges may be indirect and depend on how, where and when an approach or tool is applied (e.g. whether it is applied as a desktop study or in a participatory way, what MSP context it is applied in, in which cultural context it is placed). It should also be pointed out that this assessment is based on existing knowledge or assumptions regarding the tools; these still need to be verified by testing the tools in actual MSP contexts. An evaluation of selected tools will be carried out as part of BONUS BALTSPACE, leading to a more detailed assessment of the capacity of teach tool against the integration challenges identified. This will consider that the capacity of each tool will also be influenced by other contextual factors, such as time and resources available, the training of staff, or the policy and cultural context of MSP.

Overall, Table 3 highlights that the more general tools lend themselves to addressing a broader range of integration challenges. Process-oriented tools are also capable of addressing a wider range of challenges than the more specific data-oriented tools. Multi-scale and transboundary integration are addressed by the greatest number of tools. Table 3 therefore also indicates gaps that future tool development could fill.

Table 4 specifies the role of the tools in facilitating integration in some more detail and summarises the potential outputs of using each tool, differentiating between tangible and intangible (or indirect) outputs for MSP. Here, the scale of application is an important consideration. For example, it is easier for tools to contribute to vertical integration if it is applied in a context spanning several levels of administration and/or spatial scales. Vertical integration is easier to achieve for process-oriented than data oriented approaches, again if used in a context combining several levels of administration and / or spatial scale). Again, it should be noted that the list of outputs describes conceivable outputs; they have not been verified within the BONUS BALTSPACE context.

Table 3: Relationship of tools to MSP integration challenges (Bold type: categories of integration challenges, normal type: sub-categories)

	Policy and sector integration	Integration of environmental policies and Blue Growth	Integration of sectors in public policy	Integration of public, private and voluntary sector activities	Coordination of sectoral/policy interaction	Reduce conflicts between sectors	**Multi-scale and transboundary integration**	Integrating different (geo)political scales in MSP	Integration of MSP across national borders	Integrating MSP and terrestrial planning	Increasing policy coherence	**Stakeholder integration**	Integrating stakeholder values, interests, and procedural aspects	Integrating stakeholder views in MSP processes	**Knowledge integration**	Integration of different types of knowledge	Risk and uncertainty analysis, sustainability assessments/ criteria	Sectoral knowledge	Integration of decision support tools in practical MSP processes	Integration of data (technical)	Comments
Bowtie analysis	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)						x		x		Analytical tool. Each bowtie is based on fixed questions with a certain world view). Many different bowties are possible.
Culturally Significant Areas				x	(x)	x		x		x			x	x		x	x			x	Analytical tool focusing on the understanding of cultural values by communities and their spatial expression.
Governance Baselines	x	(x)					x														Analytical tool, focus on the evolution of institutions/ organi-sations. Facilitates analysis of barriers to policy and sector integration.

	Policy and sector integration	Integration of environmental policies and Blue Growth	Integration of sectors in public policy	Integration of public, private and voluntary sector activities	Coordination of sectoral/policy interaction	Reduce conflicts between sectors	**Multi-scale and transboundary integration**	Integrating different (geo)political scales in MSP	Integration of MSP across national borders	Integrating MSP and terrestrial planning	Increasing policy coherence	**Stakeholder integration**	Integrating stakeholder values, interests, and procedural aspects	Integrating stakeholder views in MSP processes	**Knowledge integration**	Integration of different types of knowledge	Risk and uncertainty analysis, sustainability assessments/ criteria	Sectoral knowledge	Integration of decision support tools in practical MSP processes	Integration of data (technical)	Comments
Integrated indicator system for assessing cumulative impacts		(x)					x			x					x	x	x			x	Indicators are scale-dependent (different data needed for different spatial scales), therefore multi-scale integration is difficult.
Marxan/ MarZone	x	x		x	x	x	x	x	x	(x)		x	x	x	(x)	(x)		(x)	x	x	Different levels of data detail will be needed for different spatial scales
Open Standards for Conservatio n	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x			Analytical and project management tools combined with facilitated discussion process. Inherent flexibility: Many x possible if used consciously to address these aspects. Adaptation may be needed.

	Policy and sector integration	Integration of environmental policies and Blue Growth	Integration of sectors in public policy	Integration of public, private and voluntary sector activities	Coordination of sectoral/policy interaction	Reduce conflicts between sectors	**Multi-scale and transboundary integration**	Integrating different (geo)political scales in MSP	Integration of MSP across national borders	Integrating MSP and terrestrial planning	Increasing policy coherence	**Stakeholder integration**	Integrating stakeholder values, interests, and procedural aspects	Integrating stakeholder views in MSP processes	**Knowledge integration**	Integration of different types of knowledge	Risk and uncertainty analysis, sustainability assessments/ criteria	Sectoral knowledge	Integration of decision support tools in practical MSP processes	Integration of data (technical)	Comments
Quality Assurance in MSP based on a risk mana-gement approach	x	x	x	x	x	x	x	x	x	x	x	x	(x)		(x)		x				Provides a structure and quality criteria for setting up the MSP process and for evaluating plan outputs.
Rapid Policy Network Mapping	x	x	x		x		x	x	x	x	x										Analytical tool, focus on full inclusion and rapid assessment of institutions, organisations and legal settings/ policies along spatial scales and levels of decision-making.
Scenario analysis	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	*(x)*	*if linked to modelling.* Identifies potential pathways and visions. Enables discussion about the future.

	Policy and sector integration	Integration of environmental policies and Blue Growth	Integration of sectors in public policy	Integration of public, private and voluntary sector activities	Coordination of sectoral/policy interaction	Reduce conflicts between sectors	**Multi-scale and transboundary integration**	Integrating different (geo)political scales in MSP	Integration of MSP across national borders	Integrating MSP and terrestrial planning	Increasing policy coherence	**Stakeholder integration**	Integrating stakeholder values, interests, and procedural aspects	Integrating stakeholder views in MSP processes	**Knowledge integration**	Integration of different types of knowledge	Risk and uncertainty analysis, sustainability assessments/ criteria	Sectoral knowledge	Integration of decision support tools in practical MSP processes	Integration of data (technical)	Comments
Spatial Cost-Benefit Analysis	x	x	x		x		x	x		x	x	x			x		x	x		x	Macroeconomic analysis. Also addresses temporal dimension of economic develop-ment. Promotes land/sea integration as focus is on impacts of marine development on land.
WebGIS/ interactive maps	(x)	x		x		x	x	x	(x)	x	(x)	x		x	x	(x)		x		(x	Illustrative, multi-purpose tool with focus on communication and the drafting /discussion of options.
	6	*6*	*4*	*5*	*5*	*5*	*8*	*7*	*4*	*7*	*4*	*5*	*3*	*4*	*4*	*3*	*5*	*3*	*2*	*4*	*No. of tools directly addressing the inte-gration challenge*

x = direct contribution, (x) = indirect contribution

Table 4: Role of tools in the context of integration challenges and expected outputs

Tool	**Role in facilitating integration**	**Tangible outputs**	**Intangible outputs**
Bowtie analysis	• Facilitates vertical and horizontal integration • Enables interagency and strategic integration • Can also enable integration of MSP process with other sectoral processes, integration of MSP planning with MSP implementation, and integration of MSP and ecological management.	• Quality analysis and visual representation of science and policy objectives within a management context • Understanding of policy/legislative framework • Identification of legislative/policy gaps • Analysis of temporal and spatial approaches being considered during the planning process • Facilitates the communication of objectives and management approaches being implemented • Forces specification of aims/objectives of MSP plan (what is it trying to mitigate/prevent) in order to assess management options	• Learning process for all participants • Facilitates systems thinking/link of MSP to DPSIR framework
Culturally Significant Areas	• Integration of tacit/community knowledge and cultural values • Enables the inclusion of intangibles in the planning process • Stakeholder integration: Facilitates a broadly participative process, including wider communities and stakeholders not normally included • Facilitates land-sea	• Identification of areas that are of significance to communities • Maps of culturally significant areas • A baseline of cultural values in the planning area	• Learning process for all participants • Integration of social sciences in MSP

	integration in terms of combined coastal/marine value assessments		
Governance Baselines	• No direct relationship with integration challenges, but furnishes useful background information which can support horizontal and vertical integration/ interagency integration	• Assessment of the evolution of institutions	• Learning process for all participants
Integrated indicator system for assessing cumulative impacts	• Facilitates knowledge integration and may support interagency integration	• A tested indicator system and methodology	• Learning process for all participants • Facilitates systems thinking • Focus on evaluation of planning solutions
Marxan/ MarZone	• Horizontal/vertical integration: brings together different data and targets from various stakeholders/institutions/processes • Interagency integration: Brings together ecosystem targets with sectoral interests/economic and social targets • Knowledge integration: translates different types of data/knowledge with a transparent methodology into a spatial format • Stakeholder integration: Brings together different stakeholders for generating and assessing results (scenarios) • Brings out the	• Scenarios of how zones could be formed in future plans • Analyses whether the potential conflicts really occur in the area, if all or which targets can be met and if some sectors or ecological components suffer under the agreed distribution of space	• Facilitates dialogue/communication by asking stakeholders to define targets/set out objectives • Facilitates deliberation of different options/scenarios based on real data input and based on assessing different costs and benefits of the various options.

	implications of agreed targets and conflicts related to them		
Open Standards for MSP	• Horizontal/vertical integration: brings together various stakeholders/institutions/processes • Stakeholder integration: brings together different stakeholders for content and process design	• A logical process framework • Jointly defined vision, goals, targets, objectives based on commonly agreed priorities, which can be related to an evaluation framework including relevant indicators to monitor outcomes and if necessary adapt management • Facilitated interaction between stakeholders and manager	• Facilitates dialogue/communication by enabling stakeholder contribution to process design • Process ownership by those involved
Quality Assurance in MSP based on a risk management approach	• Contribution towards all integration challenges as the approach offers quality objectives for the MSP process and plan	• A transparent, clearly structured and designed planning process along clearly defined objectives. • Criteria for monitoring and evaluation of the process and its achievements • The ability to justify and explain MSP decisions according to clear criteria	• Learning process for planners • Identification of gaps and needs for improvement
Rapid Policy Network Mapping	• No direct relationship with integration challenges, but furnishes useful background information which can support horizontal and vertical integration/ interagency integration	• Assessment of the evolution of institutions	• Learning process for all participants
Scenario analysis	• Analytical tool to identify potential development paths and future visions	• Future visions captured in writing or images	• Learning process for all participants • Enables

	• Indirect contribution to all integration challenges, especially stakeholder and knowledge integration • Can be tailored to address a wide range of specific integration challenges (e.g. land-sea, ecological/socio-economic, policy, sectoral) • Not necessarily a spatial tool (can be used to create scenarios of processes)		discussion about the future • Greater mutual understanding / understanding of stakeholder interests and priorities
Spatial Cost-Benefit Analysis	• facilitates knowledge and stakeholder integration	• Monetary costs/benefits of different sector developments in relation to geographical areas • Compare potentially different costs and benefits to political objectives (economic, social, environmental) • Economic consequences of different development scenarios for different stakeholder groups	• Learning process for all participants
WebGIS/ interactive maps	• Supports vertical and horizontal integration by visualising options and scenarios • Supports stakeholder integration by involving them in discussing planning options • Supports knowledge integration as long as knowledge can be shown spatially • Integration of ecological and other types of knowledge	• Communication tool • Tangible web interface or maps that can be customised and used in different contexts	• Dialogue with a wide range of stakeholders and the general public

6. Combining tools for mutual support

While each approach/tool focuses on particular aspects of information and addresses several integration challenges, none can cover everything. Combinations of tools that bring together aspects related to governance, the social and economic sphere and the natural sciences may therefore provide additional support for dealing with integration challenges in MSP. Table 5 indicates the theoretical potential for synergy among the tools listed in this catalogue based on existing knowledge. Each tool is listed as an influencing agent and agent influenced, highlighting how tool may be able to complement each other in different ways and consciously used in combination.

It should be pointed out that this assessment is tentative and not based on actual evidence. Some combinations of tools will be tested as part of BONUS BALTSPACE, providing more detailed information on the combination of tools and the added benefits this may yield.

Table 5: Potential synergies between tools and approaches in BONUS BALTSPACE

Across: Impacting tool (e.g. how bowtie analysis may impact on the other tools/approaches), down: Tools/approaches as impacted by other tools

	Bowtie analysis	**Culturally Significant Areas**	**Governance Baselines**	**Integrated indicator system for assessing cumulative impacts**	**Marxan / MarZone**	**Open Standards for MSP**	**Quality Assurance in MSP based on a risk management approach**	**Rapid Policy Network Mapping**	**Scenario analysis**	**Spatial Cost-Benefit Analysis**	**WebGIS / interactive maps**
Bowtie analysis		Bowtie analysis may point to gaps with respect to cultural values or policy related to culturally significant areas	Detailed analysis of risks and policy gaps can feed into Governance Baselines	Results from risk assessment could be used to further develop indicators	Bowtie analysis can be used to analyse policy context and policy gaps related to MarZone scenarios	BowTie may feed OS with risk assessment. Information and policy gap analysis	Bowtie supports analysis of policy context and identification of policy gaps		Results may influence scenarios	Results of Spatial Cost-Benefit Analysis could be included in risk assessment	
Culturally Significant Areas				May provide indicators of change for culturally significant areas	Can be included in MarZone scenario development	May provide information for risk assessment			Can be included in scenario analysis		Can provide useful added layers in WebGIS or interactive maps
Governance Baselines	Bowtie may be supported by evolutionary perspective					Governance Baselines could support OS by bringing in evolutionary information on institutions as background information	Can give useful information on institutional evolution and constraints		Can provide input to scenario development from the perspective of institutions and policy		
Integrated indicator system for assessing cumulative impacts	Can improve ecosystem-based approach to governance in the Baltic by assessing human activities and pressures based on robust indicators considering the complex Baltic marine ecosystem					Indicators may help to evaluate scenarios and effects.			Can inform scenario development		

Marxan / MarZone	Lessons from risk assessment could be included in MarZone scenario development			MarZone shows costs per conflicting feature which is similar to cumulative impacts, except that Marxan works with the existing state of ecological features and not with a baseline		Complementing OS with a spatial perspective. OS could discuss MarZone scenarios and decide on priorities			Can provide input to scenario analysis		Can provide input to WebGIS
Open Standards for MSP	OS may provide policy objectives to be analysed for policy context and policy gaps by bowtie analysis			Provides process and objectives to be assessed by indicators for cumulative impacts	Development targets and potential conflicts as needed in MarZone could be developed with OS					OS could provide a framework for discussing the results of Spatial Cost-Benefit Analysis	
Quality Assurance in MSP based on a risk management approach											
Rapid Policy Network Mapping			Complements governance baselines								
Scenario analysis											Can provide input to WebGIS
Spatial Cost-Benefit Analysis				Spatial Cost-Benefit Analysis could provide economic input to the indicator system	Results of Spatial Cost-Benefit Analysis could be included in MarZone scenario development	OS could discuss results of Spatial Cost-Benefit Analysis scenarios and decide on priorities					
WebGIS / interactive maps		Can supply spatial visualization for Culturally significant areas			Can collect input for MarZone	Can supply spatial visualization for OS					

7. Tool evaluation

7.1 Next steps in BONUS BALTSPACE

This catalogue does not provide an evaluation of the tools/approaches based on actual BONUS BALTSPACE field experience. This will come at a later stage of the BONUS BALTSPACE project, when many of the tools listed in the catalogue will be tested in selected case studies spanning different geographical and political contexts. Some of the tools listed in this catalogue will be evaluated according to the following:

1. Which integration challenges can sensibly be addressed by the tool/approach?
2. What are the strengths and weaknesses of the tool/approach with respect to the integration challenges identified? What are important basic conditions for their application, such as data requirements or the involvement of stakeholders?
3. How would the tool/approach need to be refined in order to better resolve MSP integration challenges?
4. How can the tools/approaches be combined with other tools/approaches to compensate for potential weaknesses?
5. Are there integration challenges that the tools/approaches listed cannot address?
6. Are there any new tools that need to be developed?

Based on this, practical guidance for practitioners will then be developed on when and how to apply the selected tools and approaches or combinations.

7.2 Challenges

A number of challenges should be highlighted in the context of tool evaluation. These challenges also apply to the tentative assessments of the tools provided in the catalogue.

- **Being clear on the specific function of each tool.** The tools and approaches considered here serve a specific function, and all have their specific range of application and limitations. As most of the tools selected are analytical, it should be clear that they may only pave the way towards addressing integration challenges, e.g. by generating relevant information and/or building capacity (e.g. by learning). Applying the tools does not automatically lead to integration, nor do we presume that greater integration is always required for improving MSP outcomes. Understanding of the tool's capacity is therefore essential in order to prevent misunderstandings of its application and role.

- **Differentiating between direct and indirect contributions of each tool.** One of the challenges is to differentiate between a tool's direct and indirect contributions to the various integration challenges. For example, the beneficial impact of a tool may relate less to the actual purpose of the tool – such as bringing together different types of data - but more to the process of applying it. Using a tool as part of stakeholder processes may give rise to a range of "soft" integration factors (or facilitators of integration), such as mutual trust, better understanding of each other's points of view and limitations, which may then lead to better vertical and horizontal integration as an indirect outcome. A clear distinction therefore needs to be drawn between e.g. the indirect learning effects arising as a result of applying a tool, and the desired end goal of applying the tool (e.g. greater policy coherence). The advantage of some tools may also simply be that they offer space for deliberation; how the results of such deliberation are then incorporated in formal MSP processes is another matter.

- **Differentiating between the capability of the tool as such and the influence of context on its successful application.** Tools may have proven their worth in different contexts already and in theory may have every capability of resolving a particular integration challenge. Still, a tool is only as good as the respective setting allows it to be. For example, if there is overall willingness to engage, openness to change and capacity for institutional learning, it is more likely that the tool will lead to a successful outcome and that the process itself will be experienced as valuable.

8. Detailed description of tools and approaches

8.1 Bowtie analysis

General

As a means of organizing and visualizing all of the elements of risk, bowtie analysis is used to analyse the pathways of risks linking the risk source to the causes to a potential undesired event and consequences. Bowtie analysis is listed as a risk assessment technique of the IEC/ISO 31010 standard (IEC/ISO, 2009) which is part of the suite of standards of the ISO 31000 risk management standard (ISO, 2009b and 2009c). Bowtie analysis was included as one of more than 25 risk assessment techniques listed in the IEC/ISO 31010 risk assessment standard of the system of management controls. Originally, the approach was developed for managing health and safety risks in the petro-chemical industries.

Overview

In the management of risks related to human activities in a marine context, bowtie analysis has been adapted to the analysis of environmental management policies and measures within the context of marine spatial planning (Cormier et al., 2013, 2015; ICES, 2014). Figure 2 is a DPSIR diagrammatic representation of the analysis. The DPSIR framework reflects a chain of causal links starting with ‘driving forces’ (economic sectors, human activities) as the sources of risk, generating ‘pressures’ (emissions, waste) that can cause changes to the ‘states’ (physical, chemical and biological) of the environment resulting in ‘impacts’ on ecosystems, human health and safety. It shows where ‘responses’ (prioritization, target setting, indicators) should be implemented to prevent a change in the state of the environment or an accident and mitigate the consequences of the impacts.

Use

In MSP, bowtie analysis would be used to analyse and evaluate spatial and temporal management options to either prevent environmental effects, health and safety incidents or user conflicts or to mitigate environmental impacts, socio-economic consequences or legislative repercussions. In addition to the identification of legislative and policy gaps, a bowtie analysis includes scenario analysis of management options in the evaluation and development of a marine spatial plan. In the implementation stage, the analysis is used to develop monitoring and compliance surveillance programs.

Inputs

Scientific reports, legislation and policies are the primary inputs to a bowtie analysis. They may also integrate information generated from environmental impacts and strategic assessments. The analysis is usually conducted within the context of multi-disciplinary inputs (including stakeholder inputs) with respect to policy objectives and temporal and spatial allocations.

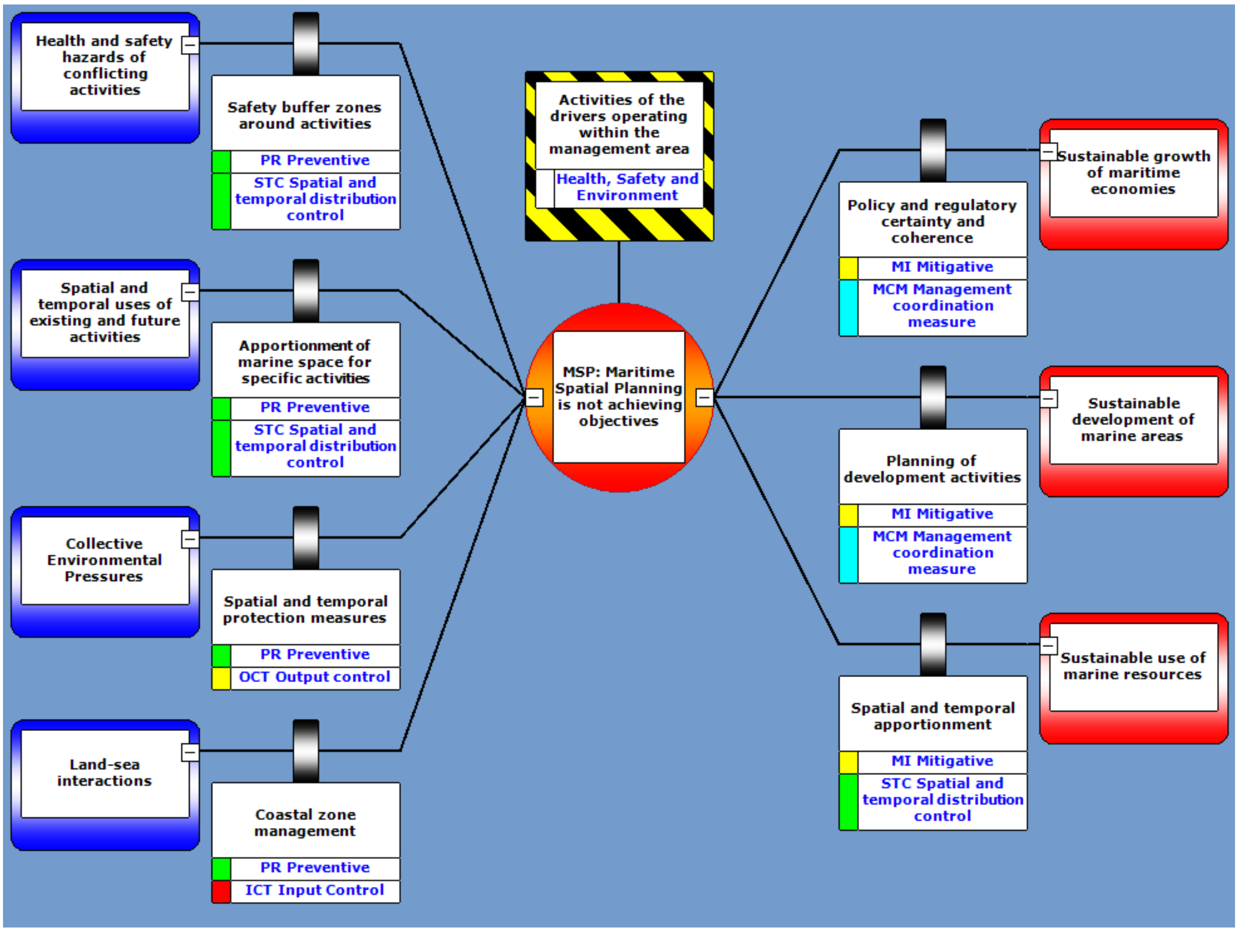

Figure 2. Bow-analysis in an MSP context (Software: BowTieXP)

Process

The process involves the identification of sources of risk related to the existing and future activities operating in the given management area. Based on the sources of risk, causes are identified, i.e. those activities that give rise to an undesired event. The consequences that would result from the undesired event are also identified. The true value of the analysis is the subsequent identification of preventive and mitigation measures.

- **Risk Source**: Activities resulting from the drivers operating inside the marine management area or from outside the area but with consequences in the area.
- **Operational events between drivers**: In the context of activities, an event is described as impeding the achievement of an MSP outcome (MSP is not achieving its objectives). This can be expressed e.g. as an accident, as encroachment or displacement events occurring as a result of hazards, conflicts, incompatibilities or security aspects resulting from the activities operating in the management area, affecting features and assets valued by society.
- **Environmental events** related to activities: In the management of activities that create pressures on the marine ecosystem, an event is described as having the potential to prevent a certain ecosystem management outcome (e.g. relating to ecosystem components or ecosystem services). It should be noted that not all activities create ecosystem pressures and that activities may not create pressures if management controls and mitigation are successful. They can be expressed in terms of environmental effects or a negative change to ecosystem integrity as a result of the pressures introduced.
- **Causes**: These are defined as conflicting, incompatible or hazardous activities in the management area, or pressures introduced to the marine ecosystem as a

result of activities, pressures emanating from outside the management area but whose consequences need addressing within it.

- **Consequences**: These can be economic consequences due to business disruptions, liabilities or regulatory compliance enforcement, or cultural, social or economic consequences due to the loss of a valued ecosystem service, or ecosystem level impacts due to the degradation of ecological or biological features and processes.
- **Management measures:** These are preventive management measures such as temporal and spatial controls, input and outputs controls to either eliminate, avoid or control the risks associated with the undesired event. They also include mitigation management measures such restoration, remediation measures to reduce the scale, intensity and duration of the consequences.

Outputs

The key output is a bowtie diagram with supporting documentation, risk assessment results and the effectiveness of management measures. The tool integrates multidisciplinary information in one standardized analysis for decision-making, focusing on the necessary management measures that help to achieve a given policy objective.

Strengths

The method offers the quality analysis and visual representation of science and policy objectives within a management context. It facilitates the identification of policy/management gaps and the analysis of temporal and spatial approaches that are considered during the planning process. It also facilitates the communication of implemented objectives and management approaches.

Limitations

Given the complexity of the multidisciplinary aspects of MSP, the tool may have limited quantitative applications (ICES, 2015).

Software

BowTieXP: CGE Risk Management Solutions (http://www.cgerisk.com/software/risk-assessment/bowtiexp). The software allows to summarise existing legislation and policies integrating management measures within a risk management structure and context in relation to MSP objectives. In MSP, it visualizes the system of spatial and temporal management measures facilitating the analysis and supported by reference documentation such as scientific studies, existing legislation and management measures. Add-on modules include development of audit questionnaires and data from Excel sheets.

Key References

Cormier, R., A. Kannen, M. Elliott, P. Hall, and I.M. Davies. 2013. Marine and coastal ecosystem-based risk management handbook. ICES Cooperative Research Report No. 317. 60 pp

ICES. 2014. Report of the Joint Rijkswaterstaat/DFO/ICES Workshop: Risk Assessment for Spatial Management (WKRASM), 24–28 February 2014, Amsterdam, the Netherlands. ICES CM 2014/SSGHIE:01. 35 pp.

ICES. 2015. Report of the Workshop on Probabilistic Assessments for Spatial Management (WKPASM), 9–13 March 2015, Hamburg, Germany. ICES CM 2015/SSGEPI:16. 32 pp.

Cormier, R., Kannen, A., Elliott, M., and Hall. P. 2015. Marine Spatial Planning Quality Management System. ICES Cooperative Research Report No. 327. 106 pp.

Websites

http://www.cgerisk.com/software/risk-assessment/bowtiexp

8.2 Culturally Significant Areas

General

In many areas there is insufficient knowledge of the entire range of values the sea provides. Whilst it is common to focus on the economic values provided by the sea (such as fishing, shipping, offshore wind farming), it is less common to regard the sea as a place defined by cultural meanings. For example, what is the value of recreational, aesthetic or spiritual services provided by the sea? How can we measure the benefits arising from an aesthetic or spiritual experience of the coast, and how are these experiences linked to particular spaces, places and settings? For planners and managers, the question is therefore how MSP can take account of immaterial cultural values in risk assessment in a way that is commensurate with ecological or economic values.

Overview

The method for defining culturally significant areas was developed in 2013 by the ICES working group on marine planning and coastal zone management (ICES 2013). It encompasses the following aspects:

a) Codifying cultural values for MSP purposes
b) A method for identifying marine places of socio-cultural importance
c) Rating impacts on marine cultural places of importance
d) Mapping spatially relevant information

Use

The method is used to identify places of particular cultural significance to communities, putting cultural values on a par with ecological or economic values and enabling the priorisation and management of culturally important places just like other priority areas.

Inputs

Inputs include information on existing designations of culturally significant areas (e.g. heritage sites, nature conservation sites), but also known beauty spots or other known areas important for recreation and tourism. In order to fully understand intangible cultural values, however, it is necessary to conduct qualitative research with relevant communities. This then needs to be coded and converted into spatially relevant information.

Process

Identifying culturally significant areas for MSP is a collaborative approach which relies on input by relevant communities, which could be local communities living on the coast, first nations or communities of interest (e.g. recreational groups). Working with representative communities through social science methods (e.g. interviews, questionnaires, workshops), the approach firstly identifies a cultural values baseline in the planning area. This may encompass a range of cultural values, such as aesthetic, recreational and inspirational values, historic and heritage values, nature conservation values etc. Secondly, these values are located in space, identifying the location and spatial extent of places that are valued for different cultural reasons. The third step then rates the importance of the places identified based on the following five criteria:

- Cultural uniqueness,
- Broad cultural/community reliance,
- Importance of the feature to the resilience of the social-ecological system,
- Degree of tradition,
- Dramatic cultural change.

An area of high cultural significance may thus be a place that is valued for its beauty or tranquillity, or because it provides the resources for a particular activity, and particularly important because it is unique or because large parts of the community rely on it. Added considerations are the temporal dimension (some places may be highly significant, but only during certain times a year) and the environmental quality required for the cultural feature or practice in question. Mapping of these places may be possible, although exact delineation can be difficult in a marine context. In a last step, potential impacts of activities on culturally significant areas are identified and linked to risk assessment (e.g. assessing the significance of the impact of an offshore wind farm on an area treasured for its visual beauty). Management measures can then be taken to protect the essential qualities of those culturally significant areas that are given priority.

Outputs

Outputs of the method include a baseline of cultural values in the planning area (which is comparable to a baseline of ecological values) and can be used for regular monitoring activities (e.g. tracing value changes over time). Maps of culturally significant areas can be generated to inform MSP and also to act as a communication tool.

Scalability

Yes

Strengths

The strength of the method is its ability to elicit intangible values and make them amenable to MSP. The method is generic and can be applied in many different contexts. It is also advantageous for building close relationships with local communities and communities of interest in that it supports participative planning processes and can lead to a broad debate on the future of the sea area in question and visions for the future.

Limitations

- The method is time-consuming and requires an investigator skilled in social sciences and sensitive to the communities in question. A good rapport with the community and mutual trust are crucial which take time to build.
- Some intangible values are difficult to articulate or there may be resistance on the part of the community to share information, as cultural values can be linked to strong emotions.
- As in all qualitative approaches, representativeness is important as there may be diverging views of cultural significance within the community.
- It can be difficult to identify the community/community of interest.
- Not all culturally important areas can be mapped in a definitive way.

Software

N/A

Key References

ICES. 2013. Report of the joint HZG/LOICZ/ICES workshop: Mapping cultural dimensions of marine ecosystem services (WKCES), 17-21 June 2013, Helmholtz Zentrum Geesthacht, Germany. ICES CM 2013/SSGHIE:12.70 pp.

Websites

N/A

8.3 Governance Baselines

Overview

The governance baseline approach was developed by Olsen et al. (2006, 2009) in order to document and analyse how the governance system in a specific place has responded – or failed to respond – to the trajectory of ecosystem change. Analysis takes long-term environmental trends and contrasts these with developments in the marketplace, government and institutions, and civil society arrangements as the three mechanisms by which the processes of governance are expressed (Juda 1999; Juda & Hennessey 2001; Olsen et al. 2006). Simplified versions of Governance Baselines have also been used to understand the history of organisational and institutional developments in regional seas against the context of wider societal and environmental trends (e.g. trends in environmental policy).

Use

A 'classic' governance baseline is developed in a collaborative process with stakeholders and has two parts. Part One is a documentation and analysis of past governance responses to ecosystem change. Part Two is forward-looking, seeking to outline a strategic approach to addressing the ecosystem management issues of a defined area. This builds on the strengths of the existing governance system and works to reduce its weaknesses. Taken together, parts One and Two form the reference point against which future changes in the ecosystem, the governance system and the efforts of the program (in this case, MSP) can be gauged. The advantage of the method is that it encourages a long-term perspective, an appreciation of the roles played by civil society, markets and government and a holistic, ecosystem-based, approach to coastal and marine stewardship. Developing Governance Baselines can therefore contribute to organisational learning and adaptive management. Nevertheless, a governance baseline is a complement to, not a substitute for, an analysis of the other features of a coastal system including its socio-economic and biophysical characteristics (Olsen et al. 2009).

Governance Baselines have been used to understand history and context of institutional developments and to analyse change of governance mechanisms and management paradigms over time (e.g. KnowSeas project).

Inputs and process

The development of a governance baseline is a structured process which involves the following stages and inputs:

- Defining the area of focus (which could be a marine planning area)
- Identifying drivers and responses to the trajectory of ecosystem change
    - How have types and intensity of human activities changed in the area of focus over the past hundred years?
    - What was the response of the governance system to key events and ecosystem change?
- Develop a timeline that identifies events and expressions of environmental and societal change over the past fifty to one hundred years. A shorter term analysis will not reveal the larger patterns of change that are shaping current conditions and will be less likely to reveal the traditions, the strengths and the weaknesses of the existing governance system in the area of focus. A long-term perspective will also shed light on how power and influence is allocated and how the relationships between institutions are evolving. Entries in a timeline should be segregated in to three columns labelled, Pressures, State and Response.
- Long term trends in the condition and use of ecosystem goods and services
- Identification of eras of governance

Outputs

Analysis can result in a variety of products, such as generalised governance timelines for a regional sea (see KnowSeas for all European regional seas) or more specific development trajectories of organisations involved in governance. Below is an example of a governance timeline for the North Sea (Kannen et al. 2012) and a development trajectory for the Trilateral Wadden Sea Forum, showing the various stages and milestones of the Forum's development and the main outputs it generated during its lifetime (Fischer 2011).

Scalability

Yes

Strengths

Governance Baselines have successfully been used to understand history and context of institutional developments and to analyse change of governance mechanisms and management paradigms over time (Kannen et al. 2012).

Limitations

Limitations are mostly related to data sources.

Key References

Fischer, C.: Auf dem Weg zu einer integrierten Meerespolitik für die Europäische Union – Erfahrungen aus der transnationalen Zusammenarbeit am Beispiel der Trilateralen Wattenmeerkooperation, MSc Thesis, University of Lueneburg (in German).

Olsen, S.B.; Page, G.G. & Ochoa, E. (2009): The Analysis of Governance Responses to Ecosystem Change: A Handbook for Assembling a Baseline. LOICZ Reports & Studies No. 34. GKSS Research Center, Geesthacht, 87 pages.

Kannen, A., Gee, K., Fischer, C., Varjopuro, R., Knudsen, S., Fitzpatrick, M., O'Mahony, C., Potts, T., Frangoudes, K., de Vivero, J.L. (2012): Assessment of environmental governance structures and specific case studies in Europe's Regional Seas. KnowSeas Deliverable 5.3, November 2012.

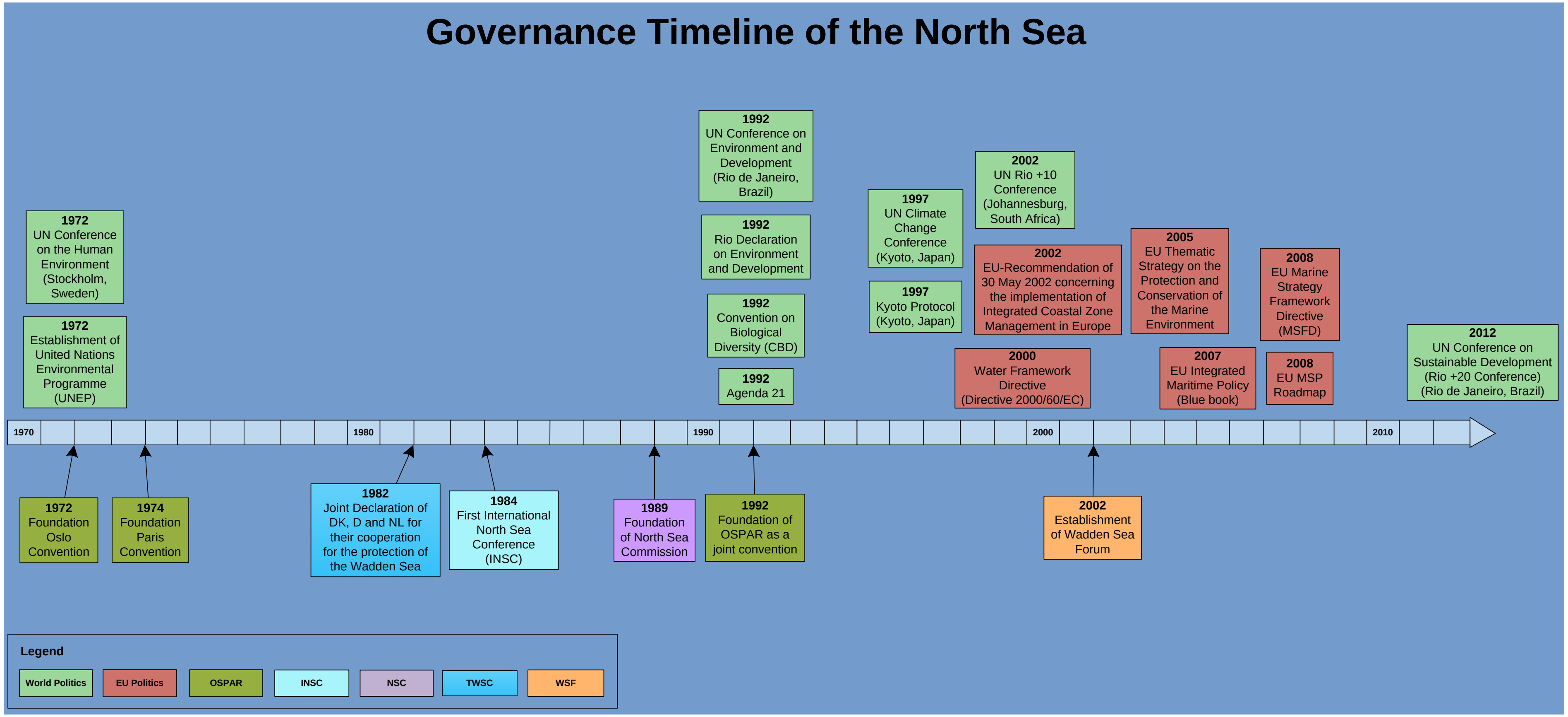

Figure 3. Governance Timeline for the North Sea as developed within KnowSeas (Kannen et al. 2012, Design C. Fischer)

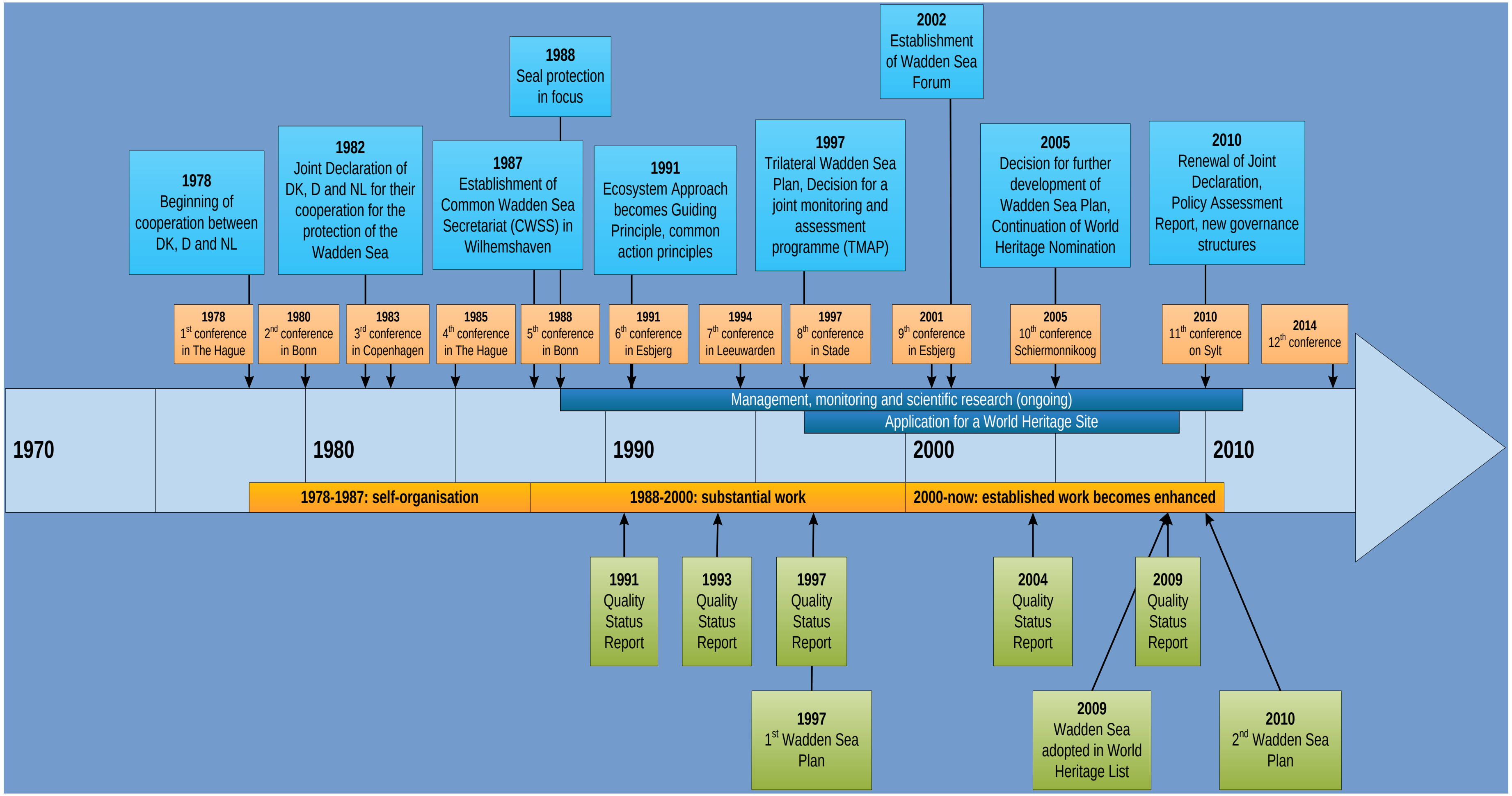

Figure 4. Key Events, Processes and Results of the Trilateral Wadden Sea Cooperation (Kannen et al. 2012 based on Fischer 2011, Design: C. Fischer)

8.4 Integrated indicator system assessing cumulative impacts of marine spatial use (in development)

Overview

The indicator system for assessing cumulative impacts of marine spatial use is a practical tool for planners in order to better understand and evaluate MSP impacts *ex-ante* in terms of spatial efficiency and functionality of ecosystems, navigation, economic cost reduction and contribution to social welfare. The proposed methodological approach aims to analyse the socio-economic driving forces, helping to identify and assess the trends of socio-economic development and natural processes as well as evaluate the environmental impacts and economic effects of implemented MSP solutions.

Use

The indicator system is really a monitoring tool developed to trace the links between maritime economic development and the environmental and socio-economic status of the planning area. The approach allows the use of certain numerical/quantitative values in order to measure the effects of spatial planning if and when implemented. The main objective is to see whether MSP is beneficial for coastal communities in terms of economic growth and social wealth being, as well as for the general ecological status of the marine environment. Ideally, the indicator system would be used before a marine plan is in place and repeated systematically within a reasonable time frame.

Inputs

The indicator system integrates knowledge on the status of both the coastal zone and the marine environment. Data needs to be able to measure two sets of established indicators:

- ICZM sustainable development indicators developed by the EU working group on indicators and data specifically aiming to trace the socio-economic and environmental quality changes in the coastal zone, and
- MSFD Good Environmental Status descriptors focusing on monitoring of changes of the marine environment.

Data needs encompass: (1) the conditional criterion – environmental status; (2) social and (3) economic development.

INPUT (1): The conditional criterion is actually the state of the marine environment – i.e. quality and availability of the marine resources including biological, ecological and mineral resources. The key questions required in order to identify the socio-economic development trends are:

- What is the current ecological status of marine environment (poor, satisfactory, good)?
- What change is expected in the ecological status within the planning period and beyond: improving, no changes expected, deteriorating?

OUTPUT (1): As a result, the status of the marine environment and trends will be measured based on the methodology (basic information on current status and defined national targets to achieve the good/better conditions) prepared to measure and monitor the 11 MSFD descriptors of good environmental status, which encompass:

TG 1. Biodiversity;
TG 2. Non-indigenous species;
TG 3. The population and heath of commercial fish species;
TG 4. Elements of food webs ensure long-term abundance and reproduction;
TG 5. Eutrophication;
TG 6. Sea floor integrity;
TG 7. Hydrographical conditions;

TG 8. Concentrations of contaminants;
TG 9. Contaminants in seafood;
TG 10. Marine litter;
TG 11. Energy including underwater noise.

INPUT (2): The status and trends of social indicators of coastal communities. The main information required for planning purposes is the demographic situation, livelihoods, human health, monetary, household and occupation and others, answering the following questions:

- What is the degree to which the population of a country or wider reference region is concentrated in the coastal zone? Tracking changes in the distribution of the population of a coastal region over time will help to assess the amount of pressure being exerted on marine and coastal resources by the demand for land, housing, employment, public services, transport, and so on.
- What is the extent to which the coast has been built-up over the past several years because this will indicate the degree of pressure on the coast and the likelihood of further changes in the future?
- What proportion of the population living at the coast is economically active?
- What work do people who live at the coast do; that is, in what economic sector do they work?
- How do they work; that is, are their jobs full-time or part-time, permanent or seasonal? Who works; that is, by gender, ethnicity and age?

OUTPUT (2): Such information is necessary to help assess the comparative strengths and weaknesses of the coastal economy and its prospects of generating sustainable employment. In this case the 27 ICZM indicators developed by the Working Group "Indicators and Data" (WG-ID) and adopted by the European Parliament and the EU Council will be used as assessment tool. The main objective of those is to facilitate achieving sustainable development in the coastal zones by means of introducing a new – integrated – way of managing these areas.

INPUT (3): The list of 27 ICZM indicators is also addressing the assessment of the current status and trends of economic activities and pressures on the coastal infrastructure. This also introduces how ready the coastal infrastructure is to service the growing marine sector and what impacts are to be expected if developments tend towards expansion. The main questions to be answered in order to reveal the socio-economic development trends are:

- What is the importance of ports to the coastal economy in terms of the throughput of both passengers and cargo?
- What is the type and amount of goods handled? And what are the related employment character as well as demand for port services?
- Will the increasing throughput of goods year-on-year will lead to a demand for additional port infrastructure such as new docks, roads, sea defences, freight storage facilities, and so on?
- What is the demand for road travel and transport? This is required in order to evaluate the pressure on existing road space and in turn to the provision of new infrastructure.
- What are the costs associated with maintaining the road network, will all rise, remain unchanged, decrease?
- What is the status of navigation? Does the existing network of shipping routes and separation schemes satisfy the current and future needs, or additional management measures (and what type of) are required?
- What is status of recreational boating as one of the fastest-growing leisure activity in coastal areas?
- What is the existing infrastructure (marinas, berths and moorings) and what will be required in the nearest future? Sailors require little more than a slipway from which to launch their craft, somewhere to park a vehicle, etc. Berths and moorings should help harbour commissioners, and local and regional planning

authorities, to assess the cumulative impact of further developments on an ongoing basis as well as identifying ‘hot spots ‘where local carrying capacity will be quickly exceeded.
- Can the existing and planned underwater infrastructure be “placed” in organized manner (paths and/corridors)? What are the obvious obstacles and benefits?
- Are the fishing activities (quotas and landing) and demand/market needed for the production in balance?
- What are the conditions for the landing of the catch? If additional landing places are needed where and what infrastructure has to be developed?
- Is the exploration of natural resources regulations satisfactory in order to control and ensure the safety of this economic activity? What resource is tend to be explored more in the future, what are the quantitative targets/demand?

OUTPUT (3): By answering these questions, it is possible to determine how and on what scale economic developments will yield varying degrees of benefit and disbenefit to the local and regional economy and environment.

OUTPUT (4): Creating special combinations of these and/or new combined indicators suitable for the assessment of cumulative effects of various maritime uses addressed in maritime spatial plans. A new approach of using indicative measures will have to be developed in order to measure/evaluate the cumulative effects of various spatial solutions provided. This work will be based on combination of existing indicators facilitated with new assessment approaches, or, if relevant by creating new – integrated indicators for assessment of cumulative impacts.

The proposed methodology will be the background for assessment and monitoring of changing socio-economic situation before and after maritime spatial planning is applied.

Scalability

The indicator system is applicable to the both marine and coastal environments, temporal and spatial scale depends on the indicator to be measured.

Strengths

The proposed approach integrates existing methodology and the commonly accepted concepts of ICZM and Good Environmental Status as introduced in the MSFD, which is widely accepted and implemented by EU Member States.

Limitations

Indicators usually do not provide absolute values and are really a tool for comparative analysis, revealing the trends and main character of the changes. Accuracy of the indicators measured also is very much dependant on the type and frequency of data collected by national statistical departments, level of scientific knowledge.

Key References/Websites

http://ec.europa.eu/environment/marine/good-environmental-status/index_en.htm
http://ec.europa.eu/environment/iczm/pdf/report_wgid.pdf

8.5 Marxan (MARine spatially eXplicit Annealing) and Marxan with Zones (MarZone)

Overview

MSP often deals with complex situations in which many interests from different sectors have to be balanced and at the same time a healthy marine environment needs to be maintained. Site selection tools as a subgroup of decision support software can help to work within the spatial context in a systematic way.

The software Marxan and MarZone were developed to provide decision support for systematic nature conservation planning, but they can be adapted to other planning purposes. They use an optimization method for site selection, designed to find the most cost efficient suggestions for suitable marine conservation areas which meet a number of ecological, social and economic objectives. Unfavourable conditions for the conservation targets are integrated into that model as so-called "costs" (Ball et al. 2009, Ardron et al. 2010). MarZone is more flexible and allows more complex setups than Marxan. Instead of one target in Marxan, zones with different independent targets can be defined and costs and conflicts can be connected very specifically to the targets (Watts et al. 2009). This makes MarZone particularly suited for MSP which is working with several interests in the same area.

Marxan/MarZone do not do ecological modelling nor do they contain any predefined conflicts. They only take account of those factors and target values that are included into the modelling process by the user (Ball et al. 2009, Ardron et al. 2010). To run Marxan or MarZone, the potential of the area, the targets and the influence of conflicting uses therefore need to be evaluated beforehand (Figure 5). The tools can easily be adapted to other site selection analyses as long as the planning question can be reduced to a setup that fits the way Marxan/MarZone handle a problem.

There are tuning options, e.g. to handle biological constrains by influencing the distance between selected sites or the size of patches or influencing the overall output by setting penalties for the different target features if not all targets can be met.

General settings require a decision on the number of iterations and the number of runs. One the one hand, these parameters are responsible for how well the optimization process is run and for the repeatability of the results. On the other, they determine how long each run takes. The number of iterations influences how close Marxan can get to an optimal solution. The number of runs determines the frequency with which planning units are selected in multiple runs and by that gives an indication of the importance of that planning unit for efficiently meeting the targets (Game and Grantham 2008).

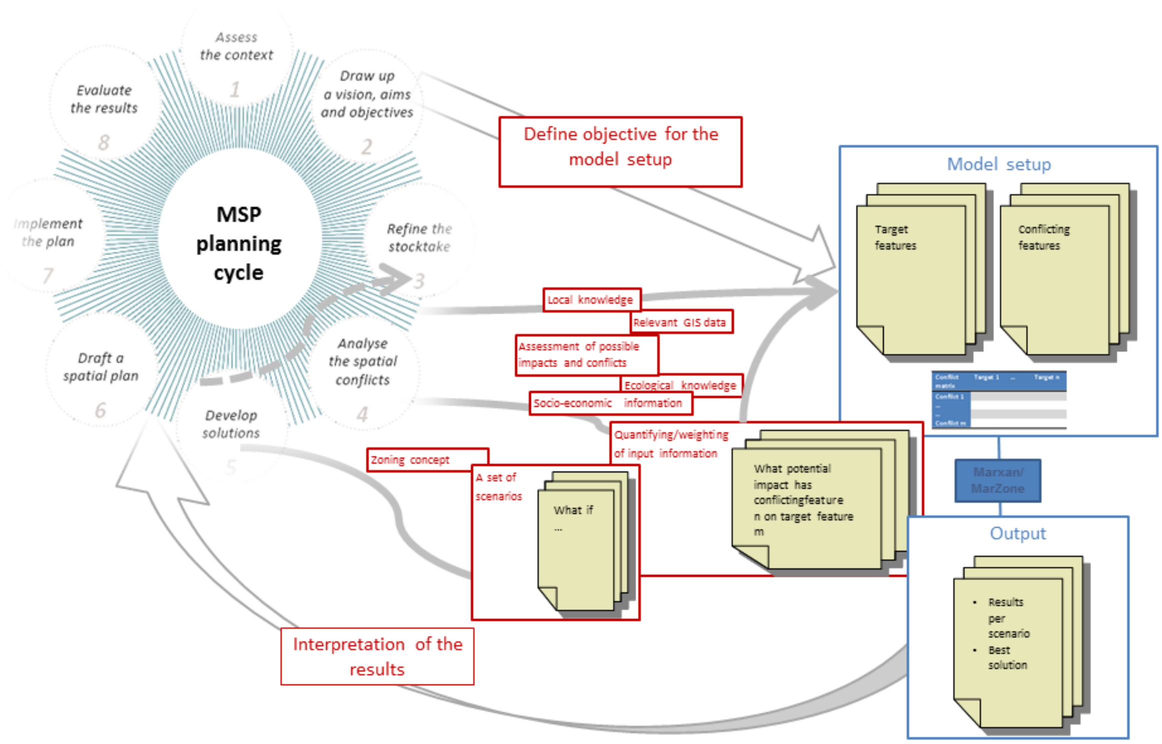

Figure 5. Marxan/MarZone implementation in connection with the planning cycle. The red boxes indicate information that is gathered during the planning process, the blue boxes are related to the Marxan/MarZone setup

Use

During the MSP process, the effect of specific decisions and the potential for development of an area can be analysed with Marxan or MarZone. With Marxan and MarZone, complex situations can be visualized in a simplified way. The output can be used to develop solutions which will be incorporated into the plan.

Inputs

Marxan/MarZone require spatial data with an adequate scale or resolution. All data needs to be quantified and set into relation with each other. Specifically, data about planning targets or the zoning concept, features supporting the targets and conflicts or costs with spatial extent are needed.

Process

Modelling with Marxan or MarZone is a process that should be integrated into the overall planning circle. Interaction with the actors and stakeholders involved before, during and after modelling is crucial. Feedback processes are often necessary where gaps in the data or in the conflict definitions are identified.

- The main spatial data load is collected from existing GIS data collections. Additional spatial data can be collected on workshops or by interviews, a typical case is e.g. position of fishing grounds.
- The importance of conflicts etc. Is difficult to weight. Here feedback from the experts and stakeholders is important. In general, the two tools generate planning scenarios in a way that input parameters (targets and costs) can be made transparent and visible and be compared with other scenarios with altered input parameters.
- The output is not a final plan, but only an option. It is necessary to allow room for discussion and interaction also at the stage of using the results.

Outputs

The output are maps and spatial data for the chosen scenarios. In addition to the best solution, Marxan provides the frequency with which each planning unit was selected during the optimizing process and an overview how well the targets could be met and at which costs.

Scalability

The program can work with data at different spatial resolutions but is used most often with planning units of the same size. It can handle complex data situations.

There is no explicit temporal component in the program, but time can be handled as layers in MarZone.

Strengths

- Extremely flexible
- Systematic approach
- Transparent methodology/repeatable
- Spatial output
- Can handle large amount of data and convert it into a comprehensive analysis of the situation.

Limitations

- Requires a good introduction to the tool
- Requires homogeneous spatial data and quantified information about targets and conflicts
- Cannot handle linear connections

Training/competence needs

Experience with GIS is recommended. It requires training in how to prepare the data, how to run Marxan/MarZone and the principles of a site selection process.

Software

Marxan and MarZone are only the functional tools for the optimising process. They require other tools for data preparation and visualization.

Marxan/MarZone:	Program for the site selection process. No user interface is given. Data is prepared with a common GIS, QMarxan or Zonae Cogito and stored in the appropriate data structure to be run by Marxan.
GIS interface	**Zonae Cogito/QMarxan** are examples for freeware supplements to Marxan with GIS functionality and interface to Marxan. The programs supply open source data preparation (with limited functionality) and formatting, data management, calibration and visualization for Marxan. Zonae Cogito is a standalone solution, QMarxan an extension for QGIS. Similar extensions are developed e.g. ArcGIS, a proprietary software.
Additional GIS Software:	Preparation of the input data (especially the first steps of preparation), analysis and visualization of the results

Key References

Tool description based on:

Göke, C., Lamp, J., 2012. Case Study: Systematic site selection for offshore wind power with Marxan in the pilot area Pomeranian Bight. BaltSeaPlan. BaltSeaPlan Report, no. 29

Mohn, C, Kotta, J, Dahl, K, Göke, C, Blazauskas, N, Ruskule, A, Aps, R, Fetissov, M, Janssen, F, Lindblad, C, Piotrowksi, M & Wan, Z 2012, Modelling for Maritime Spatial Planning: Tools, concepts, applications. BaltSeaPlan - www.baltseaplan.eu. BaltSeaPlan Report, no. 19

Marxan/MarZone in general:

Ardron, J. A., Possingham, H.P., and Klein, C.J. (eds.) 2010. Marxan Good Practices Handbook. Victoria, BC, Canada: 165 pages.

Ball, I.R., H.P. Possingham, and M. Watts. 2009. Marxan and relatives: Software for spatial conservation prioritisation. Chapter 14: Pages 185-195 in Spatial conservation prioritisation: Quantitative methods and computational tools. Eds Moilanen, A., K.A. Wilson, and H.P. Possingham. Oxford University Press, Oxford, UK.

Game, E. T. and H. S. Grantham 2008. Marxan User Manual: For Marxan version 1.8.10. University of Queensland, St. Lucia, Queensland, Australia, and Pacific Marine Analysis and Research Association, Vancouver, British Columbia, Canada.

Watts, M.E, I.R. Ball, R.R. Stewart, C.J. Klein, K. Wilson, C. Steinback, R. Lourival, L. Kircher, and H.P. Possingham. 2009. Marxan with Zones: software for optimal conservation based land - and sea - use zoning, Environmental Modelling & Software (2009), doi:10.1016/j.envsoft.2009.06.005

Watts, M.E., C.K. Klein, R. R. Stewart, I. R. Ball, and H. P. Possingham. 2008. Marxan with Zones (V1.0.1): Conservation Zoning using Spatially Explicit Annealing, a Manual.

Watts, M.E., R.R. Stewart, D. Segan, L. Kircher, and H.P. Possingham 2010. Using the Zonae Cogito Decision Support System, a Manual. pdf (1288KB)

Marxan in MSP:

Göke, C., Lamp, J., 2012. Case Study: Systematic site selection for offshore wind power with Marxan in the pilot area Pomeranian Bight. BaltSeaPlan. BaltSeaPlan Report, no. 29

Schmiedel, J., Lamp, J., 2012. Case Study: Site selection of fisheries areas for Maritime Spatial Planning with the help of tool “Marxan with Zone” in the pilot area Pomeranian Bight. BaltSeaPlan. BaltSeaPlan Report, no. 30

Websites:

http://www.uq.edu.au/Marxan

8.6 Open Standards for the Practice of Conservation (OS)

Overview

The *Open Standards for the Practice of Conservation* (OS) offer a cyclical, systematic approach to planning and implementation; they are an overall approach combining participatory, adaptive-management based process thinking, multiple practical project management tools, and a user- and coach community.

The approach was originally developed in the early 2000s, based on the perceived need of conservation organisations to monitor and evaluate their initiatives, and is today in use in terrestrial and marine conservation management worldwide – both by NGOs and authorities. It has been developed based on a reviews of scientific literature in multiple fields (such as conservation, international development, education, business), continued research, and practical experience and has since its first version been revised several times. The owner is the Conservation Measures Partnership (CMP), a consortium of over 20 conservation organizations and other collaborators. The partnership aims to achieve collective learning by evaluating and sharing experiences and to promote innovation in monitoring and evaluation of conservation projects. To facilitate logical analysis and practical management, the community has developed a management-software (MIRADI) as well as additional tools.

The OS can be seen as an overall approach consisting of the following components:

1) The *Open Standards* - project management standards and guidelines implying 5 steps based on an adaptive management and organizational learning perspective (CMP 2013, see fig. A 3-7). Further tools and activities include the Threats and Actions Taxonomies (Salafsky et al. 2008) and the auditing of conservation initiatives (CMP 2007).
2) The software *MIRADI* based on a logical framework analysis type of logic to visualize, structure and connect knowledge and procedural aspects in among others situation analysis, envisioning, goal setting, design of measures and management plan and process, and evaluation. It also assists practical project management such as budget, work plans or information exchange (ref web).
3) “Around-the-cycle” facilitated participation of stakeholders to create intensive interaction with managers and thus possibilities for mutual learning and problem solving as the process is seen as important as the results. There are no prescriptions of methods; facilitators can use and adapt what fits the situation.
4) A well-connected community of practice to exchange and reflect through e.g. meetings and trainings for facilitators and managers. This kind of exchange is important for skill development and further development of the approach.

Use

The OS approach assists MSP in the structuring of both content of planning and management and the necessary process management. It implies a cyclical, adaptive view using systematic consecutive steps from analysing to planning, implementing, and evaluating. Each step implies a facilitated and systematic discussion process among interested parts. Thus, the final outcomes are broadly anchored and logically coherent objectives, strategies, measures, and steps of implementation including an evaluation plan.

Broader sharing and learning is seen as important. The OS are linked to a community of practice, including coaches in Sweden and Europe meeting regularly to train and exchange on the approach and developing it further.

The approach or parts of it has lately also been tested in cross-level and transnational marine and coastal planning and management, combining planning and conservation and including a broadening of scope to include human use- and social welfare aspects (Sea meets land (web-ref 2014), Collaboration plans by SEPA to establish BSPAs (SEPA 2011), the Dutch Wadden Sea (FOS 2014).

Inputs

- Competences: multidisciplinary, open (both theoretical and practical), depending on the issues, as diverse as possible to cover all relevant information and experiences.
- Type of data/information: open, multi-disciplinary, scientific and experiential knowledge, depends on the issues to include. So far no geographical (GIS) component in MIRADI, but this could be coupled.
- Basic knowledge on situation, problems, sector needs and targets etc. to initiate and drive ahead a planning process
- Values and views on issues: from the participants
- Syntheses: intermittent syntheses of results so far

Process

The cyclical process is divided into five phases (see fig. A 3-7): 1. Conceptualize, 2. Plan Actions and Monitoring, 3. Implement Actions and Monitoring, 4. Analyse, Use, Adapt, and 5. Capture and Share Learning.

The process itself consists of a series of facilitated workshops and intermittent synthesis and data preparation/processing phases. The workshops are the forums, where the main interaction between different views, sectors, and stakeholders occurs. Optimal group size during the workshops depends on the purpose, but for in depth discussions there is a need to vary between small groups (ca 6-8 people) and the overall plenary.

The processing between workshops implies both processing of workshop results and technical analysis of documents and data from other types of sources.

Figure 6: Process-diagram Open Standards Manual (Source: CMP 2013)

Outputs

- A common vision
- A thorough analysis of objectives, threats and possible strategies to address these threats
- Prioritising between objectives, threats, and strategies to take realistic action
- A planning document including vision, objectives and strategies to promote them
- Possibly (if tools used) a more concrete project management and implementation plan
- An evaluation and monitoring plan based on the above
- Legitimacy and agreement (as far as is possible) among participants on all of the above and future procedure.

Scalability

According to the authors (CMP 2013), the approach can be used at different scales and used in a more or less issue specific manner. The approach can be scaled to a certain extent. For this purpose the aspects included may need to be adapted in the degree of detail or the communication process adapted to the different scales addressed. This depends on the perspective that is taken:

- Issues: e.g. by reducing the degree of detail of maps and objectives….
- Participants: depending on the amount of time. The more people needed to include, the more time and careful organization and feedback loops are required.

Strengths of approach / method / tool

- Broad applicability
- Management standards and guidelines
- The way of visualising, structuring and connecting knowledge and procedures
- Facilitated stakeholder participation and anchoring of decisions, knowledge input from stakeholders, support of process/plan from stakeholders (legitimacy). For this purpose there is a need to couple the process to legitimate decision makers too!
- Potential to anchor and mirror our experiences with others through the community of practice.

Limitations

- Time and resource limits of the conducting organization (the more complex the issues, the more participants the more time and other resources may be needed)
- Complexity of objectives: for understandability one may need to select a few (8-10) objectives to work on at a time
- Participants: active participation required over time, need to mobilise and keep interested, compensation?
- So far little used for broader issues than conservation all the way (not just the first two steps of the OS process and in the beginning of a plan).
- Scale-integration: The capacity to be coherent with regard to geographical scale - issue scale – participants/stakeholders (combining the different challenges) – needs to be tested.

Training / competence needs

Coaches and facilitators (1-2 overall coaches, group facilitators depending on audience): there is a need for coaches who know how to facilitate the workshops (minimum one overall who is very knowledgeable about the method and for each discussion group necessary one who can train up on the way). Coaches can be hired from a list of available coaches, prices for non-profit organisations are negotiable. There is a possibility to receive coach training for own purposes, this needs to be discussed/negotiated with Foundations of Success (FOS) Europe/North America.

Participants: are trained during through the facilitated process and train each other in their respective knowledge areas during the process. Otherwise the competence needed depends on the issues to be planned.

Software

Main related software is *MIRADI* the project-management software, designed by practitioners (besides the CMP two different groups of software developers were involved). "Miradi uses wizards, examples, and multiple views to help project teams design, plan, implement, and monitor … projects." "[It] provides a simple, step-by-step process for … teams to implement the … Open Standards for the Practice of Conservation." (see https://www.miradi.org/about-miradi/). The software can be tested free of charge and is not very expensive (price depends on how much user is able to pay). There are a number of further tools (see links below)

MIRADI-software: https://www.miradi.org/

Resources in general: http://www.ccnetglobal.com/coach-resources/all-resources/

Key References

Conservation Measures Partnership (CMP) 2007: CONSERVATION AUDITS: Auditing the Conservation Process: Lessons Learned 2003 – 2007, prepared by Elizabeth O'Neill for CMP, July 2007 http://www.conservationmeasures.org/wp-content/uploads/2010/04/Conservation_Audits_FINAL_DRAFT_31_July_2007.pdf

Conservation Measures Partnership (CMP). 2013. Open Standards for the Practice of Conservation (version 3.0 April 2013): http://www.conservationmeasures.org/wp-content/uploads/2013/05/CMP-OS-V3-0-Final.pdf

Salafsky N, Salzer D, Stattersfield AJ, Hilton-Taylor C, Neugarten R, Butchart SH, Collen B, Cox N, Master LL, O'Connor S, Wilkie D. 2008. A standard lexicon for biodiversity conservation: unified classifications of threats and actions. Conserv Biol. 2008 Aug; 22(4):897-911.

SEPA 2011. Samverkansplaner för värdefulla ksut- och havsormåden. Projetkrapport och rekommendationer för vidare arebete. Rapport 6471, Swedish Environmental Protection Agency, Stockholm. Report on Swedish application in relation to Collaboration plans for coastal conservation by SEPA (in Swedish): http://www.naturvardsverket.se/Om-Naturvardsverket/Publikationer/ISBN/6400/978-91-620-6471-6/

Websites

Tools and resources

- Open Standards for the Practice of Conservation: http://cmp-openstandards.org/
- The Standards in different languages: http://cmp-openstandards.org/download-os/
- Resources in general: http://www.ccnetglobal.com/coach-resources/all-resources/
- MIRADI-software: https://www.miradi.org/

The communities

- Foundations of Success and marine projects (FOS): http://www.fosonline.org/projects_tags/marine
- The organisation behind – the Conservation Measures Partnership: http://www.conservationmeasures.org/
- Coaches network: https://sites.google.com/a/fosonline.org/european-coaches-network/

Applications so far

- General for conservation – see Conservation gateway: https://www.conservationgateway.org/ConservationPlanning/ActionPlanning/CAPOpenStandards/Pages/cap-and-open-standards.aspx

- Sweden – departing from conservation but widening the perspective:
- SEPA-project Marine Collaboration Plans combining different tools for coastal management (Reports in Swedish with English summaries)
- Project final report: http://www.naturvardsverket.se/Om-Naturvardsverket/Publikationer/ISBN/6400/978-91-620-6471-6/
- Evaluation report of plans and process: http://www.naturvardsverket.se/Documents/publikationer6400/978-91-620-6435-8.pdf
- Koster Sea & Yttre Hvaler marine national parks (broader sustainable development): http://www.fosonline.org/partners/government-agencies
- Hav möter land:/Sea Meets Land (EU-INTERREG on MSP and ICZM in Kattegatt-Skagerrak): http://projektwebbar.lansstyrelsen.se/havmoterland/Sv/Pages/default.aspx
- Applications in Europe and globally:
- https://sites.google.com/a/fosonline.org/european-coaches-network/application-europe
- https://sites.google.com/a/fosonline.org/european-coaches-network/application-global

8.7 Quality Assurance in MSP based on a risk management approach

Overview

The approach is designed as a Marine Spatial Planning Management Quality System (Cormier et al. 2015), providing a generic structure on how to set up spatial planning processes in marine areas. It has been developed within the ICES Working Group on Marine Planning and Coastal Zone Management based on the outputs of a workshop on quality assurance for MSP in 2012. The structure offers guidance to practitioners on what should be incorporated when designing and subsequently managing a process of spatial planning. Furthermore, the approach provides generic quality assurance objectives for the output of the planning process (the plan) and for the planning process. The approach is conceptually linked to ecosystem based risk management as outlined in Cormier et al. 2013 and clearly distinguishes between the process of planning on one hand and the process output, which is the plan resulting out of the planning process.

Use

The Marine Spatial Planning Quality System can be used to design a planning process including its different steps and process elements. It can also be used for monitoring and evaluation of planning processes as well as planning outputs by using the quality assurance objectives *ex-post*.

Inputs and process

The approach points to sub-processes and types of information that need to be included at different stages of the process from the perspective of quality management. This ensures that the process of planning, as well as the output of the process (the plan itself) follow a clear and transparent structure. However, having a structure that contains relevant process elements does not make statements on the objectives and outputs the planning exercise should have. Defining objectives is part of the planning process itself or predefined by the policies and legislation the plan is expected to implement. As an input, therefore, excellent process skills within the competent authority are essential, as well as availability and accessibility of relevant data, information and knowledge that guide the development of the plan itself.

Outputs

Applying the approach is expected to result in a transparent, clearly structured and designed planning process along clearly defined objectives. Quality objectives for the process and plan provide guidance before and during the planning process and allow monitoring and evaluation of the process and its achievements along a set of criteria.

Scalability

Yes

Strengths

The Marine Spatial Planning Quality Management System provides a generic structure which may help to set up and design a marine spatial planning process. It also provides quality assurance objectives which should be kept in mind not only for developing a successful process, but also for achieving a plan that recognises criteria such as economic viability, social desirability and administrative achievability and that acts within the legal framework and competences relevant in the planning area. It might also support planners in reporting on to the public or politicians, e.g. on what information and actors have been included, which arguments and assumptions have been considered and how and why some issues might have been prioritized. For those involved in the planning process as advisors or stakeholders the approach provides guidance on their roles and contributions within this process.

Limitations

Limitations of the approach are mostly related to the political context of the planning process, time constraints, availability of human resources and skills available in the competent authority. Within the process itself, limitations in data and information availability or unwillingness of key actors to get involved can constrain the quality of outputs and outcomes. It also needs to be noted that a good process design may support, but does not guarantee to achieve a successful spatial plan.

Key References

Cormier, R., Kannen, A., Elliott, M. and, Hall, P. 2015. Marine Spatial Planning Quality Management System. ICES Cooperative Research Report 327, http://www.ices.dk/sites/pub/Publication%20Reports/Cooperative%20Research%20Report%20%28CRR%29/crr327/Marine%20Spatial%20Planning%20Quality%20Management%20System%20CRR%20327.pdf.

Cormier, R. Kannen, A., Elliott, M., Hall, P., Davies, I.A (2013): Marine and coastal ecosystem-based risk management handbook. ICES Cooperative Research Report No. 317, http://www.ices.dk/sites/pub/Publication%20Reports/Cooperative%20Research%20Report%20%28CRR%29/crr317/CRR317%20Marine%20and%20coastal%20ecosystem%20based%20risk%20management%20handbook.pdf

8.8 Rapid Policy Network Mapping (RPNM)

Overview

Rapid Policy Network Mapping (RPNM) is a simple, fast and pragmatic approach for capturing and describing institutional dynamics and policy information. It maps the governance system around a particular policy context 'as it is' and can form the basis for further discussions on 'how it could be' (Bainbridge et al. 2011). In particular, the approach can map policy actors across spatial scales (e.g. from local to European) and influences between scales (focusing for example on implementation from EU policies down to the national, regional and local scale). At the same time the approach allows to distinguish policy actors analytically along different categories of influence in a policy process, for example whether they make decisions as 'owners' of a component of the policy process, influence policy development, or advise as deliverers of information.

Use

The RPNM method was used by Bainbridge et al. (2011) to map and analyse the network of relations between policy actors and between policy instruments in the context of implementation of the MSFD and WFD in the UK.

Inputs and process

Based on the assumption that a significant majority of actors in a policy network are known to each other, the approach begins by analysing the documents of a single organisation, and follows a chain of references from this point. This is based on the assumption of Social Network Analysis that a policy actor or instrument is linked to other relevant policy actors and instruments in a policy community where the 'centrality' of the instrument or actor is a function of its importance within that network. Policy actor and instrument data in the case study of Bainbridge et al. (2011) was collated in Microsoft Excel. However, to ensure consistency of analysis, Bainbridge et al (2011) developed mapping templates for the actor and instrument policy communities using CmapTools software (http://cmap.ihmc.us/). The gridded templates provided a matrix for collating policy actors and instruments as a function of categories, domains and definitions, linked to the policy process flow. Relationships between actors or instruments were reported using 'ties'. The templates provided a means to generate network maps allowing process flows and relationships to be visualised.

Outputs

The approach leads to a visualised governance structure linking policy instruments and categorised actors across policy scales. This may form the basis for a more in-depth interpretation. It may be complemented by the governance baselines approach, which focuses on the historical evolution of institutions. It may also inform the bowtie approach which can be used to identify policy risks. The outputs of RPNM can reveal the power structures within policy implementation and support discussion of revised models for implementation.

Scalability

Yes

Strengths

The results of a RPNM exercise provide a map of the governance system and may form the basis for discussions on future changes. The approach is relatively simple and cheap. For policy makers it guides the pathways for policy implementation, collaboration and reducing horizontal and vertical fragmentation. It also helps to clarify the roles of different actors within marine planning processes.

Limitations

Limitations of the approach are mostly related to availability and accessibility of information of the policy process. If focussing on document analysis alone, it may miss hidden agendas and non-documented links among actors. It also lacks the historical perspective on how the current governance system evolved over time.

Key References

Tool description based on:

Bainbridge, J.M., Potts, T., O'Higgins, T.G. 2011. Rapid Policy Network Mapping: A New Method for Understanding Governance Structures for Implementation of Marine Environmental Policy. PLoS ONE 6(10): e26149. doi:10.1371/journal.pone.0026149

8.9 Scenario analysis

Overview

Scenario analysis is a name given to the development of descriptive models of how the future might turn out (IEC/ISO 2009). Scenarios are widely used in environmental management in situations where data gaps make planning difficult or where strategic visions are required. Most approaches follow the story and simulation approach (Alcamo 2001) which combines a qualitative storyline supported by data or model calculations. Others are limited to qualitative visions for a planning area based on core values (e.g. Maes 2005). Scenario analysis cannot predict the future but can help to visualise potential development options or visions which can then be discussed as part of the MSP process.

Use

Scenario analysis can be used to assist in making policy decisions and planning future strategies. In MSP, scenarios have been used as pre-defined alternative "futures" for a planning area, which are creative but plausible and contrasting storylines emphasising different planning principles (e.g. Maes 2005). The purpose of creating scenarios can be to engage stakeholders in a discussion of different options; it is also possible to use them to discuss management processes or other necessary steps for achieving the desired future. Alternatively, sets of scenarios can be used to identify what might happen under particular circumstances (e.g. different management regimes, different policy priorities etc.). With short time frames and good data, likely scenarios can be extrapolated from the present. For longer time frames or with weak data, scenario analysis becomes more imaginative and is also referred to as futures analysis. Scenario analysis may be useful where there are strong distributional differences between positive outcomes and negative outcomes in space, time and groups in the community or an organization (IEC/ISO 2009).

Inputs

The prerequisite for a scenario analysis is a team of people who between them have an understanding of the nature of relevant changes (for example, blue growth) and imagination to think into the future without necessarily extrapolating from the past. Access to literature and data about changes already occurring is also useful. Scenario analysis can be carried out in a formal or informal setting.

Process

Having established a team and relevant communication channels, the first step is to define the context and issues to be considered. Storylines then need to be created that reflect different 'futures'. These do not have to be achievable or even desirable, but they should reflect distinct possibilities. Many different methods are used in scenario storyline development. Most examples are exploratory and defined through a matrix logic that reflects different dimensions of drivers of change (Rounsevell & Metzger 2010), such as:

- external changes (such as technological changes),
- policy drivers,
- stakeholder needs,
- changes in the macro environment (regulatory, demographics, etc).

Storylines could also be developed around diverging planning objectives, or core values of sustainable development (Maes 2005), with different scenarios giving different priorities e.g. to blue growth or environmental protection. Quantitative data can be used to support the storylines, e.g. by using model calculations to present numerical estimates of future indicators (Alcamo 2001). The scenarios can then be used to test or evaluate regulatory options, e.g. testing how successful a marine plan would be at implementing a particular scenario.

Outputs

There may be no best-fit scenario but one should end with a clearer perception of the range of options and how to modify the chosen course of action.

Strengths and limitations

Scenario analysis takes account of a range of possible futures which may be preferable to the traditional approach of relying on high-medium-low forecasts that assume, through the use of historical data, that future events will probably continue to follow past trends. This is important for situations where there is little current knowledge on which to base predictions. This strength however has an associated weakness which is that where there is high uncertainty some of the scenarios may be unrealistic. The main difficulties in using scenario analysis are associated with the availability of data, and the ability of the analysts and decision makers to be able to develop realistic scenarios that are amenable to probing of possible outcomes. The dangers of using scenario analysis as a decision-making tool are that the scenarios used may not have an adequate foundation; that data may be speculative; and that unrealistic results may not be recognised as such.

Key references

Alcamo, J. 2001. Scenarios as tools for international environmental assessments. Environmental issue report. European Environment Agency. Copenhagen.

IEC/ISO International Standard 31010, Edition 1.0 2009-11. Risk management – Risk assessment techniques.

Maes, F., Schrijvers, J., Vanhulle, A. 2005. A Flood of Space. Towards a Spatial structure Plan for the Sustainable Management of the North Sea. 204 pp.

Rounsevell, M.D.A. and Metzger, M.J. 2010. Developing qualitative scenario storylines for environmental change assessment. WIREs Clim Change 2010 (1), 606–619.

8.10 Spatial costs-benefit-analysis tool (in development)

Overview

Maritime spatial planners have to make as well as justify designation decisions that impact the economic activities of sea use sectors. Among many other factors, such as environmental and social ones, the economic significance of a sea use sector as well as the spatial distribution of costs and benefits along the value chain and across the country need to be taken into account. In the scope of BONUS BALTSPACE, a tool will be developed that will help to assess blue growth sectors with regard to their spatial dimension.

Typically, cost-benefit analyses are associated with place-based scenario trade-offs. The BONUS BALTSPACE spatial cost-benefits-analysis tool takes a different approach. It will be developed to provide a frame for quantifying costs and benefits of sea use sectors as a whole in monetary terms and indicating their spatial distribution among stakeholders. The BONUS BALTSPACE spatial cost-benefit-analysis does not only provide cost and benefits for each sector in absolute terms, but also allows for cross-sectoral comparison for MSP purposes. Thereby, this tool first and foremost fosters the integration of the knowledge base as it compiles evidence that can be used for deliberation and decision making. Besides, it facilitates stakeholder communication as it can be used to portray the economic consequences of sea uses for different stakeholder groups.

Use

The BONUS BALTSPACE spatial costs-benefit-analysis tool supports planners in assessing economic costs and benefits of sea use sectors. It helps to understand who bears costs/benefits in what monetary dimension and in which geographical areas. By being able to compare costs and benefits of different sectors MSP solutions can be evaluated against political objectives (e.g. maximising social welfare, strengthening a certain sector as a whole, creating jobs in a particular area, etc.). Furthermore, the analysis of the geographical distribution of costs and benefits shall facilitate a more effective stakeholder communication and highlight blue growth dimensions to regions/stakeholder groups which may have so far not been associated with maritime uses. Moreover, the BONUS BALTSPACE spatial cost-benefit-analysis results may be used for portraying the economic status quo in stakeholder consultation as well as for explaining different priority weighing of sectors between countries.

Inputs

Quantitative economic data as defined by indicators to measure monetary costs and benefits are needed as inputs. Planners need to be able to find this data in studies, databases etc.

Process

The following blue growth activities that are included in BSR MSPs will be taken into account:

- Offshore wind energy production
- Shipping
- Sand and gravel exploitation
- Cables and pipelines
- Fishing
- Maritime tourism
- Aquaculture/mariculture

Based on desktop research and a literature review, the main stakeholder groups, their geographic location as well as costs and benefits of the economic activities are identified for each sector. Future trends of the sectors will also be analysed. In a second step the geographically categorised stakeholder groups will be matched with the associated costs and benefits in a table/matrix. For each cost and benefit item, an indicator will be defined and its value researched. Information on the spatial distribution of costs and benefits among stakeholder groups that is not available through desk research will be complemented with expert assessments. The information in the filled in table/matrix will be visualised to show a) the dimension of costs and benefits and b) their spatial distribution.

Outputs

The output will be a mapping of costs and benefits per sector, stakeholder category and the geographical distribution on land. Against the background of political objectives (e.g. maximising social welfare, strengthening a certain sector as a whole, creating jobs in a particular area, etc.) it can be assessed which sectors are particularly important and may need to be prioritised in MSP decisions.

Strengths

The tool shall help maritime spatial planners to assess the economic dimension of sea use sectors by researching necessary information that is currently not available in a compiled format. It allows for cross-sectoral comparison of costs and benefits and also possibly a comparison among countries.

Limitations

The level of analysis is macro-economic. Costs and benefits are not analysed for site-specific planning scenarios.

The cost-benefit analysis is designed to provide planners with additional information on the costs and benefits of sea use sectors and their spatial distribution (i.e. who gains/loses). This information should not be misinterpreted that in case of conflicts preference should always be given to the “strong” sectors. In fact, it can be a deliberate decision to promote sectors that are small in size or to secure employment in peripheral regions.

Training/competences

N/A

Key references

N/A

8.11 Interactive Maps/Web GIS

Overview

Interactive maps give users an overview of the situation in the area they are working in. The functionality of interactive maps is reduced compared to a full GIS, in line with the purpose they are serving. This can be the viewing of relevant spatial data, the option to annotate, draw, and measure in the map, the ability to create buffers around features but also more advanced analysis, modelling or editing.

Interactive maps typically combine data (possibly in the form of data services) from many sources. They usually visualize where different uses occur in space or which ecological components are present where. They also include socio-economic information on administrative units and options for adding one's own choice of data or services. Naturally, maps do not need to stop at the coast but can cover land areas as well. Interactive maps are more flexible than prepared maps because users can decide for themselves which data layers to combine and zoom in and out according to their needs. The interactive maps can often be saved and shared (as online maps) or exported as picture and included into other documents. Analysis data can be downloaded as spatial data, tables or reports.

Inputs

Spatial data

Outputs

Spanning from maps, spatial data, analysis reports to plans.

Scalability

Scalable to purpose

Strengths

Can be made available for everybody (typically with internet access)

Limitations

If not available beforehand, and depending on the functionality required, the setup of the tools and data is very work intensive. Requires internet access for the user and a GIS and web server. It is also possible to deliver interactive maps on DVD or other media without a server, but then they cannot be updated and no interaction is possible between users.

Training/Competence needed

Interactive maps normally have reduced functionality so that they are easy to use by untrained users. Often they contain tools that are not visible at first glance.

Software examples

General viewer:

- HELCOM's Baltic Sea data and map service, http://maps.helcom.fi/website/mapservice/index.html

With focus on MSP:

- multipurpose marine cadastre, http://marinecadastre.gov/about/ (ArcGIS based)
- marinemap www.marinemap.org (freeware)
- BoundaryGIS: http://oilrisk-web.eu/

Modelling:

- Marxan online http://marxan.net/old_index.html